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Impediments to Timely Delivery of New Products at an Industrial Products Firm

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Abstract
To identify and discuss sources of delay in the new product development process at an industrial products firm, data were collected during 11 bi-weekly project review meetings at which 42 different projects were discussed. The highest priority projects were designs for a new venture into European markets. It was suggested that manager selection, vendor monitoring, attention to physical engineering design, and bureaucratic checkpoints contribute more to project delays than do most other internal problems such as resource bottlenecks and miscommunications. A challenging trade-off existed between a well-established sign-off procedure and a less-structured but potentially more timely product development policy. In the ordinary least squares results, the largest proportion of sum of squares was attributable to the manager variable.

Getting new products to market faster than competitors is a worrisome problem for many American manufacturers. The producer first on the scene may have an advantage obtaining and keeping market share. Furthermore, shortened product life cycles necessitate more new product introductions in order to keep the product pipeline filled. Firms that are able to compress the time it takes from conceptualizing a new product to distributing it will have a scant advantage within their industries.

This article identifies and discusses impediments to the timely delivery of new products at an industrial products firm. It provides an objective indication of those technological and managerial characteristics that present obstacles to timely new product development and those that do not. This information is vital for firms attempting to reduce their product development lead times and, thereby, compete more effectively in global markets.

An early bibliography dealing with product development was prepared by Udell and O'Neill (1). Clark et al. (2) report an extensive literature survey by Shirley 3!. Current examination of popular journals such as Harvard Business Review and Fortune demonstrate considerable interest in the topic of time-based product development from both managerial and academic perspectives.

Cooper (4) synthesized much of the work done through 1983 and emphasized the need for good market research, even for industrial products, and the necessity of open and informal communication. He also developed a sequential framework of new product development that conflicts with contemporary ideas in this area.

New product introduction requires accurate knowledge of resources and a high degree of co-ordination (5). Too much paper-chasing and too many "I'II-get-back-to-yous" further expand an already time-consuming process. Functional organization, information flow, and timeliness of communication can have pronounced effect on the decision-making process (6). A parallel design process will assist managing on time as well as on cost (7).

Not surprisingly, much of the current literature has examined Japanese automobile development. A comparison of US, Japanese and European auto makers by Clark et al. 2! attempts to separate elements that are unique to the Japanese culture from those that are not. Their approach is scientific rather than subjective and supports the conventional wisdom that Japanese designers do indeed spend significantly less time on design projects. Supplier relationships, overlap of work, non-specialized design engineers, and a project manager who champions the cause are reported to contribute to the Japanese advantage S1. The work by Clark and his colleagues precedes and is referenced in the comprehensive study of the automobile industry by smack et al. (9).

The concept of overlapped activities is well-described by Takeuchi and Nonaka (10) as analogous to a rugby teamworking in harmony to move the ball downfield. This analogy is reiterated by Uttal (11).

Supplier relationships also contribute to shortened development lead times (5). Working with suppliers early on transfers some of the engineering effort to them and guarantees on-time delivery of new parts (12), (13).

Stanford University (14), Harvard University (2) and Boston University (15) have directed considerable effort towards researching new product development.

RESEARCH DESIGN

OBJECTIVES

The objectives of this research are to: (1) examine technical and managerial characteristics of the new product development process used by a major industrial products firm; (2) formulate and test hypotheses suggested by published research regarding ways to accelerate the new product development process; and (3) identify technical and managerial characteristics that appear to have a scant impact on lengthening product development lead times and those that do not.

THE INDUSTRIAL PRODUCTS FIRM

The industrial products firm is located in the midwestern United States. It is a leading manufacturer and marketer of industrial automation controls, communication systems and electronic products throughout the world. The firm employs approximately 13,000 people in plants and sales offices in North America, Latin America, Europe, Australia and Asia. It also provides customer support services for its products worldwide. It is we "-known for achieving its quality goals and for its automated factory-within-a-factory. The firm experiences nine-18-month lead times for getting new products to production.

Early in the 19S0s, the firm became committed to pursuing global markets for its industrial control products. Many of the products on which this study is based were being developed for a European trade show and subsequent marketing release. This class of products received the highest priority and was overseen by a manager with a reputation for getting things done.

Developing products for European markets presented new challenges to the design team. European technical standards are considerably different, as are product life expectancy and styling. Four-language packaging and icon signage are relatively new to American firms while European competitors have established expertise in these areas. Furthermore, European marketing and channels of distribution add to the list of new things to learn.

Other products, managed by two other administrators, were for American markets. These included upgrades of current products as well as totally new designs.

Data Collection

Data were collected over a 20-week period from mid-March to early August, 1990. The study team consisted of at least one faculty member assisted by two graduate assistants. The team attended 11 bi-weekly project review meetings (PFMs) during this period. Forty-two projects, in various phases of development, were discussed. The team only observed meetings; participation of any kind was not allowed. In addition to attending PFMs, the team was allowed to examine PERT-like project management documents and internal procedures manuals.

The PRMs were attended by 12-20 individuals assigned to the projects. The purpose of the meetings was to air and resolve problems, to keep activities on time, and to reschedule activities when needed. Data gathering concentrated on listening for sources of rescheduling, speed up or delay, and recording these announcements by project, date and type.

HYPOTHESES

Two hypotheses and three exploratory questions were developed and tested.

HYPOTHESIS 1: CHAMPIONSHIP

Clark and Fujimoto (8) report that project champions have a dramatic impact on reducing product development lead times in Japanese firms. Champions protect their projects and their design teams, argue cases for more resources, and facilitate the timely progression of their design projects.

However, the championship theory is not universally held. Wheelwright and Gi1l (16) report that Sob's project managers rotate responsibilities, being a manager on one project, then being just another team member on the next.

It was hypothesized that product development projects in an American firm, with its formal structure and controls, should benefit from a manager who could act as champion or, at a minimum, as motivator and facilitator of the development process.

HYPOTHESIS 2: EXTERNAL VS INTERNAL CONTROL

Not all elements of new product design are under direct control of the management team, the manager, or even the company. The need for new suppliers that are not part of the established network of reliable vendors and the need for contract work, again, from unproven sources, should have a greater impact on project timeliness than should internal sources of possible delay.

EXPLORATORY QUESTION 1: ENGINEERING'S IMPACT

Despite efforts to avoid it, among numerous projects, many in unchartered waters, engineering occasionally will encounter a snag in the physical design process. If this occurs, to what extent will it affect the timely completion of a project?

EXPLORATORY QUESTION 2: BUREAUCRACY

A large option naturally develops routines and procedures to guard against disastrous decisions or bad judgments. This is part of corporate learning. The downside of such activity may be the delay of a project for approvals and paperwork. Are paperwork delays impediments to timely project delivery?

EXPLORATORY QUESTION 3: CAPACITY CONSTRAINTS

Numerous projects may strain the availability of team members' time. When push comes to shove, some lower priority projects may be delayed in order to supply resources to higher priority projects. Similarly, bottlenecks and queues at engineering benches or prototype facilities may contribute to delay. Is this evident at the study site?

FINDINGS

Project management documents were provided at each of the bi-weekly meetings. Each project was assigned to one of three managers (MGR), here referred to as manager A, B or C (refer to Table I). (Table I omitted) The documents reported the next milestone (MLSTN) that the project was approaching and the priority or resource allocation order (RAO) of the project. Milestone M1 0, Available For Sale: appears to be disproportionately represented. Some redesign projects fall in this category, but most M1 projects were those to be presented at a forthcoming European trade show. The RAO guides the assignment of resources when ties occur. These three recorded variables-the manager, milestone indicators and the priority measure-were always reported for every active project at each bi-weekly meeting.

In addition to these variables, the occurrence of 34 observed or reported events (Table 11) were recorded. (Table II omitted) Owing to small sample sees ad low individual sum of squares, 30 of these event variables were categorized into the nine variables indicated with an asterisk in Table 11. The raw occurrence column reports the number of times this type of event was reported during the meetings. However, the event may not have had an immediate impact on project timeliness. In this case, the variable is lagged to the next hi-weekly measures. For example, the announcement during meeting number 5 that a vendor will be late in delivering a tool may not influence the time measure until meeting number 6. Additionally, the data are time series, necessitating that the variable be treated as a switch. If an engineering error is reported during meeting number 7 causing a ten-day slip in the project, then that ten-day slip will appear in the delivery date measures for meeting numbers 8,9, and so on. Since the effect of the slip appears in subsequent project management reports, the engineering error variable is switched on or activated from meeting number 7 onward. This is why, for example, Shift in Project Priority (variable 13) in Table II shows a raw occurrence of three but is active in 14 measures of project delivery dates. Lastly, these data may be incomplete. When a team member announced a delay, it was recorded on the tally sheets. If, however, a delay occurred but was not mentioned at the project review meeting, it (obviously) could not be counted. Table III displays the ordinary least squares results using the general linear models procedure of SAS 6.0. (Table III omitted) Total float (TTLFL T) is the dependent variable that measures project lateness. It is reported in the project management documents and is the number of business days the project is ahead of or behind its targeted due date. Total float is examined as a linear combination of the three reported and 13 observed variables described earlier. The model is significant at the 0.0001 level and explains approximately 35 per cent of the variance.

HYPOTHESIS 1: CHAMPIONSHIP

In Table III, the largest proportion of sum of squares (127,824) is attributable to the Manager variable. Furthermore, Table IV reports mean lateness for manager A to be 2.2 days while mean lateness is 33.9 and 37.4 days for managers Band C, respectively. On the surface, this appears to be strong support for the championship theory.

However, American managers are not champions in the same sense that Japanese managers may be. American managers do not have carte blanche in running their projects. They have to live within the procedures of the firm. The American counterpart may better be described as a facilitator.

Furthermore, correlation may not be causality. Manager A has developed a reputation as a mover and a shaker. Consequently, he may be given the higher priority projects based on his reputation. But the higher priority projects come with larger budgets and bumping rights for resources. On the other hand, managers Band C each have projects in their portfolios that are greatly delayed and are becoming more delayed due to lack of resources and priority. Some of manager A's success (and the high sum of squares) is a result of this interaction.

HYPOTHESIS 2: EXTERNAL VS. INTERNAL CONTROL

Vendor Delay in Communication (variable 1) and Tool Out of Specification (variable 2) are statistically significant in Table III. Vendor Parts Problems (variable 3) and Other Tooling Problems (variable 4) are not significant. The interpretation is that problems with vendors can be a scant factor in project delay, but do not have to be.

Internal problems such as Staff Changes (variable 5), Marketing Changes (variable 6), Internal Company Delays (variable 7), and Miscommunications (variable 8) are not statistically significant.

This confirms the hypothesis that internal problems can be dealt with to avoid substantial delay but that externally contracted work may require closer supervision. As more vendors are certified by the firm, external problems should become less frequent.

EXPLORATORY QUESTION 1: ENGINEERING'S IMPACT

Engineering Problems (variable 9) is significant with a p-value of 0.0044. Unlike other internal problems, engineering issues cannot be dealt with as readily. Unresolved Old Problem (variable 10) is significant with a p-value of 0.0001. This problem refers to an unanticipated design error that was discovered late in the process and that appears to require the rework of an already accepted vendor tool. This variable contributes the greatest sum of squares of any of the observed variables and illustrates the importance of physical design engineering to the timely completion of projects.

EXPLORATORY QUESTION 2: BUREAUCRACY

The Milestone variable is significant at the 0.0001 level. Table I shows 15 milestone levels. The interpretation here is that projects that are approaching early milestones have not yet experienced many delays while projects at the end of the milestone path may have accumulated considerable delays. Delays for Signoffs (variable 11) is also significant at the 0.0001 level. A large organization with tried-and-true procedures for minimizing cost over-runs may naturally be placing barriers to the timely progression of their design efforts. By comparison, Internal Company Delays (variable 7) has a value of 0.9064. As noted in the findings for hypothesis 2, internal problems do not cause much difficulty. People find ways to work with or around them. But the traditional requirement to obtain approval before moving ahead after every milestone appears to contribute to project delay and is contrary to the empowered-manager approach in use by some firms.

Resource allocation is another bureaucratic/managerial aspect of project management. As indicated earlier, it is accompanied at the industrial products firm by setting values for the priority (RAO) variable among competing projects. It is interesting to note that both the Priority variable ($p = 0.0019$) and Shift in Priority ($p = 0.0303$) are statistically significant. As expected, this indicates that proper resource management has an important effect on timely project completion.

EXPLORATORY QUESTION 3: CAPACITY CONSTRAINTS

Neither Staff Changes (variable 5) nor Queues and Bottlenecks (variable 12) demonstrate that capacity problems are statistically scant. However, the value for Queues and Bottlenecks (0.0830) suggests that, while the variable may not be statistically Significant, it deserves management's attention.

The conclusion here is similar to that drawn in regard to the issue of external vs internal control. That is, project members can be resourceful in avoiding or working around internal problems, such as capacity constraints in a pilot lab, in order to bring projects to timely completion.

SUMMARY AND CONCLUSIONS

Although it is risky to generalize on one firm's experience, this study adds to the body of knowledge about new product development practices in American manufacturing firms. In particular, it contributes to the understanding of industrial product development, whereas most other studies have examined firms that produce consumer products.

Based on this study, it appears that selection of appropriate managers is important, that vendor monitoring and communication are significant, that the nuts and bolts of engineering design is important, but that most other internal sources of delay can be dealt with. A challenging trade-off exists between a well-established sign-off procedure and a less-structured but potentially more timely product development policy.

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