A Framework for Investments in Support Building Activities (SBAs):
Support Mechanisms and Strategic Scenarios

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ABSTRACT

The success of a new technology implementation effort is ultimately dependent upon both management and user support for the project. While recent literature is replete with instances in which measures of support have been correlated with measures of success, potential objective analysis has not been well examined. Furthermore, although these effects may be inherently specific to a given organization, existing literature has instead focused on developing industry-wide generalizations. The purpose of the present work is to propose a decision support methodology for pricing and analyzing user/manager support effects on implementation, with associated justifications for investments in Support Building Activities (SBAs).

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INTRODUCTION

The term Support Building Activities (SBAs), introduced here, refers to the set of practices that organizations employ to bolster the enthusiasm of its constituency with regards to ensuing changes in its business process. SBAs may include such practices as training, team building, project ownership and incentive systems, among others. Unlike mandatory participation regulations which threaten to foster dissent for new systems, and in turn reduce the prospective scope of usage to routinization, SBAs aim to invoke a theme of positive change within the corporate culture. The benefits reaped through increased enthusiasm for a new technology may become apparent in any number of roles, including reductions in ramp time, reductions in error and reductions in retraining; all of which have significant implications for the firm’s overall competitive advantage.

With the abundance of recent findings corroborating the positive effects of various organizational support mechanisms on the success of new technology implementation (Hunton 1996, Barki 1994, Guimaraes 1992, Tait 1988), the utilization of SBAs has been granted increased justification. Unfortunately, however, SBAs don’t come free. Significant costs may be associated with the need to bring in outside consultants and trainers, as well as allocating precious resource time to such activities. Project managers must be able to weigh the benefits promised by SBAs against the costs associated with implementing them. To date however, a formal framework for doing so has not been developed.

The emergence of a methodology for estimating the net financial benefits gained through SBA investments, as presented in this work, provides a service to researchers and practitioners alike. From a research perspective, the framework is intended to serve as a structured basis upon which future empirical work in the area can be based. Such work may take forms ranging from instance parameterization to cross-industry generalizations. Since the current work represents an agglomeration of existent theory, the framework to be proposed is also intended to facilitate the
use of pseudo-experimental designs to ensure the validity of the causalities suggested by such research.

From a practitioner’s perspective, the relevancy of the current work is equally salient. As new technologies continue to develop and as the globalization of economies encourage a greater number of parties to participate in such development, both the financial availability of corporate innovations in general and the likelihood of encountering innovations that specifically cater to individual firms will increase. In response, the rate of innovation adoption has been and will undoubtedly continue to steadily increase as well. Hastened technological turnovers and the rapid availability of technological process complementaries highlight the relevance of means by which to facilitate organizational change, as well as procedures designed to assess the financial value of such means with regards to each subsequently considered innovation.

In order to set the stage for the presentation to follow, a review of current research into the benefits of user and managerial involvement in IT implementation will be provided. Succeeding this exposition, the theory and structure of the proposed SBA framework will be outlined, with particular emphasis on the nature and financial structure of the mechanisms involved. A practical analytical interpretation and simplification of this framework will be investigated and the methodological issues related to parameterization discussed. Simple illustrations of SBA option assessment will then be provided, with associated discussions of their implications. The study concludes with a discussion of proposed future work.

BACKGROUND

Implementation Success

The difficulty associated with assessing IT implementation success remains one of greatest impediments to strategic planning in the area. User satisfaction has traditionally been utilized as a
surrogate measure for overall success in specific applications, such as DSS (Bailey 1983, Ives 1983, Baroudi 1986, Doll 1988). However, the appropriate operationalization of the satisfaction construct is a daunting task in itself. In an early attempt to provide structure to this concept, Bailey and Pearson presented 39 items inclusive of such issues as information accuracy, output timeliness, reliability, completeness, relevance, precision and currency (Bailey 1983). A later scheme, proposed by Ivari and Koskela, divided the satisfaction construct into three sub-constructs relating to information quality (informativeness, accessibility and adaptability), making use of a total of eight base items (Ivari 1987, Ivari and Koskela 1987). The approaches necessarily capture an incomplete picture when applied to implementation projects in general, since the benefits reaped through such systems may partially result from automated information management, active irregardless of user satisfaction. At the same time, Tait has suggested that user satisfaction may be entirely incidental to implementation success, with emphasis instead placed upon such issues as system quality or measures of, perhaps mandated, system usage (Tait 1988).

The appropriateness of user satisfaction measures has been further questioned by recent comprehensive studies in new product development, an area with extensive analogy to IT system implementation research (Griffin 1993, Hultink 1995, Griffin 1996). As a part of the PDMA Success Measurement Project, these results suggest that, while customer satisfaction with new products remain relevant, project sponsors and managers may be much more concerned with gains relevant to competitive advantage and goal meeting; Issues not necessarily measurable from customer satisfaction alone. In the context of IT implementation, where users essentially take the role of system “customers”, similar emphasis is not entirely unlikely.

More recently in the IT literature, several researchers, including Kwon, Zmud and Apple (Kwon 1987, Zmud 1992), have suggested approaching the issue of implementation success from within a process framework. Specifically, such authors propose that the extent to which the gains of an innovation implementation are realized may be reflected in the extent to which the innovation has
been incorporated within an organization’s work systems (Kwon 1987, Zmud 1992). With regards to this incorporation, the authors distinguish two separate concepts relevant to later phases of the innovation process: Routinization and Infusion. The first of these, routinization, was coined by Yin (Yin 1979) to describe the long-term adjustment of an organization’s governance system, or administrative infrastructure, to account for the innovation. Application of this concept as representative of implementation success has involved the specification of various levels integration between innovation-specific governance systems and corporate wide systems, as well as reductions in levels of support required to maintain innovation-specific system by project sponsors or champions (Keen 1981, Fischer 1986).

Zmud and Apple have claimed that work and social system modifications, distinguished from governance systems, are not taken into consideration within the concept of routinization, and have hence proposed the use of the infusion concept to represent such issues (Zmud 1992). The process of infusion is generally considered more difficult, and has been tended to lag behind routinization in empirical experience. The authors further suggest that the traditional strategies for ensuring success, such as training and support development, have been those aimed at routinization. A lack of efforts aimed at infusing the innovation can seriously threaten its long term success, as well as the corporation’s ability to develop organized support for the diffusion of the innovation throughout the enterprise. Zmud and Apple stress:

“Before individuals can apply a technological innovation at a higher level of use, they must be able to envision and appreciate the new organizational reality enabled through that use. As the implementation context involves radical or threatening change, it is likely that the active involvement of opinion-leaders from the workplace itself will be required in efforts to transform members’ views of the new work reality (Zmud 1992).”
Support Mechanisms

Research into the nature of support mechanisms necessary in overcoming organizational resistance to change has been granted continued interest throughout the years, beginning with the introduction of planned organizational change theory (Lewin 1951, Tait 1988). Both managerial and user support mechanisms have been studied extensively in recent years, with findings suggesting significant positive effects of these concepts on various measures of implementation success (Igbaria 1990, Guimaraes 1992, Yoon 1995, Kleintop 1996). While managerial support mechanisms have direct implications within multiple contexts, user support is specifically oriented towards issues regarding system infusion. If infusion serves as an appropriate surrogate concept for measuring overall implementation success, considerations of both managerial and user support mechanisms are critical.

Although terms such as involvement and participation have been used interchangeably, even in recent years, to represent various incarnations of organizational support (Ives 1984, Doll 1988, Fuerst 1990, Guimaraes 1992), a clarifying dichotomization of these two concepts has been proposed. In Barki’s scheme, participation refers to behaviors or activities performed, while involvement refers to set of beliefs regarding the innovation and its introduction (Barki 1989). Specifically, involvement is defined as the extent to which individuals assign importance and personal relevance to an innovation, and has been shown to be a concept operationally distinct from that of participation. While participation may be purely mechanical, and a function of mandate, involvement may remain independent of governance issues. Participation is more likely to be affected by involvement, rather than the converse, and hence long term support mechanism may be eventually biased by these beliefs (Barki 1994). The implication, with regard to the innovation process, is that organizations capable of high levels of routinization may be unable to foster stabilizing infusion in the absence of user involvement, no matter how much participation is
realized. Furthermore, breakdowns in unsupported governance systems may prove catastrophic if accompanied by a dissention by the uninvolved constituency.

A natural extension of this argument leads to the incorporation of recent research in organizational theory and procedural justice, within the context of the discussion. Theory in procedural justice suggests that individuals perceiving that their own opinions are valued by decision makers, are in turn more likely to express such opinions (Folger 1977, Lind 1988, Hunton 1996). In the absence of high levels of perceived procedural justice, the movement from internalized opinion (a reflection of involvement) to expressed opinion (a participatory outlet of such involvement) may be severely constrained, resulting in a misalignment between the involvement and participation mechanisms at work, with downstream implications for levels of success in routinization and infusion. Drawing on recent organizational theory, Kim claims that the formal expression of these opinions may be interpreted as extra-role behavior, not prescribed by formal role requirements (Kim 1996). Furthermore, such behaviors need not necessarily be limited to users. In particular, Kim has shown that the extra-role behavior of high level managers positively effects traditional measures of system success as well.

The organizational view assigns significant importance to both user and managerial extra-role behavior, particularly in change environments, where the anticipation and specification of all desired formal roles may be unrealistic (Podsakoff 1994, Podsakoff 1997, Van Dyne 1998). In distinguishing extra-role behaviors that support change from those which support the status-quo, Van Dyne suggests the dichotomous use of two separate incarnations of such behavior. To that end, the authors define helping as an affiliative promotive behavior, aimed at strengthening existing relationships. Voice, on other hand, is challenging and promotive, emphasizing idea creation and is change-oriented (Van Dyne 1998). It is the abundance of voice extra-role behaviors, as participatory outlets of involvement, that contributes in particular to change-oriented innovation processes. Peer and superior reports at of past voice extra-role involvement have proven useful in these studies in predicting various measures of project performance. Recent work
by these authors in measuring such outlets for change involvement, the suggestion that the infusion context provides a valid representation of long run success, and the theoretical causal links between these issues inspires the theoretical structure outlined in this work.

**Figure 1:** The SBA Model – Investments, Organizational Mechanisms and Returns.

![Diagram of the SBA Model](image)

**THEORY**

The SBA model, introduced here, represents the culmination of various associated issues relevant to recent literature on innovation process success, organizational change and procedural justice. The model (See Figure 1) takes a “financial input → organizational process → financial output” view to this integration, in an attempt to emphasize relevancy and applicability in a business setting. At the same time, however, the nature of the internal mechanisms relevant to the model remain largely conceptual, and hence particularly robust, permitting a variety of subjective interpretations as required for application in specific settings.
**Involvement Effects on Innovation Value**

Utilization of this model requires the establishment of certain a priori mechanistic assumptions regarding quantitative representations of the internal organizational structure and some subjective estimates concerning the valuations of the innovation. The specification of a mathematical framework does not in itself suggest that the evaluation of the model is best limited to more traditional mathematical paradigms such as simulation, however. As with any model, such mechanistic specifications are necessary before any reasonable parameterization can occur, whether that parameterization be artificially or empirically driven. The absence of such a consideration may in fact suggest a conflict for many ambitious empirical studies that choose instead to assume “standard” relational laws such as linearity, normality and continuity. Given the prevalence of structural equation modeling (SEM) in current empirical research streams, such extreme assumptions threaten both the significant and, perhaps more misleading, the insignificance of findings.

Since issues of interest may prove irrelevant vis-à-vis the intended dependent variable simply on the basis of a more appropriate analytical structure, it seems logical to meaningfully define and evaluate models to be parameterized in a more general sense prior to data collection phases. Benefits that arise from such considerations may be as simple as a shortened questionnaire, and the increased response rates typically associated with such. Yet the benefits of an exhaustive mechanical review of a model structure are not limited to efficiencies in complex empirical parameterizations and use. Steiger claims that the fundamental purpose of a DSS is to help the decision maker develop an understanding of an ill-structured, complex environment represented by an explicit or embedded model (Steiger 1997). Potential understanding stems from both the deductive analysis of single model instances and the inductive analysis of multiple instances of the model (Perkins 1986, Shard and Steiger 1996). The aim of the discussions to follow is to elaborate upon both.
The process of providing definition to the structure outlined in Figure 1 begins by characterizing the investment environment in the broadest practical sense. To provide a familiar basis for consideration, one can draw analogies to the itemizations of typical corporate spending proposals. Specifically, given a planning horizon (consisting of \( T \) discrete intervals) and an expected value assessment for an innovation process, both of which are integral to any preliminary innovation proposal, planners considering the use of SBAs first need to consider best case and status quo scenarios of constituency (user and manager) involvement.

The best case per period amortization of the innovation value \( (v_B) \), derived from maximal dedication to both change involvement and voice extra-role behavior, may be the same as that provided in the original proposal, though this need not be the situation. Such an estimate begins with the consideration of the extent to which a prospective SBA can enhance the voice extra-role involvement of the constituencies. Here archival data regarding past analogous activities, consultant reports on activity success rates and the like provide a useful source of knowledge in estimation. Once assessed, archival and retrospective peer and supervisor perceptions regarding past project can also be utilized in estimating the extent to which these changes effect social and work structures (Zmud 1992, Van Dyne 1998). The value of structural changes, derived in consideration of such issues as waste (time and resource cost) reduction, serves as the financial output of interest. The status quo per period amortization \( (v_0) \) should be similarly based on an extension of the current work and social structures, static across the time horizon.

Although trend and relational analysis for use in deriving model components will almost certainly retain some level of error in estimation, such considerations are beyond the scope of the present work. Subsequently, the remainder of the discussion will deal with purely deterministic instantiations of the model. For this purpose, it is useful to consider intermediate amortized values of the innovation, between \( v_0 \) and \( v_B \), as some as function of intermediate levels of user and managerial involvement (between status quo and best case levels). Let \( I_0^U, I_B^U, I_0^M \) and \( I_B^M \), represent the status quo and best case involvement levels for users and management, respectively.
in turn. The general notation, introduced here, for the per period valuation function can then be expressed as:

\[ v_t = f(I_t^U, I_t^M) \]  

(1)

with the boundary cases, \( v_0 = f(I_0^U, I_0^M) \) and \( v_B = f(I_B^U, I_B^M) \) serving as functional constraints. An appropriate choice of the functional form should ultimately be based on the nature of the organization, the experience of the planner and indications of available past trend information. One of the simplest dependent forms is the weighted combinatorial:

\[
v_t = v_{t-1} + \left( v_B - v_{t-1} \right) \left[ \alpha \left( \frac{I_t^U - I_0^U}{I_B^U - I_0^U} \right) + \left( 1 - \alpha \right) \left( \frac{I_t^M - I_0^M}{I_B^M - I_0^M} \right) \right]
\]  

(2)

where \( \alpha \) is some weight relating extent to which the periodic value is dependent upon user involvement. Regardless of the selection of this functional form however, the present value of the innovation, based on the levels on involvement active across the planning horizon will be of the following form:

\[ V_p = \sum_{t} v_t d^t \]  

(3)

where \( d \) is the investment discount rate applicable.

**SBA Effects on Involvement**

Once the functional form of the present value of the innovation is determined, the task becomes one of specifying the functional form of the user and management involvement variables, as
functions of both the SBA investment options available and time. Again, while many alternate functions may be appropriate, perhaps the simplest is that of the weighted combinatorial case:

\[ I^U_t = I^U_{t-1} + (I^U_B - I^U_{t-1}) \sum_{k} \gamma^U_k x_{tk} \]  

(4a)

\[ I^M_t = I^M_{t-1} + (I^M_B - I^M_{t-1}) \sum_{k} \gamma^M_k x_{tk} \]  

(4b)

One can note the general similarity in form that this notation has with the form of the amortized value function. In the current notation, \( x_{tk} \) and \( x_{tk} \) represent the 0-1 integer variables designating investments in SBA activities \( k \in K \) in, at a given time \( t \in T \). The parameters \( \gamma^U_k \) and \( \gamma^M_k \) represent the fraction of remaining untapped involvement that these activities are expected to bolster.

Several constraints may be imposed on the variables \( (x_{tk}) \) to ensure tractability. The first of these is a non-simultaneity criteria, which simply requires that no two SBA implementations are active within the same time period. The primary justification for this constraint is associated with limitations in permissible human resource allocations. Those towards which the support programs may apply, may not be physically able to attend both during the same period. Furthermore, moderate temporary HR displacements may be more easily adjusted to in terms of changes in daily operations than would excessive displacements, perhaps necessary if multiple SBAs are active simultaneously. The added advantage of this constraint is that it ensures that the results of equations (4a) and (4b) never exceed the theoretical best case scenario values.

\[ \sum_{k} x_{tk} \leq 1 \]  

(5)

The non-repeatability criteria ensures that no single SBA can be applied repetitively across the planning horizon.
The assumption here is that the expected gains from SBA are based on instance usage. Though, this assumption may not necessarily be justified in all instances, it does serve to greatly simplify the problem. Specifically, the number of possible solutions to be considered with this constraint imposed is of the order $T^K$, opposed to $(2^T)^K$ when this constraint is not active.

**SBA Investment Costs**

Finally, consideration of the present and amortized costs associated with the SBA investments is necessary. Not only do net present costs of SBA detract from net present value for the planning horizon, but since costs are typically amortized across such a horizon, certain per period budget constraints may prohibit the utilization of high cost SBAs, regardless of potential benefit. The present value of the SBA investment costs, summed across the time horizon and across options takes the general form:

$$C_p = \sum_{i} \sum_{k} c_k x_{ik} d^i$$  \hspace{1cm} (7)

where $c_k$ is the investment cost necessary for a specific activity. The net present value of these investments is defined as the difference between the present value of the investment benefits less the present value of their costs.

Since costs of investments are typically spread across planning horizons, it is further important to consider amortized costs, particularly in the presence of per period budgetary constraints. The general form the amortized costs, assuming such constraints is as follows:
Though budgetary constraints need not apply on a per period basis, they are likely to be present in some form, perhaps as a full term budget for the horizon.

SIMPLIFICATIONS

Single-SBA Scenarios

A hybrid of constraints (5) and (6), provides the setting for the scenario in which at most one SBA may be implemented within the time horizon.

\[
\sum_{t=1}^{T} \sum_{k=1}^{K} x_{tk} \leq 1
\]  

In such a scenario, the task of selecting the best SBA, if any, in which to invest and the positioning of the investment along the horizon, can be determined by examining the SBA’s on case by case basis. Specifically, once the best positioning of each SBA investment is determined, these options can be compared in terms of net present value. Again, if the net present value of none of the SBA options is an improvement on the status quo estimate, no investments will be justified.

The hybrid constraint in (9) implies that only one form of involvement equations need be considered per SBA (i.e. the case occurrence of the investment at the optimal position \(t^*\) along the time horizon).

\[
I'_{t^*} = I^U_0 + (I^U_B - I^U_0)\gamma_k^U
\]  

(10a)
This result significantly simplifies the linear amortized value function, reducing it to a form independent of time for a given SBA, assuming the SBA is at some point invested in.

\[ v_{t^*} = v_0 + (v_B - v_0)\left(\alpha y_k^U + (1 - \alpha) y_k^M\right) \]  

(11)

In this particular case, the present value of the innovation reduces to the consideration of status quo amortized values up to the point of the single SBA investment and the consideration of the updated amortized value thereafter:

\[ V_{p^*} = \sum_{t=1}^{t^*} v_0 d^t + \sum_{t=t^*+1}^{T} v_{t^*} d^t = \frac{d}{1-d} \left[ v_0 (1-d^{t^*}) + v_{t^*} (d^{t^*} - d^T) \right] \]  

(12)

The present value of SBA investment costs also reduces to a discount of the SBA investment instance at the optimal positioning, \( t^* \).

\[ C_{p^*} = c_k d^{t^*} \]  

(13)

Subsequently, the net present value of a given SBA option takes the form, i.e. the difference between equations (15) and (16) takes the following form:

\[ NPV = d^{t^*} \left[ \frac{d}{1-d} (v_{t^*} - v_0) - c_k \right] + \frac{d}{1-d} (v_0 - v_{t^*} d^T) \]  

(14)

Assuming the term within the brackets in equation (17) is positive, the maximal NPV for a given SBA will occur at the earliest possible \( t^* \) subject to the budgetary constraints. Considering the
situation in which the amortized cost of investment is set equal to the periodic budget, provides the basis by which to solve for the earliest allowable date of investment:

\[ c_k d^{t^*} \frac{(1-d)}{d(1-d)} = b_i \]  \hspace{1cm} (15)

Since simply solving for \( t^* \) does not ensure an integer solution (necessary for event driven notation), the ceiling of this solution is utilized:

\[ t^* = \left\lceil \frac{\ln[b_i d(1-d)] - \ln[(1-d)c_k]}{\ln(d)} \right\rceil \]  \hspace{1cm} (16)

In order to determine the best SBA option, the NPV of each SBA option is calculated using the respective values of \( t^* \), and compared. If no NPV exceed \( v_0 \), no SBA investments are warranted.

With this groundwork established, a discussion of possible angles of assessment can now take place.

Assessment under Iso-Cost Involvement

As noted earlier, costs of SBA investment play a major role in both their feasibility and appeal. In order to illustrate the cost dependencies inherent to option selection in the single-SBA scenario, the case in which SBA costs are linearly dependent upon the gains in untapped involvement assumed to be associated with investment. The general form of these costs, designed purely for illustrative purpose, is as follows:

\[ c_k = \beta(y_k^U + y_k^M) v_0 \]  \hspace{1cm} (17)
Intuitively, \( \beta \) represents the single period cost to increase a unit (fraction of total possible) increase in involvement expressed as a fraction of amortized status quo value. Now consider the case in which three SBA options, as well as the non-investment option, exist. Again for illustration, say that the system parameters of Table 1 apply. Given these parameters, the forms of the optimal NPVs, as a functions of the Marginal Costs of Support Building, as well as the optimal placements (\( t^* \)) on which these are based, are provided in Figures 2 and 3. Here, the three gauged curves represent the three SBA options, with the vertical line at 0.8 representing the present value of continuing the status quo. Four segments of the graphs are distinguished by optimal policy. In Region I, the dominant policy is to invest in SBA\(_1\), at whatever optimal position (\( t^* \)) applies. Regions II is respectively defined, with Region 0 representing the non-investment policy. The gauged nature of these curves is an artifact of the time constraint on the optimal positioning (\( T > t^* > 1 \)). It should be observed that SBA3 is never dominant since its NPV lays entirely below that of SBA\(_2\). This is due to the specification of \( \alpha > 0.5 \), indicating a greater performance emphasis on user involvement. Equity in emphasis (\( \alpha = 0.5 \)) would result in a coincidence of these option curves.

**Table 1:** Sample Parameterization of the Single-SBA Scenario

<table>
<thead>
<tr>
<th>Time Horizon (( T ))</th>
<th>100 weeks (Annual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Discount Rate (( d ))</td>
<td>0.996 (0.7)</td>
</tr>
<tr>
<td>Relative User Import (( \alpha ))</td>
<td>2/3</td>
</tr>
<tr>
<td>Weekly Budgetary Constraint (( b_t ))</td>
<td>0.005 (0.5)</td>
</tr>
<tr>
<td>Amortized Best Case Gains (( v_B ))</td>
<td>0.0123 (1.0)</td>
</tr>
<tr>
<td>Amortized Status Quo Gains (( v_0 ))</td>
<td>0.00985 (0.8)</td>
</tr>
<tr>
<td>( \gamma^U )</td>
<td>SBA(_1)</td>
</tr>
<tr>
<td>( \gamma^M )</td>
<td>1.0</td>
</tr>
<tr>
<td>( \gamma^U )</td>
<td>1.0</td>
</tr>
</tbody>
</table>
It is interesting to note that time and budgeting constraints help to accentuate differences between SBA options, as depicted in the preceding figures. Also relevant, particularly for practitioners, is the notion that once the NPV curves are derived, sensitivity analysis regarding changes in cost effectiveness can be readily performed. With this in mind, specific attention should be addressed to the fact that the NPV of each SBA is relatively insensitive to low level changes in these cost structures, but may be extremely sensitive to higher levels.
A more complete depiction of iso-cost involvement scenarios involves considering the full set of optimal NPV curves and the upper bounds that this set implies on the NPV-$\beta$ space. Four points are relevant in defining this space, the first being the zero cost case of the maximal involvement option ($\gamma^U=1, \gamma^M=1$) with a positioning of $t^*=1$ and an associated NPV of $V_B$. The second point is that of the same option at the maximal marginal cost level at which the optimal positioning is still $t^*=1$ (NPV$_{1,1}$). The third point relates maximal marginal cost level at which the optimal positioning is $t^*=1$ for the option fully dedicated to the equally or more emphasized involvement construct (NPV$_{1,0}$ with $\gamma^U=1, \gamma^M=0$); the last point representing mandatory equality at best to the status quo when marginal costs are infinite (NPV$_{0,0}=V_0$). All options between (NPV$_{1,1}$, NPV$_{1,0}$) and (NPV$_{1,0}$, $V_0$) are intermediaries of the form NPV$_{0,\gamma}$ and NPV$_{1,\gamma}$ respectively. All points above the composite curve are theoretically unobtainable, regardless of option specification.

**Figure 4:** Upper Bound of a Complete Optimal NPV Set, for $\alpha \geq 0.5$

The implications derived from an involvement iso-costing approach include the notion that upper bounds on option value can be utilized as benchmarks to judge the relative cost effectiveness of any given SBA. Options located close to this curve, either by $\beta$, NPV or some combination of these terms appear preferable to those near the status quo origin. Once effects on involvement
estimated for each SBA, such relative comparisons can be performed for any set of $\alpha$, $V_0$ and $V_B$ assessments, hence allowing for a degree of flexibility in managerial discretion and associated sensitivity analysis.

**Assessment under General Costing**

The most immediately practical implications of the SBA model are grounded in comparisons with status quo estimates. Again, assuming no changes in amortized value, the NPV of the maintained status quo, based on equation (14) can be expressed as follows:

$$NPV_0 = \frac{v_0 d (1 - d^T)}{1 - d}$$  \hspace{1cm} (18)

Subsequently, the difference between the NPV of an optimally positioned SBA and the status quo takes the following form:

$$\Delta NPV = \frac{v_0 d}{1 - d} \left[ d^* \left( \frac{v_{0*}}{v_0} - 1 \right) - \frac{1 - d}{d} \left( \frac{c_k}{v_0} \right) \right] + (1 - \frac{v_{0*}}{v_0} d^T) - (1 - d^T)$$  \hspace{1cm} (19)

Setting this difference to zero, specifies the borderline case separating SBA investments that are not improvements in the status quo from those which are.

$$d^* \left( \frac{v_{0*}}{v_0} - 1 \right) - \frac{1 - d}{d} \left( \frac{c_k}{v_0} \right) + (1 - \frac{v_{0*}}{v_0} d^T) - (1 - d^T) = 0$$  \hspace{1cm} (20)

With analogy to the Production Possibilities Frontier of economic theory, this line is referred to here as the SBA Return Feasibility Frontier. It should be stressed that this frontier does not
explicitly specify feasibility per se, but rather investment opportunities. However, it can be shown that there exists some $t^*, T > t^* > 1$, such that all point at and below this frontier are feasible. The proof begins with the assumption that investments must occur between the first and last periods of the investment horizon. Equivalently, the adjusted discount rate, $d^{T'}$, must be greater than $d^T$ and less than $d$. Solving both equations (18) and (23) for $d^{T'}$ provides the following inequality.

$$d^T \leq d^{T'} = \frac{b_t}{c_k} \frac{d(1-d^T)}{(1-d)} = d^T \left(1 - \frac{1-d}{d} \frac{c_k}{v_{t^*} - v_0}\right)^{-1} \leq d \quad (21)$$

In order to derive a much more intuitive view of this relationship, a measure of budget utilization ($c_k/b_t$) can be solved for.

$$\frac{d(1-d^T)}{d^T (1-d)} \geq \frac{c_k}{b_t} = \frac{d(1-d^T)}{d^T (1-d)} \left(1 - \frac{1-d}{d} \frac{c_k}{v_{t^*} - v_0}\right) \geq \frac{1-d^T}{1-d} \quad (22)$$

**Figure 5:** The SBA Return Feasibility Frontier
This interpretation suggests that the maximal budget utilization for a SBA opportunity increases as the marginal cost of improvement \( (c_k/(v_t-v_0)) \) decreases. At the same time, the minimum cost for an SBA, \( c_k=0 \), corresponds to the upper limit on feasibility and hence the whole of this curve lays below this upper bound. The lower bound acts simply as a limit on actualized profit, as all points below both the frontier and this lower bound have optimal investment positions of \( t^*=1 \). This partitioning of investment cost space by the frontier and the budgetary bounds is depicted graphically in Figure 5.

The Return Feasibility Frontier provides a much simplified depiction of the decision structure of single-SBA investment scenarios. Here points, close to the origin represent those SBA options of greatest cost efficiency and greatest budget planning flexibility. Consideration of the space below the Return Feasibility Frontier provides as means by which to compare SBAs vis-à-vis the status quo, both in terms of strictly objective measures (Adjusted Budget Utilization, or Adjusted Latest Positioning) and somewhat subjective measures (Marginal Cost of Improvement); Though, as stated before, given past information on SBA analogous costs and effects, such subjectivity may be considerably reduced. The greatest benefit that any remnant subjectivity, as in the iso-costing case, again allows a certain degree of leeway often critical to decision makers.

**CONCLUSIONS & FUTURE WORK**

It has been long agreed that extra-role expression of user and top manager involvement serves as an often necessary condition, among others, for the successful implementation of new systems. IT implementation managers must be aware of a number of issues when considering the utilization of activities aimed at bolstering such supportive involvement. From a subjective standpoint, managers must assess the impact that specific support building activities (SBAs) have on the
overall levels of status quo involvement, as well as the effects that such involvement will have on the present value of the innovation. From a financial standpoint, managers are constrained both by limited budgets and a need to provide a return on investment superior to that of maintaining the status quo. Several approaches to framing and visualizing the SBA selection and positioning problem, such as those selected here, are available to aid in these complex decisions.

Though several interesting implications are suggested by linear formulations and by the single-SBA scenario in general, such simplifications may not be entirely applicable. Potential non-linearities and the advent of multi-SBA option planning make possible considerable analytical complications, which though beyond the scope of the current introduction are likely not beyond the scope of in-field computational analysis. Furthermore, since estimates of accrued benefits are inherently associated with some level of estimation error, field analysis would most likely involve the additional consideration of stochastic elements via risk assessment and expected NPV comparisons. In any event the application of the decision support model in practice should be studied to assess its true applicability, beyond that of a financial exercise.
REFERENCES


