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FUNCTIONAL SPECIALIZATION IN TECHNOLOGY BASED NEW VENTURES

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Functional Specialization in Technology Based New Ventures

ABSTRACT

This paper is an extension of existing contingency theories of organization design as it looks at the firms stage of growth as a determinant of structure through an organization's initial growth cycle. The sequence and extent of functional specialization are seen as the product of an organizational learning process. This proposition results in five specific hypotheses which are tested with a sample of over 100 technology based new ventures created within the past fifteen years. Based upon analysis of variance, specific hypotheses were supported with stastically significant results - four of five cases. Further, these results held when analyses were conducted controlling for external variables such as size, age, and rate of growth.

INTRODUCTION

Organizational growth is a topic of great interest certainly in managerial circles, but clearly in academe as well. In fact, issues of growth have been addressed at length within the disciplines of economics (Coase, 1952; Commons, 1934, Arrow, 1974; Penrose, 1957 and Williamson, 1975); business policy (Chandler, 1962; Scott, 1970; Wrigley, 1970 and Rumelt, 1974); and organization theory (Starbuck, 1971; Filley, 1962; Grenier, 1972; Kimberly, 1980; Normann, 1977; and Rhenmann, 1973). In all instances such research focused on a common set of inquiries - how and why do organizations grow?

Although it may be obvious to some, it is important to emphasize that growth is not spontaneous. It is the consequence of decisions: decisions to introduce new products and services, to stimulate demand, and so forth. The relationship between specific decisions and ultimate expansion of the organization may be tenous, but expansion is necessarily dependent upon some decisions and the actions which follow them (Starbuck, 1971). The purpose of this paper then is to understand and explain the relationship between growth and the nature of structure in technology-based new ventures.

The model to be proposed is developmental as it views the institution and changing nature of organizational structure over time as a manifestation of organizational learning. A prime determinant of structure for new ventures (the subset of organizations studied) is hypothesized to be the stage of growth.

This paper therefore represents the nexus of several literatures - growth, structure, and the emerging work on new ventures - in a fashion not yet undertaken in the field.

STAGE OF GROWTH MODEL

The growth model proposed in this research might be interpreted as what Starbuck (1971) terms a metamorphosis model, in that it describes problems likely to result. The term stage of growth was selected advisedly for lack of a better descriptor. Although numerous references in the literature and grounded case examples support the model to be discussed, it should be made explicit that none of these phases define an organization's life cycle per se. Further, it is contended that there is no life cycle or phased sequence applicable to all organizations, and that recurrent cycles and patterns in organizations, which in fact do exist, are a product of environment and task requirements.

Therefore, it is critical that this research be seen as a mid-range theory (Pinder and Moore, 1977) of growth. That is, the validity of this stage of growth model is a function of its assumptions and focal population, which are: (1) that it obtains for high technology new ventures only; (2) that it explains only internally generated growth as opposed to growth by acquisition or merger; (3) that a market segment or niche exists such that demand conditions are not limiting; and (4) that the focus is an initial growth within a single product/technology base (Filley and House, 1969).

New ventures are created for the specific purpose of developing and marketing a new product or service (to be referred to as product). The types of specialized knowledge or competence--the task system by which the firm's purposes are achieved (Normann, 1971). The objective of the new venture therefore is to define, develop and market the product while constructing the appropriate and supportive task system.

As part of this process, it has been observed that the venture manager faces a patterned range of strategic and operational problems (listed in Chart 1) from product conceptualization to organizational maturity. This list emerged from the cases, but was subsequently field tested and refined through interviews with managers of other new ventures, venture capitalists, and researchers of new ventures. It appears that some are more dominant at times than others and that a sequential pattern of dominance exists. The particular problems faced at a given time will define the venture's position in a new stage of growth, as depicted in the diagram below.

Dominant Problems ⟶ Stage Growth

The four stages of growth are summarized below:

Stage 1, Pre-Start Up: This stage of growth is one not mentioned in many existing models and is largely unique to technology new ventures. Prior to the true creation of the new venture, as signified by incorporation or gaining of a major source of initial financial backing, virtually all ventures go through a period during which the primary focus of the entrepreneur and possibly several others, is on the

invention and development of a product and/or a technology. In fact, this may be a circumstance in which some of the critical functions are assigned to part time employees or may be contracted out. For all purposes, structure and formality are non-existent, with almost all activity focused on technical issues as defined and directed by the founding entrepreneur(s). Major problems of the organization at this point include: construction of a product prototype (initially one with requirements for multiple prototypes shortly thereafter), and selling of the product and business idea to financial bankers. At this stage the organization is engineering dominant with manufacturing done largely in a model shop mode. The functions, if considered at all, tend to be done implicitly, usually by the entrepreneur himself.

Stage 2, Start-Up: Given financial backing, new ventures go through a period, during which the major focus of the organization is on developing the product/technology for commercialization. At this point, the organization largely resembles a new product development team, with its problems and competences largely being technical. The focus is primarily on learning how to make the product work well and on how to product it beyond the model shop prototype approach of Stage 1. Here, the first consideration emerges for building the organization's task system in addition to developing the product. By this time, the organization's engineering and manufacturing functions are formally created, and in many cases, the marketing and

finance/administration functions appear in embryonic stage. Here again the venture will be dominated by a single owner or small number of partners. Usually, there are no explicit objectives for the firm, with the level of professionalism and training low. Communication and control is personal, face to face and revolves around the owner/partner. It is toward the end of this stage that the ventures product is publicly announced or first made available for sale.

Stage 3, Growth: Given technical feasibility and successful market acceptance, a period of high growth will typically result. The major problems of the firm at this point then, are to produce, sell and distribute the product in volume, while avoiding the shakeout of less effective or efficient firms from the market.

With pressures to attain profitability, the venture must carefully balance profits against future growth. Many ventures experience a sequence of functional "shocks" or "crises" as each function faces difficulty of building an efficient and effective task system. It is in period that the firm experiences an almost constant state of change. The owner/partner remains central to all decision making, but little sense of hierarchy exists at first, as employees still feel a team spirit in the task of achieving success with an innovation. The number of employees increases rapidly an new functions are continually added. Employees tend to be entrepreneurial risk takers usually willing to forego prospects of a higher salary elsewhere in return for

the opportunity for rapid promotion and advancement. Early in the growth stage, most employees find themselves to be generalists performing a broad range of tasks. However, later in the stage, as new functions are added, employees become increasingly more specialized. By this time engineering, manufacturing, marketing and finance/administration are firmly established as functional specialities. Also during this stage, the function of human resource planning/personnel is added, typically in response to the need to hire large numbers of individuals.

This stage might best be described as transitional. Formalization of structure, procedures and processes is at least initiated, if not established in all functions. However, the tendency of the owner/entrepreneur to be involved in all decision making is hard to unlearn and so a constant tension exists between the formal and informal structures. Communication and control becomes increasingly more impersonal throughout the stage.

Stage 4, Maturity: As the growth rate slows to a level consistent with market growth, the firm enters a new stage. The major problems of the organization at this point are to maintain the growth momentum and market position. The typical focus accordingly becomes development of a second generation product which presents new challenges. By this time, the venture has evolved from an organic R&D lab into a stable functional operating company characterized by rational, bureaucratic principles across the organization.

Usually, the owner/partner had been either replaced or supported by a professional, experienced manager or team of managers. A formal structure has been established and is closely adhered to with rules and procedures correspondingly standardized and formalized and impersonal. The major issue for firms in this stage then is how to allocate managerial attentions and resources between the current product operations and new product development efforts.

STRUCTURE

Considerable research has documented the relation of increased structure with size. Viewing growth as an increase in size, organization theorists have in fact documented that the underlying dimensions of structure increase as size increases. In reporting results of research on "fifty-two work organizations, forty-six of which were a random sample stratified by size and product or purpose," Pugh et al (1969) concluded that:

> "It can be hypothesized that size causes structuring through its effect on intervening variables such as the frequency of decisions and social control. An increased scale of operation increases the frequency of recurrent events and the repetition of decisions, which are then standardized and formalized (Haas and Collen, 1963). Once the number of positions and people grows beyond control by personal interaction the organization must be more explicitly structured. Insofaras structuring includes the concept of bureaucracy, Weber's observation that the "increasing bureaucratic organization of all genuine mass parties offers the most striking example of the role of sheer quantity as a leverage for, the bureaucratization of a social structure is pertinent (Gerth and Mills, 1948)" p. 366.

Several years earlier, Starbuck (1965) observed that "the formalization process continues as an organization gets older and

larger, though no doubt the earliest manifestations of formalization are the most striking ones. Patterns of behavior stabilize; individuals settle into characteristic roles; standard operating procedures are established." (p. 54). Subsequently, and throughout the 1970's, the relation of size and structure was tested, retested and debated repeatedly as this portion of the larger contingency theory of organization took hold.

However, in the case of high technology new ventures with extremely rapid growth rates, the timing of increased structure emerges as a critical factor - one rarely addressed in the literature. The descriptions of Alpha and Beta are largely the descriptions of evolving functional specialization. The timing issue is pertinent in that if structure in the form of hierarchical supervision as well as specialized jobs and functions, are imposed too early in the life of the venture, then the entrepreneurial climate and spirit which carry the organization may be squelched. In other words, stage 1 and stage2 ventures reflect high levels of task uncertainty, specifically surrounding product development, requiring a primarily organic organizational form.

Conversely, if the introduction of structure and supporting administrative processes and controls are excessively delayed, the organization may not survive especially as competition emerges resulting in some industry shakeout period. In large part, the stage 3 and stage 4 organization experience less uncertainty as tasks are directed toward developing efficiency, but growth also brings greater task diversity and

interdependence, therefore, requiring more patterned mechanistic properties.

More pointedly, functional specialization is of interest because the major objectives of product/technology development and the construction of a task system, which becomes the organization itself, strongly suggests a sequential pattern of functional development.

The focus on functional specialization is supportable not by the case data developed by the author (Kazanjian, 1983), but in the growth literature as well. In attempting to develop a meaningful description of organization from a rich, highly detailed longitudinal data base on a sample of ten manufacturing firms, Starbuck (1966) finally decided to "resolve the dilema by specifying five descriptive variables, each of which states the number of employees of a given type. (The) five variables constitute a mutually exclusive partitioning of all employees of the firm" (p. 279). His classification of variables was essentially the firm's major functions: production, sales, control, research, and management. The relevance of his variables to this dissertation is direct in that Starbuck used them to demonstrate "that change in organizational structure is occasionally punctuated by abrupt, major transformations which sharply distinguish one period of organizational history from another" (p. 275). In fact, Starbuck used functional specialization as the main structural variable in an empirical stage of growth - metamorphosis study which looked at the relation of structure to output at varying points in time.

Therefore, functional specialization serves as a pertinent variable of structure within this context.

Support for the proposition of the sequential development of functions can be found as well. Wickesburg (1961, cited in Starbuck, 1965) in exploratory research on small manufacturing firms found support for a probable sequence in which functional specialization develops. The findings supported the following sequence of specialization: production, then sales, followed by purchasing and finally quality control. The subsequent series of specializations were too ambiguous and largely unsupported. The sequence of functions within new ventures are expected to differ due to their high technology base. Further this research proposes a more meaningful comprehensive set of functional specializations. The argument could be made that procurement and quality control are typically sub-specializations of production. Therefore, Wickesberg's findings only support the contention that production is specialized before sales, and to a greater extent at utilizing a three state model as a reference, Filley and House (1969) hypothesized that:

> "As an organization passes through stages of growth, it adds new functional emphases in a predictable fashion: in early stage business organizations, the firm emphasizes a single function; following take-off, it tends to emphasize either sales or production, followed by the alternative; then finance and finally separation of administration from operation." (p. 462).

This proposition, based upon clinical observations, was not empirically tested, however.

Given the above discussion, the following proposition is established:

> Proposition: Functional specialization within high technology new ventures will differ by stage of growth and will will develop in a sequential pattern with the following order: engineering and manufacturing first, followed by marketing and finance/administration, with personnel last.

RESEARCH DESIGN

As has been discussed previously, the focus of this research is on the hypothesized stages of growth experienced by high technology new ventures as they move from the inception of a product or technology idea to a mature single business entity. This research focus, the theoretical model developed and its associated assumptions placed very specialized parameters on the sample of firms required, as the model is thought to obtain for certain types of firms only. To be included, firms must have been young (created within the last 15 years), independent new ventures situated in a high technology industry. Given that many such firms are privately held, and that many actively shun publicity for purposes of protecting proprietary product/market developments, they tend to be difficult to locate. Additionally, it becomes necessary to conduct research via primary data collection as public information - annual reports, 10-K''s, etc. - do not exist. For these reasons, the focus of this research is on venture capitalist backed firms which in all other aspects fulfill the theoretical assumptions. Venture capitalists in effect served as a location mechanism for potential firms to

be included in the sample as well as a point of entree to firms which might not otherwise respond.

The firms included in the sample were located through venture capitalists or similar institutions. Four such sources provided the names and addresses of 225 firms which met the required criteria. To be included, a venture had to have been created since 1970, situated in a business considered high technology-computers, electronics, and related - and must be an autonomous, free standing firm. No intra-corporate start ups or joint ventures were included. A total of 105 (46%) of those surveyed responded, which appears quite reasonable when compared to response rates from mailed questionnaires usually reported in the organizational literature.

OPERRATIONALIZING STRUCTURAL CONSTRUCTS

A number of highly reliable structural measures have been developed in the literature to capture various elements pertinent to this study. For example, Tyler (1973), Hage (1965), Hage and Aiken (1967), Samuel and Mannheim (1970), and Hall (1972) all have developed and tested measures of specialization. Van de Ven (1980) offers measures on both individual and unit specialization. More directly related to the variables in this study, Azumi and McMillan (1975), and Hsu, Marsh, and Mannari (1983) have used measures used in the Aton studies (Inkson, Pugh, and Hickson, 1970). The existence of such a body of established measures would argue against the creation of new measures for the purpose of this data collection effort.

As outlined earlier, the particular structural focus of this research is functional level structure. From the case data generated, it appears that considerable problem solving activity and focus is built around the individual functions which in fact, serve as learning systems by which the firm institutionalizes its specific problem related knowledge over time. Further, each of these functional elements - engineering/technology, manufacturing, finance/administration, marketing/sales, and employee relations - can be examined separately.

In a longitudinal study examining major organization transitions over time, Starbuck (1976) used the number of employees in each function as a measure of functional structure. Given the source and types of data available to him and the nature of his propositions, this was particularly appropriate, but would be too gross a measure of functions in this instance. Further, the particular mechanism by which functions serve as learning systems is through the designation or creation of specialized roles or positions, which size would not capture.

Therefore, the concept of structure as pertinent to this research has been operationalized by the construct of functional specialization. The measurement paradigm employed then is that used by the Ashton group (Inkson, Pugh, and Hickson, 1970) in their measures of structural specialization cited earlier. The specific measures from the questionnaire are listed in Table I. As can be seen, each respondent was asked to indicate for each position whether or not at least one person performs that

particular function and no other function. Affirmative responses for each position were coded a 1 and negative responses were coded a 0. Responses were then summed at each functional level for each case, comprising the measure of functional; specialization. The specific activities listed were generated from the two case studies as well as extensive interviewing of managers at one addition high technology new venture not included in this study.

In order to assess the reliability of these indices, a split-half reliability analysis was conducted. Each functional specialization scale of activities was randomly split into two equal groups and a mean specialization score was then calculated for each. Correlations of the two halves were then run and used to calculate a reliability coefficient. The split-half reliability coefficients, presented in Table II are all of the .75 level or higher, demonstrating strong measurement reliability.

IMPACT OF STAGE OF GROWTH ON FUNCTIONAL SPECIALIZATION

As stated above, an overall, one-way analysis of variance was conducted with the five structural functional specialization variables - engineering/technology, manufacturing, finance/administration, marketing/sales, and employee relations - against stage of growth. Statistically significant relationships were found in all but one case as can be seen in Table III. Each variable will be discussed in relation to specific hypothesis.

The essence of the theoretical model, as pertains to the impact of stage of growth on structure, is that functional specialization in high technology new ventures will differ by stage of growth, with some functions specialized in earlier stages, others in later stages. That proposition explicated earlier, translates to the following specific hypotheses which were tested:

H_1: Firms in stages 3-4 will exhibit greater engineering/technology functional specialization than will firms in stage 1.

This hypothesis is not directly supported. The overall ANOVA was not significant ($F = 1.3974$, $P < .2482$). More specifically, the planned comparison of functional specialization measurement means of firms in stage 1 vs. firms in stages 2-4 generated roughly the same results ($F = 1.4018$, $P < .2392$), as shown in Table IV. However, based upon these contrasted with firms in stages 3 and 4 was also conducted. Although a greater difference was observed, the relationship was not significant ($F = 3.6677$, $P < .0583$) here either.

H_2: Firms in stages 2-4 will exhibit greater manufacturing functional specialization than will firms in stage 1.

This hypothesis was strongly supported at highly significant levels by both the overall ANOVA ($F = 7.2562$, $P < .0002$) and the planned comparison ($F = 16.455$, $P < .0001$), which are shown in Table V. As an examination of Table 5.1 readily indicates, manufacturing functional specialization increased markedly for

firms in stage compared to stage 2, while flattening out somewhat across stages 3 and 4. This largely confirms the theory which suggests that stage 2 is focused on preparation for product introduction and commercialization, which entails trial production runs and the development of mass production methodologies (in contrast to prototype production in stage 1). It would stand to reason that functional specialization would continue to increase into stage 3 a rapid growth of output would put new strains on production methods focusing on a search for greater efficiencies and allowing for greater specialization:

H_3: Firms in stages 3 and 4 will exhibit greater Finance/Administration functional specialization than will firms in stages 1 and 2.

Results of analyses testing this hypothesis demonstrate very strong support, with the overall ANOVA ($F = 7.6581$, $P < .0001$) and the planned comparison of functional specialization ($F = 24.3337$, $P < .0000$) both significant at high levels. The theory suggests that it is some of the postulated dominant problems of stage 3 - defining organizational roles, responsibilities, and policies, developing management information systems and financial information systems and financial information systems, cost control, and attaining profitability - which require management attention and control related structure becomes the mechanism by which these solutions become institutionalized.

H_4: Firms in stages 3 and 4 will exhibit greater Sales/Marketing functional specialization than will firms in stages 1 and 2.

Here again, highly significant findings support the theory proposed. It was suggested that not until the firm faced the problems of meeting sales targets, providing customer service, and field support in a rather dominant fashion would corresponding elements of organizational structure emerge. In fact, the overall ANOVA ($F = 8.96$, $P < .0000$) shows a strong relationship to stage of growth, while the planned comparison of the functional specialization means of stage 1 and 2 firms against stage 3 and 4 firms shows equal strength ($F = 25.3055$, $P < .0000$).

H_5: Firms in stage 4 will exhibit greater Employee Relations functional specialization than will firms in stages 1-3.

This hypothesis is supportable, but an examination of the overall ANOVA ($F = 3.479$, $P < .0188$) might suggest another equally important relationship. The planned comparison of the means of firms in stages 1-3 against firms in stage 4 is significant ($F = 8.10058$, $P < .0056$). However, the post-hoc and comparison indicates an equally meaningful comparison to be between firms in stages 1-2 and those in stage 3-4 ($F = 10.3733$, $P < .0017$). The increase in functional specialization at stage 3, in retrospect, seems more consistent with the theory, for the problems of attracting capable personnel and maintaining management talent and depth seem most acute during periods of high growth and as stated in chapter four, the rate of growth for firms in stage 3 is the highest of all firms and, in fact, is more than 50% greater than that of the next closest stage - stage 2.

ASSESSING THE IMPORTANCE OF STAGE OF GROWTH

Given the nature of the research question, the hypothesis testing effort to this point has utilized analysis of variance and analysis of covariance. Such techniques focus on specific treatment variables and whether mean responses differ significantly across treatment variable levels. However, they do not indicate how much of the variance associated with the dependent variable is attributable to the treatment. In multiple regression, R^2 plays an important role as a summary measure of the adequacy of fit of some model to the data. Correspondingly, the omega-squared coefficient, analogus to R^2, can be used as a goodness of fit measure, as it also provides an estimation of the treatment's effects on the variation in the response variable (Green, 1978).

Using the formula:

$$\omega^2 = \frac{SSA - (J-1)\,MSW}{SST + MSW}$$

where MSW denotes the within group mean squares, SSA denotes the sum of squares among groups, SST denotes the total sum of squares, and J denotes the number of levels over which the treatment variable is classified (Green, p. 225), the coefficient is readily computed from the output of the ANOVAs conducted.

The omega-squared coefficient was calculated for each dependent variable, based on results of the one-way overall ANOVAs. Interestingly, the results indicate that in addition to the fact that the means of dependent variables differ by stage with high statistical significance in most cases, even when

controlling for external variables, stage of growth is a prime determinant of the associated variance.

For those dependent variables with statistically significant relationships to stage, omega squared ranged from .07-.19 indicating accountability for 7-19% of the variance. These values would correspond to r values of .27-.44.

IMPLICATIONS

There is a strong connection between the organization structure of a company and its ability to grow. The bureaucratic organizational structure does little to develop the individual: it
offers little opportunity for individual initiative, and its major requirement is that its members should follow the rules (Normann, 1977, p. 89). In fact, Burns and Stalker (1961) proposed an alternative form or organization, termed organic which, being less rule bound and defined, allowed the individual wide latitude and choice. As the contingency theorists would argue, however, no one form of organization is inherently better than others. In the context of this research, it was argued earlier that more organic forms of organization are well suited to early stage firms where the tasks and problems are more uncertain and inventive in nature. Unfortunately, many managers who correctly perceive the importance of very organic forms in early stages see that as universal relationship and resist the institution of necessary and appropriate bureaucratic characteristics.

Single business companies, as confirmed by empirical studies (Rumelt, 1974), are typically organized in functions. Naturally, the core groups of an emerging company do not immediately adopt this organization as such a sharp division of labor obstructs the overall view so necessary for success at this point. Nonetheless, as this research confirms, functional specialization is ultimately adopted. Further as postulated, functional specialization is not embraced uniformly and simultaneously across the company, but rather in a pattern in accordance with problems encountered. It was expected, corresponding to this scheme, that engineering/technology would be the first to formalize. However, the findings suggest no difference in functional specialization across stages. It appears however, that a moderate degree of functional specialization (range of 3.47 - 4.76 on a scale of 6) was uniform across the stages and was adopted in the first stage. In effect, functional specialization was evident from the beginning of the firm.

More strictly in accordance with the hypotheses, increased functional specialization was observed for manufacturing in stage 2 (with another increase in stage 3). Finance/administration and marketing/sales registered significant increases with stage 3 as theorized.

Employee relations showed increased functional specialization in stage 3, as well as in stage 4 as predicted. Generally however, ratings of employee relations functional specialization (range of .7391 - 2.1389 on a scale of 6) were low, and in fact were found through analysis of covariance, to be

attributable largely to the effects of size. As the firms in the sample are generally small (mean size 262 employees), it would appear that firms must achieve a considerably larger size before they require functional specialization to any extent for this purpose. What is of most interest related to this finding is that determinants of structure are not uni-dimensional. Ascribing organization structure to size, stage of growth or any other single factor may be misleading as it appears that different factors determine different internal structures.

Accounting for these variations then, the sequential specialization by stage, of the five prime functions of the firm is supportable. Additionally, the trend of increasing structure (resulting from the independent effects of stage and not attributable to external factors as confirmed by analysis of covariance) is supportable as well.

Table I

Structural Measures

SECTION 3

Functional Characteristics of the Firm

Each section below focuses on a major function of the firm. For each activity listed within a functional area, please indicate with a check those for which at least one person performs that function and no other function. Please check such items even if they are located in a different function in your firm, other than the one in the section heading

Does one person perform the task full-time?	Yes	No	Unsure
Engineering/Technology			
Director/Manager of all engineering			
Design engineering			
Development engineering			
Drafting			
Model making			
Functionally dedicated engineering (electrical, mechanical, etc.)			
Project dedicated engineering			
Long range, pure research			
Manufacturing			
Director/Manager of Manufacturing			
Inventory Control			
Production Scheduling			
Purchasing			
Manufacturing engineering			
Quality assurance			
Product line production			
Assembly			
Test			
Cost Estimating			

Table I (continued)

Structural Measures

Functional Characteristics of the Firm (Continued) Does one person perform this task full-time?	Yes	No	Unsure
Finance/Administration			
Director/Manager of Finance			
Accounts Payable			
Payroll			
Cost Accounting			
Invoicing and collections			
Controller			
Budget planning and analysis			
Preparation of management reports			
Internal auditing			
Management information systems (MIS)			
Strategic Planning			
Legal Counsel			
Marketing/Sales			
Director/Manager of all marketing			
Director/Manager of all sales			
Market research and analysis			
Advertising, promotions and publications			
Account manager			
Customer service and product support			
Group or regional sales			
Product management			
Warranty processing and service			
Employee Relations			
Director/Manager of Employee Relations			
Compensation and benefits			
Technical training			
Non-professional hiring			
Professional hiring			
Management development			
Physical Facilities			
Organizational Development			
Security			

Table II

Split-Half Reliability of Functional Specialization Measurement Indices

STRUCTURAL INDEX	SPLIT HALF RELIABILITY COEFFICIENT
Engineering Technology/Structure	.757
Manufacturing Structure	.930
Finance/Administration Structure	.875
Marketing//Sales Structure	.758
Employee Relations Structure	.773

Table III

Overall Analysis of Variance: Stage — Functional Specialization Means

FUNCTIONAL SPECIALIZATION VARIABLE	Stage 1	Stage 2	Stage 3	Stage 4	F =	P <	Results
ENGINEERING/TECHNOLOGY	3.4783	3.5769	4.7647	4.2500	1.3974	.2482	Not Signif.
MANUFACTURING	2.6087	4.6538	6.0000	6.4722	7.2562	.0002	Significant
FINANCE/ADMINISTRATION	2.3913	2.4231	5.0588	5.2500	7.6581	.0001	Significant
MARKETING/SALES	2.2174	2.9615	5.0508	4.7778	8.9600	.0000	Significant
EMPLOYEE RELATIONS	.7391	.8846	1.8235	2.1389	3.4790	.0188	Significant

Table IV

Engineering/Technology Functional Specialization Means

PLANNED COMPARISON

	Stage 1	Stage 2-4	F =	P<	Results
ENGINEERING/ TECHNOLOGY	3.4783	4.1392	1.4018	.2392	Not Significant

POST-HOC COMPARISON

	Stage 1,2	Stage 3-4	F =	P<	Results
ENGINEERING/ TECHNOLOGY	3.5306	4.4151	3.6677	.0583	Not Signif.

Table V

Manufacturing Functional Specialization Means

PLANNED COMPARISON

	Stage 1	Stage 2-4	F =	P <	Results
MANUFACTURING	2.6087	5.7722	16.455	.0001	Significant