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 & Geijsbeek (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-

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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 system¹. 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-

tial 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 (Bonoma (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 (Bonoma (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

Table 1
 Varimax Rotation Principal Factor Scores Change in Importance Questions & Factor Weights Used to Determine Complexity Factors and Scores

Change in Importance Question Number	Questions Content	Complexity Rank Question Number	Changes in Importance Factors							
			Partial Risk	Accounting Measure	Project Fit	Cost of Capital	Present Value	EAT Based Returns	Free Cash Flow	Operating Costs
q4e	Negative Skew	q8c	0.9719							
q4d	Positive Skew	q8d	0.9603							
q2b	Accounting Rate of Return ARR	q6b	0.7707							
q4e	Beta	q8e	0.6624							
q2d	Internal Rate of Return	q6d	0.6152							
q4b	Undiversifiable Risk	q8b	0.5303							
q3b	Earnings After Taxes	q7b		0.8499						
q3a	Operating Income	q7a		0.8221						
q5b	Project Cost	q9b		0.6346						
q1a	Unit or Department Sponsoring/ Initiating the Project	q10a		0.5219						
q1f	Top Management Commitment	q10f			0.8350					
q1g	Firm Directional Fit of the Project	q10g			0.8075					
q2a	Payback	q6a			0.6830					
q1c	Analysis of Novel Projects	q10c			-0.5099					
q3d	FASB 95 Cash Flow From Operations	q7d				-0.8445				
q5a	Cost of Capital	q9a				0.6461				
q4a	Total Risk	q8a				0.6135				
q2e	Net Present Value	q6e					0.7396			
q3c	Capital Budget Fit	q9c					-0.7035			
q1d	Analysis of Essential Projects	q10d						0.7577		
q3c	Earnings After Taxes Plus Depr.	q7c						0.7214		
q2c	ROI/ROA/ROE	q6c						0.5482		
q1e	Project Ease of Management	q10e							0.9057	
q1b	Person or Position Sponsoring/ Initiating the Project	q10b							0.4712	
q3e	Free Cash Flow	q7e							0.8601	
q3f	Operating Costs	q7f								0.8719

Adjusted for missing values.

* Adjusted for missing values.

change in importance using a five-point scale. For example, a large decrease in importance was designated as -2 and a large increase in importance was designated a +2 with integer valued choices in between. Participants were then asked to rank these same items in the same categories in terms of complexity. The term complexity should describe how difficult the element is to use and understand. Participants placed a number one next to the element in the category that was easiest to use and understand, the number two next to the one that was second easiest to understand and so on until all elements in the category were ranked. Participants were also asked to indicate the number of capital budgeting requests they have been involved in, their position, and their functional area.

Analysis and Results

Appendix A (available from the authors) provides relative frequencies of responses, measures of central tendency, dispersion and asymmetry of responses to each question which summarizes participants' perceptions concerning capital budgeting element change in importance as requests move through the capital budgeting process and perceived complexity.

Participant changes in importance responses were subjected to varimax rotation

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 $PRI_j = (149.298 PRC_j)^{-1}$ 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 $AMI_j = (10.9602 AMC_j)^{-1}$. Project fit change in importance factor scores are a cubic function of project fit complexity rank factor scores: $PFI_j = 1.9941PFC_j - 0.3672 PFC_j^2 + 0.0189 PFC_j^3$ 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: $EATI_j = -0.507 EATC_j + 0.1842 EATC_j^2 - 0.0107 EATC_j^3$.

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).

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