

Research Program on the
Management of Science and Technology

PROJECT MANAGEMENT AND THE
ROLE OF THE PROJECT MANAGER⁽¹⁾

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INTRODUCTION

As part of a larger study of project management, (Marquis and Straight [2],) (Rubin and Marquis [5],) data were gathered on the background characteristics of a large sample of project managers. Although the project manager's role is felt to be critical, little empirical research exists to suggest which personal characteristics or role behaviors most directly affect project performance.

Several questions can be asked in this regard. First, is there a relationship between project manager characteristics and project characteristics? In other words, do organizations select project managers with particular traits to work on certain kinds of projects? Swanson [6] suggests that the selection process of project managers is "understandable and describable even though it is carried out in an informal and mostly unconscious way. A set of criteria involving technical and contract administrative experience are matched with characteristics of particular individuals. Ordinarily, one person is tentatively selected at the outset, and his match is compared with that of others who come into consideration" (Marquis [1]). Second, if such a decision process exists, can its usefulness be validated by examining its impact on project performance?

Similarly, do different kinds of project managers perform better in different forms of project organizations. Pace [3] has found that in "a matrix overlay organization the project manager gets the necessary work done by negotiation with the functional divisions. Questionnaire

Project Management and the Role of the Project Manager⁽¹⁾

by

Irwin M. Rubin

ABSTRACT

The study reported in this paper focuses first on the relationship between a project manager's background characteristics and certain characteristics of the projects he is asked to manage. The impact of this decision process is then examined by relating project manager traits and project characteristics to a measure of project performance.

It appears that organizations select their oldest, most experienced project managers to head-up large, high priority projects. Performance is thus improved, not because of the project manager's prior experience, but because of the high priority given larger projects. With the exception of a measure of "growth in responsibility" none of the project manager traits measured were found to bear any direct relationship to project performance.

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data on attitudes and orientation of support personnel toward their functional manager and project manager indicate that the effectiveness of the latter depends on how he handles motivating and rewarding forces". (Marquis [1])

METHOD

Sample Characteristics

A project was selected in a company or a government agency on the basis of three criteria:

1. All were R&D contracts awarded by a government agency (or industry prime in several cases) to an industrial firm.
2. All were over \$1 million in total value (excluding follow-on production work).
3. All were very recently completed or rapidly nearing completion.

Projects were located in two ways. Alternate firms in the list of 100 largest defense and space firms were invited to cooperate, and if they were willing, a division laboratory was randomly selected, and its most recently completed (or terminated) project became the target of study. The other source was a government contracting agency, in which one or more projects were chosen randomly from those most recently completed. Contracts from twelve government agencies were included.

The projects ranged in size from \$1 million to \$60 million with a median of \$4 million. The average project duration was 3.4 years and

none lasted more than 6 years. Almost all of the projects required advances in the "state of the art" in a technological field such as advanced radar systems, microminiaturization of electronics modules, electronic data processing, interfaces with telemetry systems, etc. The projects studied are more developmental than fundamental in research character.

The firms studied are all in the aerospace and electronics industries. Eighty percent of them are among the 100 largest performers of government-funded R&D. They are located in all parts of the country.

Information on each project was obtained from five sources: the laboratory manager, the project manager, the government technical monitor, the government contract administrator, and the company contract administrator. Judgments of successful performance and a statement of the criteria which they used for evaluating successful performance were obtained from all but the company contract administrators.

Although a total of 48 projects were studied, inevitable difficulties in securing some of the desired information resulted in some incomplete records in several cases. In 75% of the cases the records are complete. Incomplete information results primarily from an inability to interview either the laboratory manager, government technical monitor, or government contract administrator.

Measure of Project Performance

It is presently impossible to compare the technical performance of different projects by any objective measures. In one instance, speed

may be the primary technical objective of a system (missile, airplane, etc.), while in another case range is most critical. In an electronics system reliability or maintainability may be the chief goal. Consequently the measure of successful technical performance used in this study are expert judgments by the most fully informed individuals (cf. Peck and Scherer [4]).

Success ratings were obtained independently from the project manager, the laboratory manager, the government contract administrator and the technical monitor. The ratings were on a scale from one to nine, with nine representing an outstanding success and one signifying a failure (in some relative sense, since no project in this study achieved the absolute failure of being cancelled before completion).

The measure of performance used in this study is the average of the ratings provided by the project manager and the government technical monitor, plus a constant term to account for the fact that project managers were consistently more optimistic than technical monitors. All except one of these scores fell in the range of five to nine within which there was a symmetrical distribution with the median at 6.4.

Project Manager Characteristics

Table 1 contains a summary of the project manager characteristics investigated in this study. With the exception of Responsibility Index, they are self-explanatory.

The Responsibility Index was derived by taking the ratio of the dollar size of the project under investigation (present project) to the dollar size of the project manager's most recent project (prior project). In other words, if the present project were \$2M and the prior project were \$1M, the Responsibility Index would be 2.0. A ratio of less than 1.0 means that the present project was smaller than the prior project.

Three project characteristics were also included in this investigation; contract type (sole source vs. competitive), contract size in terms of the number of full-time technical professionals, and the priority level-granted the project within the performing organization.

TABLE 1
Summary of Project Manager Characteristics

Project Manager Characteristics	Sample Size	Range	Median	Mean
Years from B.S. to first supervisory job	38	0-11	4	4.5
Years total experience (years since B.S.)	41	6-28	17	18.0
Number of previous projects managed	34	1-20	5	7.0
Length of service with company	40	1-24	8	10.0
Responsibility Index	27	0.04-30	2.0	3.1

RESULTS

Selection of Project Managers

The question of interest here is; Do organizations select project managers with particular traits to work on certain kinds of projects? Figure 1 summarizes the results of these analyses.

When an organization receives a large contract requiring the efforts of a large number of full-time professional technical personnel, several things appear to happen. One, the project is given a very high level of internal priority.⁽²⁾ Furthermore, the larger the project (and the higher its priority), the more likely is the organization to seek an older more experienced project manager.⁽³⁾

Although the causal linkages are impossible to prove, the method of partial correlations was utilized to provide some insights. It appears that high priority results from the fact that a particular project is large and probably important to the organization. The organization then reacts by selecting its most experienced project managers (total experience and project experience) to head up these high priority efforts.

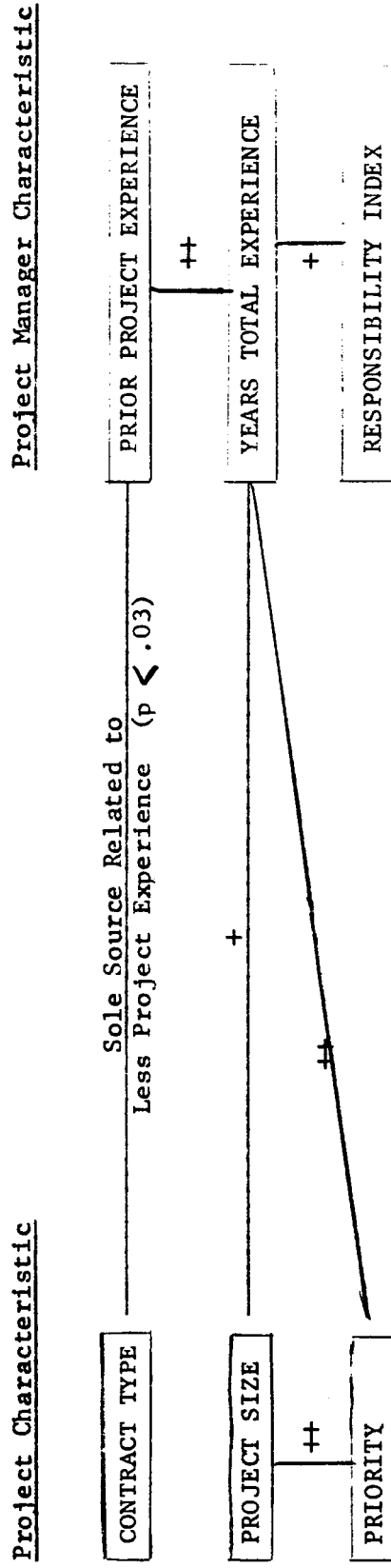
With respect to type of contract, a somewhat surprising phenomenon appears to be operating. Project managers selected for sole source contracts have had significantly less prior project experience (average of 5.0 prior projects managed) than project managers selected

² Number of full-time professionals vs. priority; Kendall Tau=0.28, N=33, $p < .03$

³ Priority vs. years total experience; Kendall Tau=0.36, N=36, $p < .003$
Number of full time professionals vs. years total experience; Kendall Tau=0.19, N=37, $p < .06$

FIGURE I

Summary of Relationships Between Project Characteristics and Project Manager Characteristics



NOTE: + indicates a positive relationship which is significant at the 0.10 level or less

++ indicates a positive relationship which is significant at the 0.05 level or less

for competitive projects (average of 9.0 prior project-managed).⁽⁴⁾
Possible reasons for this will be discussed in a later section.

Finally, it should be noted that none of the project characteristics investigated were directly related to the responsibility index.

Effects on Performance

The focus in this section will be on the relationship between project characteristics, project manager characteristics, and project performance. The problem, as before, will be of deciding which of two variables, both related to performance, is the more influential. Where feasible, the method of partial correlations will be utilized to suggest causal linkages.

Considering the case of sole source vs. competitive contracts sole source projects are more likely to be headed by project managers with less prior project experience. Technical performance, however is negatively related to amount of prior project experience. (See Table 2). Furthermore, within the sample of projects studied, sole source projects achieve higher levels of technical performance. (Rubin and Marquis [5]).

Here again, we are faced with the problem of three intercorrelated variables. In this case, the relationship between technical performance and prior project performance disappears when the effect of contract type is eliminated. The critical variable affecting performance, therefore, is the fact that the project was sole source; the relationship between performance and prior project experience occurs only because contract type was related to both variables.

⁴ Mann-Whitney U Test, $p < .02$ $N_1=11$, $N_2=20$

TABLE 2

Relationship Between Number of Previous Projects
Managed (Prior Project Experience) and Technical Performance

Prior Project Experience

	Low (≤ 4 prior projects) (N = 14)	High (≥ 5 prior projects) (N = 20)
Median Technical Performance	7.7	5.7

p < .05, Mann-Whitney U Test

The level of internal priority given a project was also found to affect final performance; the higher the priority the better the technical performance.⁽⁵⁾ (See Table 3)⁽⁶⁾

As discussed earlier, priority was also related to size of project (# of full time technical professionals) and to the project manager's years total experience. Years total experience, however, is unrelated to technical performance.⁽⁷⁾ (See Table 4)

⁵ Mann-Whitney U Test, high vs. low priority, p < .03

⁶ Tables 3,4,5 are included to provide a graphic display of the results discussed. The reader should note that tests of statistical significance applied to the data in the tables may not yield probability levels consistent with those presented in the text. This can happen because a simple frequency count (i.e. contingency table) wastes much of the data. The actual tests utilized to analyze the data are more powerful. In all cases, the tests actually used and resulting probability levels will be provided.

⁷ Technical performance vs. years total experience; Kendall Tau = 0.02, N=41, p = 0.40, not significant.

TABLE 3

Relationship Between Priority and Technical Performance

		<u>Priority Level</u>		
		HIGH	MEDIUM	LOW
TECHNICAL PERFORMANCE	$\% \geq$ MEDIAN PERFORMANCE	70%	60%	31%
	$\% <$ MEDIAN PERFORMANCE	30%	40%	69%
		N=13	N=10	N=16

TABLE 4

Relationship Between Years Total Experience and Technical Performance

		<u>Years Total Experience</u>	
		$<$ MEDIAN	$\geq$ MEDIAN
Technical Performance	$\% \geq$ MEDIAN PERFORMANCE	57%	55%
	$\% <$ MEDIAN PERFORMANCE	43%	45%
		N=21	N=20

Responsibility Index, which was unrelated to any of the project characteristics discussed, is significantly related to technical performance; the higher the Responsibility Index, the higher is technical performance.⁽⁸⁾ (See Table 5) The distinction between a decrease or no change in responsibility and some increase in responsibility is marked. Only one project manager who was not given some increase in responsibility was associated with a project whose technical performance was high.

⁸ Responsibility Index vs. technical performance; Kendall Tau=0.30, N=27, $p < .02$

Finally, no relationships were found between project performance and the remaining project manager characteristics; years from B.S. to first supervisory job and length of service with the company.

TABLE 5
Relationship Between Responsibility Index and
Technical Performance

		Responsibility Index		
TECHNICAL PERFORMANCE		NO CHANGE OR DECREASE (≤ 1.0)	MODERATE INCREASE ($>1<3$)	LARGE INCREASE (≥ 3.0)
	% $\geq$ MEDIAN PERFORMANCE	11%	82%	71%
	% $<$ MEDIAN PERFORMANCE	89%	18%	29%
		N=9	N=11	N=7

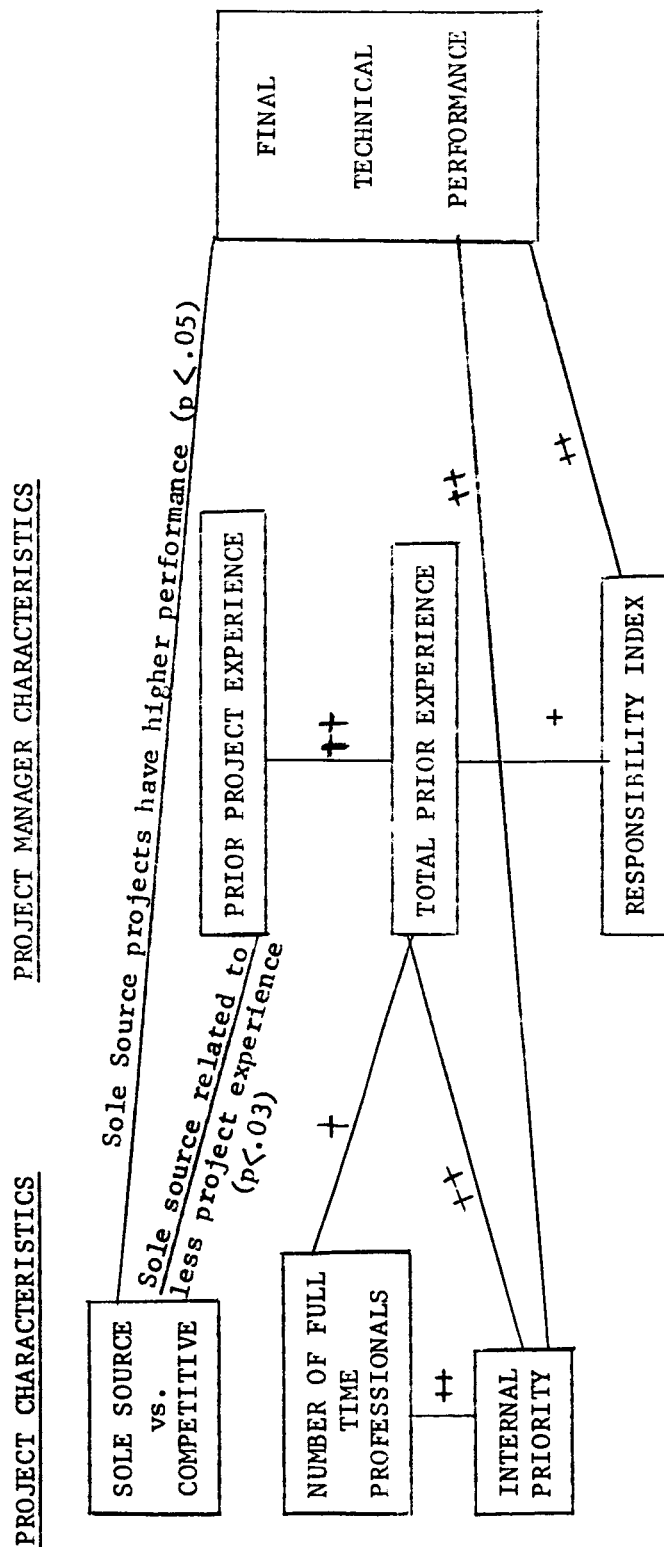
DISCUSSION

The major results of this investigation are summarized in Figure 2. The absence of a line between two variables means that no relationship was found to exist.

The finding concerning the relationship between contract type and the extent of a project manager's prior project experience was somewhat surprising. There are several possible explanations. An organization may, for example, use sole source projects as a training ground for its project managers. For a technical area in which the organization has unparalleled ability, as represented by the fact of a sole source contract,

FIGURE 2

Summary of Results



NOTE: ++ indicates a positive relationship which is significant at the 0.05 level or less

+ indicates a positive relationship which is significant at the 0.07 level

the role of the project manager may not be critical. On the other hand, the project managers selected for sole source contracts are probably younger and may be more up to date in the required technical areas.

From another point of view, the selection process may simply reflect the organization's marketing strategy. Quite plausibly, the organization may place its more experienced project managers on competitive projects as a selling point to the customer. A sole source contract, on the other hand, sells itself. Data were not available to test these hypotheses.

The relationships found between number of full-time professionals, priority level, project manager's years total experience, and performance are interesting. It appears that an organization selects an older, more experienced project manager to head up a large, high priority project. This selection is undoubtedly based on the belief that utilizing more experienced project managers will lead to better project performance. Final performance is indeed improved but not because the project manager was so experienced. The critical variable is the level of internal priority given the project.

The Responsibility Index devised also deals with a project manager's past experience but is much more specific in focus. The implicit assumption made was that a decrease in responsibility stems from less than satisfactory performance on a prior project. This is obviously not true in all cases. In spite of this qualification, the relationship found was particularly strong and clear cut. What

may have been observed was affirmation of a feeling, long held by laboratory directors, that the best way to select a project manager is to observe his performance as a project manager.

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