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Pursuing Product Modifications and New Products : The Role of Organizational Control Mechanisms in Implementing Innovation Strategies in the Pharmaceutical Industry

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RESEARCH AND DEVELOPMENT
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PURSUING PRODUCT MODIFICATIONS AND NEW PRODUCTS:
THE ROLE OF ORGANIZATIONAL CONTROL MECHANISMS IN
IMPLEMENTING INNOVATION STRATEGIES IN THE
PHARMACEUTICAL INDUSTRY

Working Paper 91-121*

by

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Executive Summary

It is widely believed that firms pursuing product modification strategies require one set of control mechanisms and that firms pursuing new product strategies require a different set of control mechanisms (Dewar & Dutton, 1986; Ettlie, Bridges, & O'Keefe, 1984; Kaluzny, Veney, & Gentry, 1984). However, few studies have examined the role of innovation strategies and control mechanisms in the innovation creation process. Using data from 45 pharmaceutical firms I investigated the effects of innovation strategies and formal control mechanisms on innovation outcomes. The findings suggest the following:

- First, strategic intent does not have a direct effect on innovation outcomes as hypothesized. Theories that focus on intended strategies did not receive support in this study. These results are consistent with the recent anecdotal evidence in business publications that suggest that the desire to be innovative and the commitment of innovation-targeted resources does not help organizations realize innovation outcomes (O'Reilly, 1991; Vanston, 1988).
- Second, it appears that control plays a more critical role than expected in the innovation creation process. Control mechanism effects were clear and systematic, although, not always supporting the hypotheses based on the literature. The results suggest that the innovation process is not stochastic and that managers can use formal control mechanisms to proactively guide the process.
- Third, the determinants of product modifications and new products do not appear to be different. All three types of control mechanisms, input, process, and output, were found to be positively related to both the number of product modifications and new products.
- Fourth, although strategic intent did not have a direct effect on innovation outcomes, it does have an indirect effect on innovation outcomes through control mechanisms. Although not explicitly tested in this research, strategic intent had a direct effect on control mechanisms, which in turn affected innovation outcomes. The results clearly suggest that managers must choose control mechanisms that support innovation strategies.

References: Dewar & Dutton, Management Science, (vol. 32), pp. 1422-1433; Ettlie, Bridges, & O'Keefe, Management Science (vol. 30), pp. 682-695; Kaluzny, Veney, & Gentry, Health and Society (vol. 52), pp. 51-82; O'Reilly, Fortune, June 3, pp. 48-63; Vanston, Business Week, June 13, pp. 8.

Purpose of the Study

Although innovation strategies (strategic goals) and realized innovation outcomes (product modifications and new products) represent different endpoints of the innovation process, little empirical work exists that has attempted to link innovation strategies and innovation outcomes. The overall purpose of this research was to study formal mechanisms that managers can use to influence the innovation process in their R&D laboratories to successfully realize innovation goals. More specific subgoals are listed as follows:

- First, this project examines the determinants of the innovation creation process in R&D laboratories. Prior research examining the determinants of innovation has focused on innovation adoption (e.g., once the NOW checking account was created at one bank, NOW accounts were adopted by the rest of the banking industry), but not innovation creation. Researchers examining innovation creation have described innovations across a product's life cycle (e.g., automobiles, starting with the Ford Model T), but not the determinants of the technical innovations themselves (Abernathy & Clark, 1988; Tushman & Anderson, 1986).
- Second, the project examines the match between innovation strategies and control mechanisms and their corresponding affects in achieving product modifications versus new products. It was hypothesized that different innovation strategies (the strategic intent to pursue product modifications versus the strategic intent to pursue new products) require differential control mechanisms. Specifically, it was expected one set of control mechanisms would enhance the pursuit of product modifications, and that the same set of control mechanisms would hamper the pursuit of new products.
- Third, the project examines a more encompassing set of control mechanisms than previously studied. Although process control mechanisms (targeting behaviors and activities) have been the most studied type of control, they also have been the least recommended form of control when the transformation process is uncertain; for example in the research and development process. Therefore this project also looked at input controls (specialist diversity, specialist depth, and professionalization) and output controls (goal specificity, emphasis on outcomes in evaluation, and rewards and bonuses linked to results), in addition to process controls (centralization, documentation, formalization, frequency of performance appraisals).

Definitions

Strategic Intent Variables

- *Strategic Intent to Pursue New Products/Drugs* - The extent to which top management emphasizes new product development as a vital element of its strategy and as a means to compete.
- *Strategic Intent to Pursue Product Modifications* - The extent to which top management emphasizes improvements to existing products as a vital element of its strategy and as a means to compete.
- *R&D Spending/Sales* - average R&D spending as a percentage of sales for 1979-83.
- *Targeted Percent of Sales from New Products* - Targeted percentage of sales from new products for 1979-83.

Organizational Control Variables

- *Use of Input Control Mechanisms* - The extent to which control mechanisms control for the degree and variety of core knowledge, skills, experiences, and attitudes displayed on the job for R&D professionals.
 - *Specialist Diversity* - the number of different scientific specialties
 - *Special Depth* - the degree to which personnel are concentrated in a few core specialties.
 - *Professionalization* - the number of years of specialized schooling and the propensity to seek contact with professional colleagues outside the immediate work setting.
- *Use of Process Control Mechanisms* - The extent to which control mechanisms are used to regulate and monitor activities and behaviors displayed by R&D professionals.
 - *Centralization* - the degree of decision-making authority at lower levels of the organization hierarchy.
 - *Documentation* - the amount of record-keeping of work behaviors required by R&D professionals.
 - *Formalization* - the extent that rules governing behavior are precisely and explicitly formulated.
 - *Frequency of Performance Appraisals* - the number of times behavior is measured and evaluated.
- *Use of Output Control Mechanisms* - The extent to which control mechanisms are used to control results and outcomes produced by R&D professionals.
 - *Goal Specificity* - the extent to which goals are explicitly, clearly defined, and provide unambiguous criteria for selecting among alternative outcomes.
 - *Rewards and Bonuses Linked to Results* - the degree of public recognition R&D professionals receive for outstanding achievements.
 - *Emphasis on Outcomes* - the degree to which the quantity of outcomes is emphasized in performance appraisals and rewards.

Innovation Variables

- *New Products* - were drugs approved by the FDA representing chemical structures never previously available in the U.S. to treat a particular disease (New Chemical Entities).
- *Product Modifications* - were drugs involving new dosage forms, new indications, formula changes, name changes, and status changes.

Research Method

Sample and Sample Selection

A comprehensive list of U.S. pharmaceutical firms was developed using multiple sources: the National Pharmaceutical Council's membership list, the Pharmaceutical Manufacturers Association's membership list, the Generic Association's membership list, Medical Advertising News (Top 50 Pharmaceutical Firms Special Issue), Paul de Haen's New Product Survey and New Product Index, Pharmaceutical Manufacturers of the United States, R&D Laboratories in the U.S., Physician's Desk Reference, and Approved Drug Products with Therapeutic Equivalence Evaluations. After excluding firms that no longer existed, were duplicate listings, or had no in-house R&D, a final sample population of 154 firms remained. Fifty-five agreed to participate and provided full or partial data, constituting a response rate of 35.71%. Forty-five complete sets of questionnaires were completed by both the CEO (or a Senior Level Manager) and R&D Director and used for this study. Fourteen of the firms in the sample were members of the National Pharmaceutical Council.

Data Collection

Two primary types of data collection methods were used for this study: archival data collection and questionnaire data collection methods. An archival data methodology was used to collect data for innovation outcomes. A questionnaire methodology was used to collect data for strategic intent and control mechanisms.

Innovation data was collected from archival sources from 1984-1988. CEOs were asked retrospective questions concerning strategic intent to innovate during 1979-1983. R&D Directors were asked retrospective questions concerning control mechanisms in their firms' R&D laboratories during 1979-1983.

Sample Characteristics

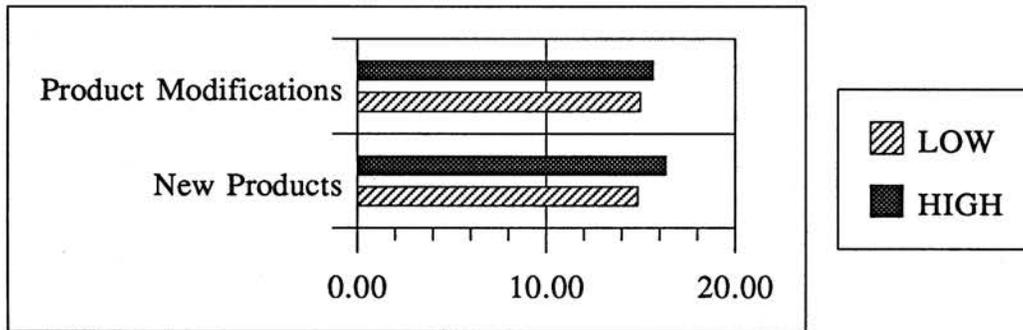
	Average	Range		
Senior Level Manager Characteristics				
Years in Current Position	7.24	1.00	to	31.00
Years in Firm	14.18	2.00	to	31.00
Years in Industry	17.70	2.00	to	36.00
R&D Director Characteristics				
Years in Current Position	6.47	1.00	to	36.00
Years in Firm	13.58	1.00	to	37.00
Years in Industry	18.29	1.00	to	37.00
Business Unit Characteristics				
Number of Employees	2722.68	11.00	to	31,500
ROI	14.90	-2.50	to	42.45
ROA	9.90	-2.50	to	42.45
Number of New Products (NCEs)	.87	0.00	to	11.00
Number of Product Modifications	3.56	0.00	to	14.00
R&D Laboratory Characteristics				
Number of Employees in R&D Laboratory(ies)	370.87	1.00	to	3356.00
R&D Spending/Sales	12.45	2.45	to	32.45
Targeted Percent of Sales from New Products	22.45	2.45	to	52.45

Primary Findings

Influence of Strategic Intent on the Number of Product Modifications and New Products

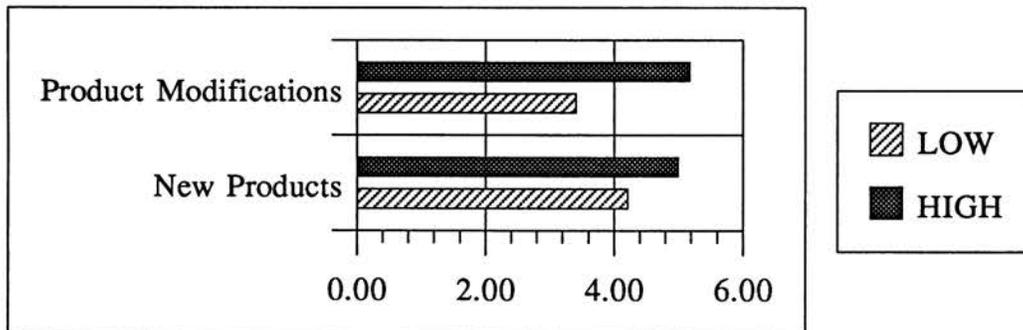
Do pharmaceutical firms with a higher level of commitment to product modifications exhibit a greater number of product modifications and new products?

Average Level of Strategic Intent to Pursue Product Modifications



Do pharmaceutical firms with a higher level of commitment to new products exhibit a greater number of product modifications and new products?

Average Level of Strategic Intent to Pursue New Products

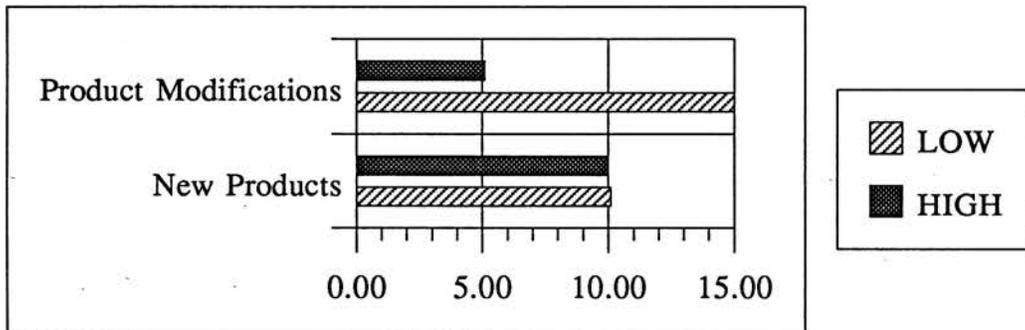


Influence of Strategic Intent on the Number of Product Modifications and New Products

(continued)

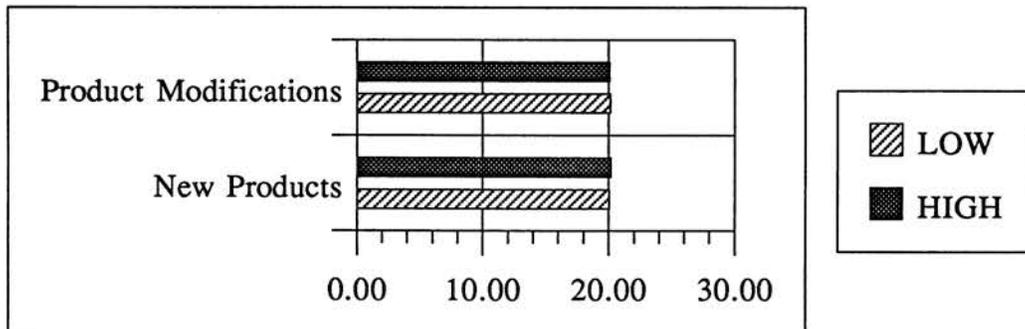
Do pharmaceutical firms that spend a higher level of R&D spending as a percentage of sales exhibit a greater number of product modifications and new products?

Average Level of R&D Spending as a Percentage of Sales



Do pharmaceutical firms that target a higher percentage of sales to be generated from new products exhibit a greater number of product modifications and new products?

Average Percentage of Sales to Be Generated from New Products



**Influence of Strategic Intent on the Number of
Product Modifications and New Products**

(continued)

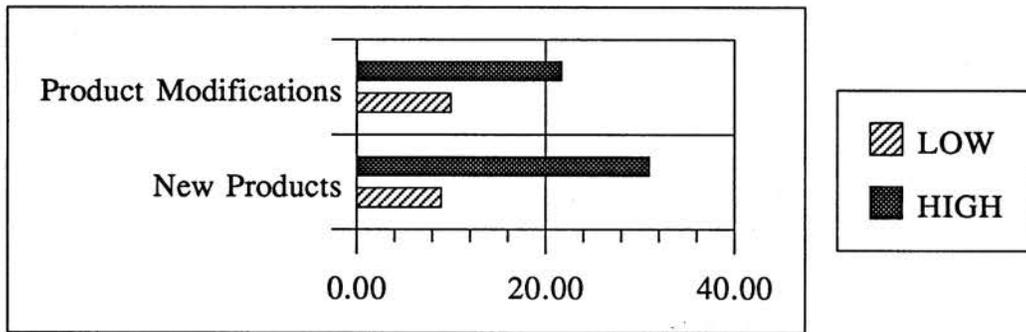
Comments:

In general, there were few differences between pharmaceutical firms with respect to achieving higher level of product modifications and new products for the strategic intent variables. The only exception was that firms that exhibited higher levels of commitment to new products exhibited a higher level of product modifications (note that this was the only statistically significant finding for the strategic intent variables).

Influence of Input Control Mechanisms on the Number of Product Modifications and New Products

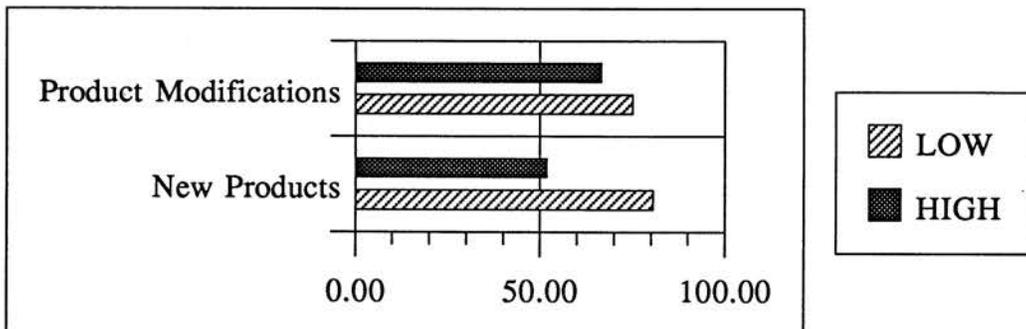
Do pharmaceutical firms with higher levels of specialist diversity in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Specialist Diversity



Do pharmaceutical firms with higher levels of specialist depth in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Specialist Depth

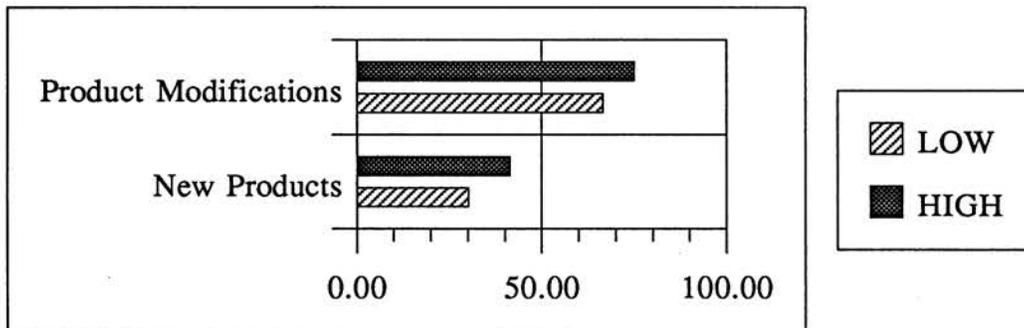


Influence of Input Control Mechanisms on the Number of Product Modifications and New Products

(continued)

Do pharmaceutical firms with higher levels of professionalization in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Professionalization



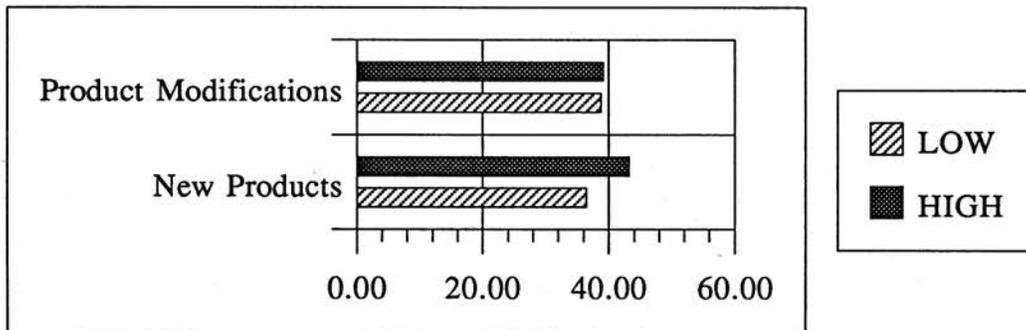
Comments:

Pharmaceutical firms with higher levels of specialist diversity and professionalization and lower levels of specialist depth exhibited higher levels of product modifications and new products (note that effects of specialist diversity, specialist depth, and professionalization on product modifications and new products were statistically significant).

Influence of Process Control Mechanisms on the Number of Product Modifications and New Products

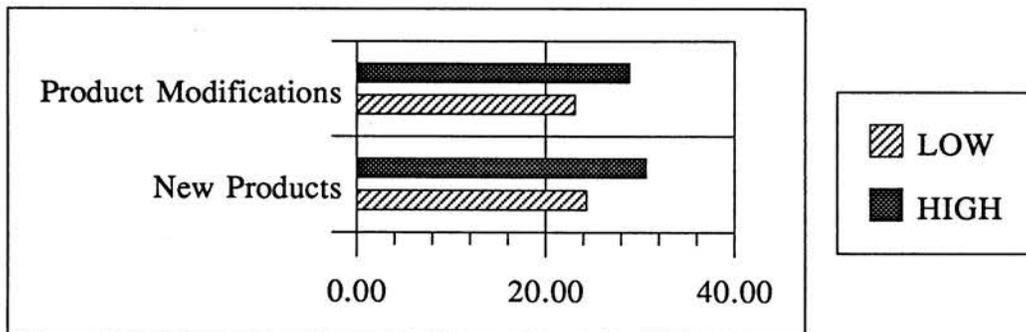
Do pharmaceutical firms with higher levels of centralization in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Centralization



Do pharmaceutical firms with higher levels of documentation in their R&D laboratories exhibit a greater number of product modifications and new products?

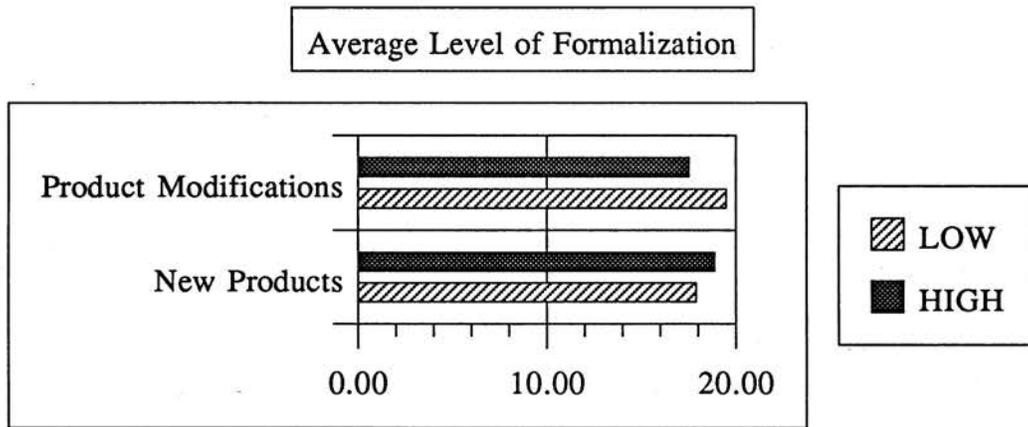
Average Level of Documentation



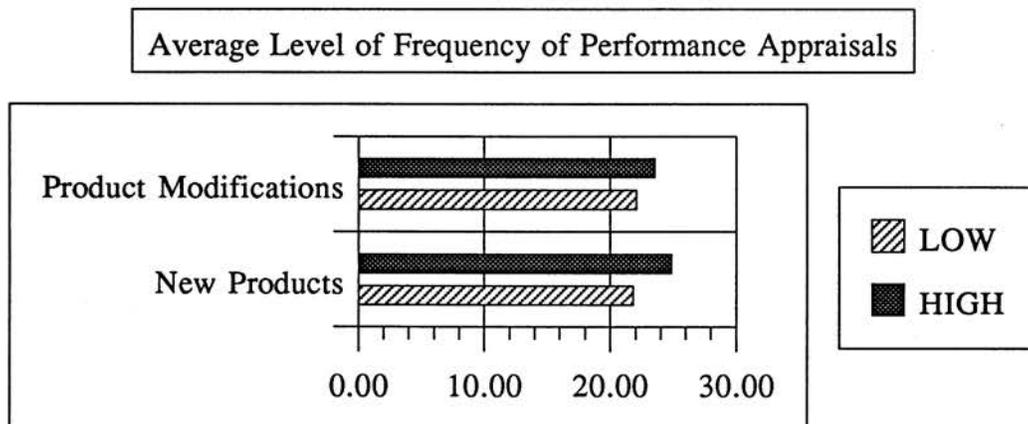
Influence of Process Control Mechanisms on the Number of Product Modifications and New Products

(continued)

Do pharmaceutical firms with higher levels of formalization in their R&D laboratories exhibit a greater number of product modifications and new products?



Do pharmaceutical firms with higher levels of frequency of performance appraisals in their R&D laboratories exhibit a greater number of product modifications and new products?



**Influence of Process Control Mechanisms on the Number of
Product Modifications and New Products**

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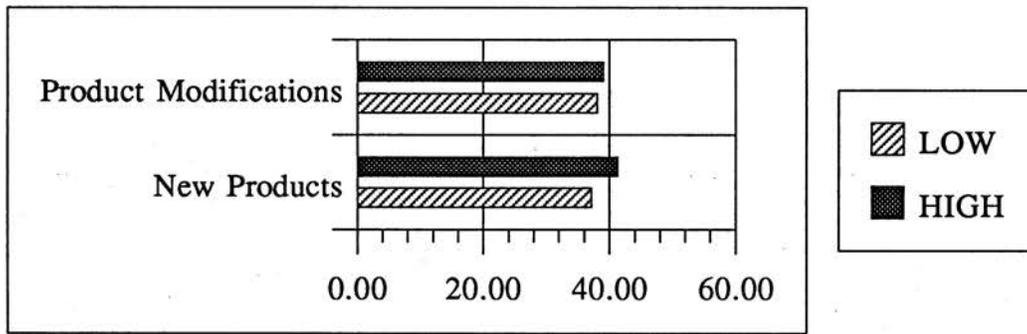
Comments:

Pharmaceutical firms with higher levels of centralization, documentation, formalization, and frequency of performance appraisals exhibited higher levels of product modifications and new products (note that effects of documentation and frequency of performance appraisals on product modifications and new products were statistically significant, while centralization and formalization were not).

Influence of Output Control Mechanisms on the Number of Product Modifications and New Products

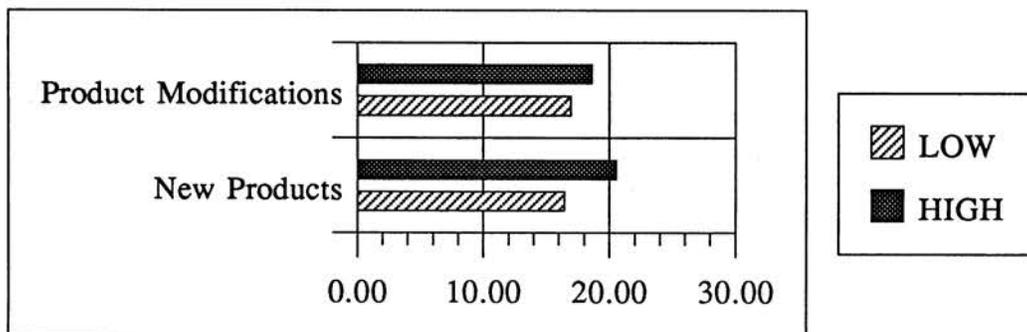
Do pharmaceutical firms with higher levels of goal specificity in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Goal Specificity



Do pharmaceutical firms with a greater emphasis on outcomes in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Emphasis on Outcomes

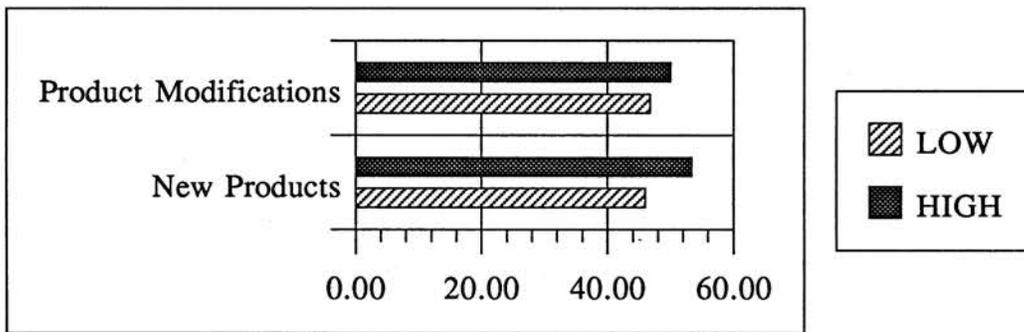


Influence of Output Control Mechanisms on the Number of Product Modifications and New Products

(continued)

Do pharmaceutical firms with higher levels of rewards and bonuses linked to results in their R&D laboratories exhibit a greater number of product modifications and new products?

Average Level of Rewards and Bonuses Linked to Results



Comments:

Pharmaceutical firms with higher levels of goal specificity, emphasis on outcomes, and rewards and bonuses linked to results exhibited higher levels of product modifications and new products (note that effects of emphasis on outcomes and rewards and bonuses linked to results on product modifications and new products were statistically significant, while goal specificity was not).

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