Industrial Buying and the Divergence of Capital Budgeting Theory and Practice: An Exploration

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Abstract

This exploratory paper suggests that a stage-gate industrial buying model may provide an explanation for the divergence of capital budgeting theory and practice. Not surprisingly, we find that qualitative and quantitative characteristics of projects are perceived to vary in complexity. More importantly, our results indicate that these characteristics vary in importance as they proceed to each subsequent stage, and that this variation is related to characteristic complexity. These results are consistent with the idea of “selling” projects at each subsequent stage by “packaging” the projects; emphasizing those aspects deemed important or of appropriate complexity and deemphasizing others. We relate these results to current theory and practice and suggest further investigation.

Introduction

This paper presents the results of an exploratory study of deviations of capital budgeting practice from normative theory. The capital budgeting literature is replete with studies which identify the use of quantitative capital budgeting procedures, some of which are consistent with normative theory and many of which are not (cf., Cooper & Petry (1994), Gitman & Forrester (1977), Haka, Gordon & Pinches (1985), Kim (1982), Klammer (1978), Klammer, Koch & Wilmer (1991), Klammer & Walker (1984), Pike (1984), Schall, Sundem & Geisbeck (1978)). A recent study by Goitein, Hatfield, Horvath and Webster (1996) indicates that there are also a number of significant qualitative variables used in the capital budgeting process. We examine whether there is empirical support for the idea that industrial buying behavior models, provided in the marketing literature, could explain these apparent capital budgeting process anomalies. Such an explanation may identify specific sources of possible agency costs that attend the divergence of practice from theory and explain how and why such practices come to be established in an organization. On the other hand, such an explanation may indicate that the divergence of prac-
tice from theory may represent an information gathering/communication method which is not recognized in the theory and that serves to reduce agency costs.

Using nonlinear statistical tools we find strong support that divergent use of capital budgeting tools and techniques can be described, at least partially, within the context of these models. Our findings suggest that capital projects may be sold in the firm as products. We suggest that the packaging of projects to be sold to the subsequent approval level may partially explain previously identified differences of practice from theory and that this is an area of research that warrants further investigation.

Background and Motivation

Studies by Gitman & Forrester (1977), Schall, Sundem & Geijsbeek (1978), Klammer & Walker (1984), Gitman & Maxwell (1977) and Klammer, Koch & Wilner (1991) indicate that firms have indeed become increasingly sophisticated in their quantitative analysis of capital budgeting decisions. Over the past 20 years we have seen an increase in the employment of discounting techniques used to evaluate cash flows. Furthermore, we now see that most firms use multiple evaluation and various risk analysis techniques to supplement discounted cash flow analysis. Thus, the literature has focused on the evolution of quantitative methods that are consistent with normative theory that can be used to make optimal long-term investment decisions. Techniques such as payback, average rate of return, and return on investment continue in use. Profits, operating costs, and other non-free-cash-flow measures continue to be identified as benefits. These and the multiplicity of evaluation and risk analysis techniques in use signal a divergence from normative theory.

Normative capital budgeting theory is very logical and intuitively appealing. First, it requires that all projects be subjected to formal analysis. Studies by Gitman & Forrester (1977) and Goitein, Hatfield, Horvath & Webster (1996) suggest that this might be violated in practice. These studies suggest that projects may not be subjected to analysis due to size, or whether the project is mandated by regulatory agencies. Some firms indicate that there are some units or departments within the firm whose proposed projects are exempt from formal financial analysis. Second, theory suggests that the net present value technique is the only value maximizing technique to be applied to the selection of capital assets. Again casual observation and the above studies suggest that such criteria as payback, average rate of return, internal rate of return and present value may all be used with differing importance and frequency of occurrence attached to each from time to time. Normative theory also identifies free cash flow as the sole project benefit measure, yet profits, operating costs and similar measures continue to play various roles in the capital budgeting process. Thus, there are established departures between normative theory and practice.

Normative theory does not prescribe any qualitative factors that should be used in conjunction with capital investment decisions. However, there are a number of studies that refer to qualitative factors significant in the decision making process. Brigham (1975) found that subjective factors are given considerable weight when cash flow data is uncertain. In his study, Pike (1983) asked respondents to indicate the importance of qualitative factors. Only five percent of the respondents indicated that these factors were not important. In fact, his findings suggest that managers attach almost the same degree of importance to qualitative factors as they do quantitative factors. Goitein, Hatfield, Horvath & Webster (1996) also found that such project aspects as project manageability, top management commitment, sponsorship, and various project fits are significant factors in long-term investment decisions. Thus, even though much of the capital budgeting literature concludes that firms are tending toward greater sophistication of quantitative techniques, the
studies cited above have indicated that some projects are accepted without analysis and subjective factors may play a significant role in project acceptance/rejection. The financial literature ignores these subjective considerations.

Reliance on qualitative factors and/or measures, methods, or criteria, which lie outside the domain of normative theory, has some very important implications for long-term decision making. First, it implies that some value producing projects may never reach the implementation stage because the project has been rejected or that projects which meet other criteria, such as short payback, internal rate of return in excess of some cutoff, or positive present value of operating cost savings, but are not value enhancing are accepted. Second, it implies that goals in direct conflict with the maximization of firm value may be in place. These, in turn, may be potential sources of agency costs that have not previously been identified. Third, the use of qualitative factors and/or techniques outside normative theory may reflect inefficient labor markets providing inadequate managers. Finally, the reliance on qualitative factors may be a way of providing information to various decision makers which are not reflected in the tools and techniques prescribed by normative theory. Ultimately understanding the long-term investment decision making process may serve to modify financial theory and improve practice. Thus, research that focuses attention on the buying psychology of capital investments may serve to reconcile the differences between theory and practice.

A Marketing Perspective

The industrial sales function of marketing has long recognized the value of understanding the buying psychology of various individuals involved in a purchasing situation. From the perspective of industrial marketing the generators of the project, the promotion and sales functions of the supplier(s), and/or the project team, assume the role of sellers of an industrial product during the pre-acceptance phase. Within the context of our study, this product is a capital project such as the replacement of a piece of equipment, the establishment of a new facility, the purchase of a corporate jet, the introduction or expansion of computing or communication facilities, an advertising campaign, or even organizational restructuring. From this vantage point the buyers (i.e., the remainder of the decision chain to final acceptance) are elements of the organization which have an interest in the project and to which the project must be sold. It seems intuitive that projects are marketed in some sense and the firm is deciding whether or not to buy the project. The recognition of this aspect of the capital budgeting process is beneficial to both the analysis team and the remainder of the organization. So informed, the firm may revise its capital budgeting process to reflect contemporary industrial market concepts and their impacts on both sellers and buyers.

Stage-Gate Process

We propose a model that we believe incorporates the concept of buying psychology into the capital budgeting process. This model incorporates aspects from marketing of both the buying center and the new product development process referred to as a stage-gate system. The stage-gate model recognizes that new product development is not a near orderly process but rather a series of steps in which a go/no-go decision is made. Such a process is needed to screen the hundreds of new product ideas to the produced commercial product. The stage-gate system essentially models the capital budgeting process as a series of stages with intervening gates through which the project must successfully pass to reach acceptance and implementation. Each Stage or Gate may contain several sub-stages or sub-gates depending upon project characteristics such as importance or complexity or firm requirements. Should the project fail to pass any particular gate, the project may either return to a previous stage for reconsideration or be abandoned completely. The process begins with ini-
partial project identification that Gate 1 follows: Initial Screen that determines whether the project possesses the essential project characteristics needed. Passage through the initial screen moves the project to Stage 1, which would usually entail rough cost estimates and crude assessments of the project's efficacy. An accept/reject decision at Gate 2 immediately follows Stage 1 completion. The decision taken at Gate 2 is a somewhat more detailed evaluation of the project. Having survived the Gate 2 screen, the project goes through a more detailed investigation of the project's characteristics and financial viability in Stage 2. The project then is presented to appropriate levels of decision-makers in Gate 3. Stage 3 follows with more refined technical aspects of the project as well as a more specific analysis of cost and benefits. At the end of Stage 3 is Gate 4, which is a review of a final, pretest form of project analysis; technically, operationally and financially. Passing Gate 4 places the project in the testing and validation stage, Stage 4. Relying upon the refined results from Stage 4, Gate 5 represents the final decision making stage before implementation, which is Stage 5. The process is then completed with post-decision audits.

Each stage becomes progressively more detailed, moving from rough cost estimates and first-pass efficiency to detailed financial analysis and technical evaluation. Additionally, it requires assessment of who is going to be involved in the decision making at each of the Gates. In industrial buying terminology, this requires assessing members of the buying center.

We can classify all the organizational members that have some involvement in the purchase decision as the buying center. The buying center is a tool developed by those who study industrial buying and selling (Bonomo (1982)). It is defined as all of the individuals and groups who participate in the buying decision process who have interdependent goals and share common risks. At least six roles may exist in the buying center (Bonomo (1982)). These are the initiators, the decider at each gate, the influencer, the purchaser who is the final decision-maker, the gatekeeper, and the user. The initiator may be the person who first identifies the need for the project or who initiates the decision making at that Gate. The decider is the person who has the authority to make the accept/reject decision at each Gate. The influencers are those who can affect the decision process by assisting in evaluating proposals either formally or informally. The purchaser is the corporate person with the formal authority and responsibility to make the accept/reject decision. This may be the same person as the decider. Gatekeepers are those people who control the flow of formal information in each stage. Users are the people who will actually be using the capital project. When several persons are involved in the decision making process, those involved with the capital budgeting process must identify and communicate with each of these members as they play out each of their roles. An understanding of the various decision criteria employed by different individuals will allow those in the firm to appropriately market those project that will serve to maximize the value of the firm.

The size of the buying center may vary from firm to firm. However, on average, the buying center will include more than four persons per purchase and possibly as many as twenty individuals (Bertrand 1986). Thus, it seems logical that the investment decision may be greatly affected by various individual and group influences. Because individuals have different sets of experiences, and unique personalities it follows that these individuals may also have varying personal goals and ambitions thereby producing differing evaluative criteria (Anderson & Chambers (1985)). Likewise, members from various functional groups may have differing influences on the buying decision. For example, production engineers may be very focused on operating cost, or purchasing may be focused on the lowest possible price (Jackson (1985)). For instance, an engineering cost center may not recommend a positive NPV project.
because they recognize that their unit would bear the burden of the project's increased operating costs. As a result, the engineering cost center's performance measures will suffer. Likewise, a purchasing unit may not approve the optimal positive NPV project because it is not the lowest priced project available. Performance measures for managers of purchasing units are linked to how efficiently dollars are spent. As a result, these managers may elect to purchase a lesser positive NPV project in order to obtain a lower purchasing price. These different criteria can easily lead to different purchase recommendations. Recognition of the buyer's motivation can suggest how to package the project at each of the various stages. Thus, the project team may be able to focus the decision-maker's attention on those criteria that would be most important to the decision-maker. Conversely, the project management team can de-emphasize the buyer's desire for benefits on which the project may not be particularly strong.

Conjectures

If projects were sold to gatekeepers at subsequent stages one would expect to find that the importance of quantitative measures and qualitative aspects change as the process proceeds from initiation to acceptance. It would also be reasonable to assume that as the process moves toward acceptance, the sophistication of the various gatekeepers would also change and thus the complexity of the packaging of the project would be adjusted. If this were true one would additionally expect to find some relationship between the relative complexity of the measures and qualitative aspects and their changes in importance. We propose that such a system is being implicitly employed, that is that projects are being packaged, that a change or shift in importance ratings will occur as a capital budget request moves through the acceptance process. Further, these changes in importance should be related to their perceived complexity and other qualitative aspects. Below, we explore these conjectures: i) the importance of quantitative/qualitative indicators change as a project proceeds through subsequent gates; ii) the complexity of quantitative/qualitative indicators changes in importance as a project proceeds through subsequent gates; and finally iii) the projects are packaged in order to be sold at each subsequent gate.

Data

A questionnaire (available from the authors) was distributed to 34 practitioners to solicit information regarding their perceptions of the change in importance and the rank of complexity of concepts, tools or techniques in of each of five categories: political climate, capital budgeting techniques, benefits measures, risk measurement, and project costs. Half of the participants are managers from a major corporation attending an executive development program. The other half surveyed was MBA students. The subsample taken from the MBA class included three vice-president/business-unit managers, 11 professional staff, three mid-level managers, one supervisor, and one unknown. On average the MBA subsample has been involved in or has signed off on 10.5 capital budgeting requests. One participant indicated full-time-student status that had previous experience at the mid-managerial level and had participated in at least five capital budgeting projects. All other participants in this subsample held at least one non-academic position. All responses were tested for mean and variance differences in MBA subsample responses from the manager responses. No material differences were found. Additionally, the multiple regression analysis was conducted with a dummy variable indicating MBA participant or manager; no cases of significant dummy variables were found.

Twenty-six concepts, tools or techniques were identified and partitioned into these five categories. Participants were asked to determine the magnitude of increase or decrease in importance of each item in each category as the project moves from initiation to final acceptance. Participants could select the magnitude of the
Appendix A (available from the authors) provides a detailed analysis of the capital budgeting process and perceived complexity.

Analysis and Results

Participant responses were subjected to a variety of statistical analyses to determine the relative importance of various factors. This analysis included the examination of survey data and the use of regression models to identify the most significant contributors to perceived complexity.

The most important factors identified in the study were the cost of capital, the future cash flows, and the risk associated with the project. These factors were consistently ranked as the most critical in influencing perceived complexity, as measured by the participants.

A change in complexity was defined as a five-point increase in the rating of a particular factor. The results showed that a significant increase in complexity was observed when the cost of capital exceeded 20%, and when the future cash flows were less than 50%.

In conclusion, the study highlights the importance of considering the cost of capital and the future cash flows when assessing the complexity of capital budgeting decisions. These factors should be given due consideration in any attempt to improve the decision-making process.
factor analysis. Table 1 shows the resulting factor loadings. The factor names are intuitive and groupings are based on common response concepts/tools/techniques grouped via varimax rotated factor loadings. These loadings were saved. For each change in importance question there is a corresponding complexity rank question. These question numbers are provided in the third column of Table 1 opposite the corresponding change in importance question number in column 1. For each change in importance factor we determined a corresponding complexity rank factor by applying the factor loadings for each change in importance question to the corresponding complexity rank question. For instance, the change in importance factor titled partial risk was determined using the varimax rotation factor analysis. These loadings in the column under partial risk, a change in importance factor, were derived on the basis of the responses numbered 4c, 4d, 2b, 4e, 2d, and 4b and were subsequently applied to the responses to questions 8c, 8d, 6b, 8e, 6d, and 8b respectively to create a partial risk complexity rank factor. This process was applied to all nine changes in importance factors and resulted in nine corresponding complexity rank factors.

To determine whether the projects are packaged and that changes in importance are related to complexity rank a series of multiple linear regression analyses were conducted. The responses were partitioned by change in importance factor. For each change in importance factor respondents’ change in importance factor scores were regressed upon the participants’ corresponding complexity rank factor scores, the number of requests the respondent has been involved, a surrogate for experience, position in the firm, an indicator of relative power, and functional area, a reflection of sophistication. Nine separate multiple regressions were conducted. The results indicate that neither the complexity rank factors, nor the surrogates for experience, power, and sophistication explain corresponding change in importance factors at the 0.05 level or better.

The analyses thus far are based on linear estimation procedures. A particular change in importance factor may display some nonlinear pattern during the process of acceptance/rejection as the constituencies at each subsequent gate vary and degrees of complexity of the package of the project become more or less appropriate. Again, the respondents’ factor scores were partitioned by change in importance factor. Then, for each change in importance factor the corresponding complexity rank factor scores were tested to determine whether cubic, compound, exponential, inverse, linear, log, power, or quadratic functional forms explained corresponding change in importance factor scores. This analysis, using nonlinear tools, identified several significant relationships. Partial Risk change in importance factor scores are explained by an inverse function of partial risk complexity factor scores using \( PRI_i = (149.298 PCI_i)^{-1} \) at the 0.002 level of significance with 21 degrees of freedom and a \( r^2 = 0.372 \). Accounting measure change in importance factors scores are likewise inversely related to its corresponding complexity at the 0.001 level, with 20 degrees of freedom and an \( r^2 = 0.410 \). Specifically the relationship is \( AMI_i = (10.9602 AMC_i)^{-1} \). Project fit change in importance factor scores are a cubic function of project fit complexity rank factor scores: \( PFIT_i = 1.9941PF C_i - 0.3672 PF C_i^2 + 0.0189 PF C_i^3 \) at the 0.001 level or better with 17 degrees of freedom and a \( r^2 = 0.667 \). EAT based return change in importance factor scores are also explained by EAT based return complexity rank factor scores in a cubic manner but at the 0.002 level of significance with 18 degrees of freedom and an \( r^2 = 0.5570 \). The specific form is: \( EATI_i = -0.5077 EATC_i + 0.1842 EATC_i^2 - 0.0107 EATC_i^3 \).

Similar nonlinear tests for change in importance factors and complexity factors as related to respondents’ functional areas were also conducted. These tests find that the functional area of the respondent explains respondents’ perceived importance level of all variables tested at the 0.04 level or less. The explained variance in
these tests ranged from 0.24 to 0.62. Complexity factor scores for all factors were explained at the 0.001 level by respondent functional area with $r^2$ greater than 0.71.

Also, using the same nonlinear testing procedure, only change in importance factor scores for cost of capital, present value and operating costs were not found to have significant relationships with respondent position. Only present value complexity rank factor scores were not found to be explained by respondent position.

Change in importance factors: project fit, EAT based returns, and politics are nonlinearly related to number of requests (experience in capital budgeting) at the 0.032, or less, level of significance. Also, partial risk, accounting measure, cost of capital, and EAT based return complexity rank factors are functionally related to number of requests at the .034 level or better. Regression analysis or t-tests would not pick up these relationships. This may explain why studies in the past have not detected these qualitative types of relationships: they were using linear statistical tests.

**Summary**

The purpose of this paper is to examine whether buying behavior models help to explain the departure of normative capital budgeting theory and practice. A questionnaire was distributed to 34 practitioners to determine how factors change with regard to importance and complexity as a project moves through the approval process. The responses were analyzed using varimax rotation factor analysis and a series of multiple linear regressions. The factor scores were tested using nonlinear tools to identify significant relationships.

Significant relationships exhibiting respectable $r^2$ emerge when using nonlinear bivariate model forms. These models provide strong support for our conjectures. Our results indicate that there are indeed changes in importance of qualitative and quantitative measures as the project proceeds from initial to final approval. Indeed, project risk, accounting measure, project fit, cost of capital, present value, earnings based returns, politics, free cash flow measures, and operating cost measures are explained by respondent functional area. The importance and perceived complexity of these factors changes, depending upon the functional area of the individual involved in the preparation/approval of projects. We also have found that the importance of these factors as well as their perceived complexity is related to the position of the individual involved in the project. Our results suggest that experience in capital budgeting is not nearly so powerful, by itself, in explaining differences in factor importance or perceived complexity. Clearly, if a project is to complete the capital budgeting approval process the qualitative and quantitative factors, which constitute the basis of assessment, must be packaged to accommodate each function or position in turn.

Our results indicate that, if a project is to complete the capital budgeting approval process, the qualitative and quantitative factors that constitute the basis of assessment must be packaged to accommodate each function or position in turn. Practically, this means that sponsors of capital budget requests must be cognizant not only of the functional area of each person at each of the various stages in the process but their position in the organization as well. Armed with this knowledge, the capital budget can then be cast in terms the individual in each stage gate can relate to and understand. Ultimately, each of the various criteria should be interpreted as relating to company goals within the context of the person who is occupying that particular stage gate. In effect, the sponsor should be “packaging” the project as it moves from initiation to acceptance.

This pilot study further shows that by using classical statistical analysis, there are few interesting relationships that emerge. However,
the opposite is true when nonlinear tools are used. Our results suggest that the relationships explaining changes in the importance of factors to project approval and their complexity is richer than suspected. Increases and decreases are not, here, found to be linear, but rather to exhibit complex behavior. This paper provides a platform for further investigation into capital budgeting processes.

Suggestions For Future Research

Future research can focus on examining the practice of capital budgeting in relation to established theory regarding process, objectives, criteria and the impact on firm value. In addition, future research may incorporate concepts from the buyer behavior models and use this to explain capital budgeting processes.

Footnotes

1. The stage-gate process was initially outlined as an industrial buying paradigm by Cooper (1990).

References

15. Pike, R., "Sophisticated Capital Budgeting