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A new framework for determining critical success/failure factors in projects

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Only a few studies in the project management literature concentrate on the critical factors that affect project success or failure. Whereas many of these studies generate lists of critical success factors, each list varies in its scope and purpose. The success factors are usually listed as either very general factors or very specific factors affecting only a particular project. However, lacking a comprehensive list makes it difficult not only for project managers but also for researchers to evaluate projects based on these factors. In this study, we suggest a new scheme that classifies the critical factors, and describes the impacts of these factors on project performance. Emphasis is given to the grouping of success factors and explaining the interaction between them, rather than the identification of individual factors. An empirical study is conducted to test the practicality of using such a scheme. The statistical analyses of the results demonstrate the differences between the critical success factors identified in a previous study from literature and the factors identified with the use of our scheme. Many critical factors, such as factors related to project managers' performance, factors related to team members and environmental factors, became apparent with this study. The results are encouraging, in that practitioners support the use of this scheme for determining and analysing critical success factors and how systems respond to these factors. Copyright © 1996 Elsevier Science Ltd and IPMA.

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Since the 1950s most of the work in project management has focused on project scheduling problems, assuming that the development of better scheduling techniques would result in better management and thus the successful completion of projects. However, there are many factors outside the control of management which could determine the success or failure of a project. In the literature, these factors are referred to as critical success/failure factors and only a few studies have been done to assess, clarify, or analyse these factors. Most of the early studies in the area focused on the reasons for project failure rather than project success.[1–5] In these studies it was assumed that if a projects completion time exceeded its due date, or expenses overran the budget, or outcomes did not satisfy a company's predetermined performance criteria, the project was assumed to be a failure. Today we know that determining whether a project is a success or a failure is far more complex. Delays in project completion times are common. Because of the delays, project managers sometimes pay penalties which increase overall project costs.[6] Yet these projects are still considered to be successful. On the other hand, a project that is perceived as a success by a project manager and team members might be perceived as a failure by the client.

Apparently, there can be ambiguity in determining whether a project is a success or a failure. There are two main reasons for this ambiguity. First, as mentioned in a paper by Pinto and Slevin,[7] it is still not clear how to measure project success because the parties who are involved in projects perceive project success or failure differently. A project which is considered to be a success by the client might be considered a failure by top management, if the project outcome does not meet top management specifications, even though it might satisfy the client. In this case, both of these parties are evaluating project success differently and thus they value the outcome differently. The

second reason, which is the motivation of this study, is that lists of success or failure factors vary in various studies in the literature. Although several lists of factors are generated, they seem to tabulate individual factors rather than grouping them according to some criteria, to help analyse the interaction between them and the possible consequences. Furthermore, many of these factors do not, in practice, directly affect project success or failure. Usually a combination of many factors, at different stages of project life cycle, result in project success or failure. There might be additional problems with the use of these tables. For example, due to the unique nature of projects, most of the factors in a list might not be applicable for a particular project, or a factor which is the main determinant of success for a project might not be listed. The purpose of this study is to classify success factors and identify the effects of the factors on project performance. Thus, instead of analysing individual factors, one would first be able to identify the group a factor belongs to, and then determine the combined effects of these factors in eventually leading to project success or failure.

The organization of the paper is as follows. In the following section we will review the literature on the factors affecting project success or failure. In the third section, we suggest a new framework that groups the critical success factors and identifies their possible effects on project performance. The results of an empirical study are also given in this section The last section is devoted to conclusions and future research directions.

Literature review

Table 1 summarizes the literature on critical success/failure factors. The theoretical and empirical studies are grouped chronologically. The success and failure factors were first introduced by Rubin and Seeling[8] in 1967. They investigated the impact of a project manager's experience on the project's success or failure. Technical performance was used as a measure of success. It was concluded that a project manager's previous experience has minimal impact on the project's performance, whereas the size of the previously managed project does affect the manager's performance. Rubin and Seeling's study was followed by a theoretical study by Avots.[1] He identified reasons for project failure and concluded that the wrong choice of project manager, the unplanned project termination and unsupportive top management were the main reasons for failure.

In 1983 Baker, Murphy and Fisher[9] suggested that instead of using time, cost and performance as measures for project success, perceived performance should be the measure. Hughes[10] conducted a survey to identify the factors that affect project performance. He concluded that projects fail because of improper basic managerial principles, such as the improper focus of the management system, by rewarding the wrong actions, and the lack of communication of goals.

In their book, Morris and Hough[11] studied eight large, complex projects which had great potential economic impact but were poorly managed and generally failed. They identified the success and failure factors for each of them. Based on this experience, they suggested seven dimensions of project success (see *Table 2*). They concluded that although their analysis of success factors is aimed at large, complex projects, they are also relevant to projects in general.

One of the first efforts to classify critical factors was carried out by Schultz, Slevin and Pinto.[12] They classified factors as strategic or tactical. These two groups of factors affect project performance at different phases of implementation. The strategic group includes factors such as "project mission", "top management support" and "project scheduling" whereas the tactical group consists of factors such as "client consultation", "personnel selection and training". In their follow-up work, Pinto and Slevin[7] identified success factors, and their relative importance, for each stage of a research and development project life-cycle. Finally, in a similar study by Pinto and Prescott,[13] the relative importance of each group (tactical vs. strategic) over the project life-cycle was analysed. It was found that the relative importance of success factors varies at different stages of the project's life-cycle, depending on the success measure used. When external success measures are employed, planning factors dominate tactical factors throughout the project life-cycle.

In addition to the literature described above the reader is referred to project management books by Locke,[14] by Meredith and Mantel,[15] and by Martin[16] for further discussions on critical success/failure factors.

Table 1 A classification of literature on success/fail factors

Theoretical studies	Empirical studies
Avots[1] (1969)	Rubin and Seeling[8] (1967)
Jonason[17] (1971)	Baker, Murphy and Fisher[9] (1983)
Archibald[18] (1976)	Pinto and Slevin[20] (1987)
Martin[16] (1976)	Morris and Hough[11] (1987)
Markus[19] (1981)	Pinto and Prescott[13] (1988)
Hughes[10] (1986)	Magal, Carr and Watson[21] (1988)
Schultz, Slevin and Pinto[12] (1987)	Nutt[22] (1989)
	Pinto and Slevin[7] (1989)
	Pinto and Prescott[23] (1990)

Classification of critical success factors

Table 2 gives seven different lists of critical factors from the literature.[20] As mentioned in a recent study by Pinto and Slevin,[24] all but one of these lists are theoretically based, rather than empirically proved. Furthermore, as can be seen from the table, whereas some are general in scope, they address specific points of interest.

Most, if not all, of these lists include factors related to the project manager and to the organization the project belongs to, and seem to ignore project characteristics, characteristics of team members and factors external to the project. For example, for construction projects, weather conditions can be considered as a critical factor for completing the project on time. Similarly, for product development projects, the project life span and its cost are critical factors for the immediate release of a product to the market. These are two of many factors which are neither controlled by project managers nor by organizations. However, they are critical for the successful completion of projects.

Our purpose here is not to come up with all possible critical factors that might affect project outcome, which is impossible because of the diversity of projects, but to show that the identification of the groups to which the critical factors belong would be sufficient for better evaluation of

Table 2 Seven lists of critical success factors developed in the literature

Martin[16] (1976)	Locke[14] (1984)	Cleland and King[25] (1983)	Sayles and Chandler[26] (1971)	Baker, Murphy and Fisher[9] (1983)	Pinto and Slevin[7] (1989)	Morris and Hough[11] (1987)
Define goals	Make project commitments known	Project summary	Project manager's competence	Clear goals	Top management support	Project objectives
Select project organizational philosophy	Project authority from the top	Operational concept	Scheduling	Goal commitment of project team	Client consultation	Technical uncertainty innovation
General management support	Appoint competent project manager	Top management support	Control systems and responsibilities	On-site project manager	Personnel recruitment	Politics
Organize and delegate authority	Set up communications and procedures	Financial support	Monitoring and feedback	Adequate funding to completion	Technical tasks	Community involvement
Select project team	Set up control mechanisms (schedules, etc.)	Logistic requirements	Continuing involvement in the project	Adequate project team capability	Client acceptance	Schedule duration urgency
Allocate sufficient resources	Progress meetings	Facility support		Accurate initial cost estimates	Monitoring and feedback	Financial contract legal problems
Provide for control and information mechanisms		Market intelligence (who is the client)		Minimum start-up difficulties	Communication	Implement problems
Require planning and review		Project schedule		Planning and control techniques	Trouble-shooting	
		Executive development and training		Task (vs. social orientation)	Characteristics of the project team leader	
		Manpower and organization		Absence of bureaucracy	Power and politics	
		Acquisition			Environment events	
		Information and communication channels			Urgency	
		Project review				

projects. Project managers would then have a clear understanding of which aspects of projects might be critical for their successful completion. As will be demonstrated in the following section, some of these factors might already be in the literature, whereas the missing ones will become apparent when representing the new framework. It is also our intent in this paper to clarify what should be considered as critical factors, and their effects (called "system responses") which lead to project success or failure. Identification of this cause–effect relationship, initiated by critical factors, constitutes an initial effort in this area.

A new framework

The framework in *Figure 1* addresses many of the drawbacks in the literature. We grouped the factors into four areas:

- factors related to the project,
- factors related to the project manager and the team members,
- factors related to the organization, and
- factors related to the external environment.

As can be seen from the figure, the groups are interrelated. A factor in one group can influence a factor in another group, and a combination of several factors from various groups might lead to project failure. For instance, top management support is a factor related to an organization which can be affected by the general state of the economy. Similarly, the uniqueness of project activities can affect the project manager's competence on the job. Lack of top management support together with the project manager's lack of competence on the job might lead to project failure.

One of the advantages of grouping the factors in this fashion is that although it might be difficult to identify the success factors specific to certain industries or organizations, it might be easier to identify whether the success or failure is related to the project manager and/or to the project and/or to external factors. Note that these four groups offer a comprehensive set in that any factor listed in the literature, or even specific points of consideration, should belong to at least one group.

The framework we suggest here not only brings advantages by grouping critical factors, but also helps project managers understand the intra-relationships between the factors in different groups. For instance, in the literature the availability of resources is considered to be a factor necessary for the successful completion of projects. Here, however, we suggest that resource availability is a *systems response* to organizational, environmental and project management-related factors such as top management support, project managers' negotiation skills and the general economic situation. This will help project managers evaluate and monitor their projects more accurately. Similarly, project managers' competence is a critical factor that affects project planning, scheduling and communication. Thus, effective planning, scheduling and communication are really not factors but immediate effects of factors related to a project manager, such as his managerial skills, competence and his technical background. Using this framework, project managers can easily observe these cause–effect relationships. Furthermore, they can easily adapt this

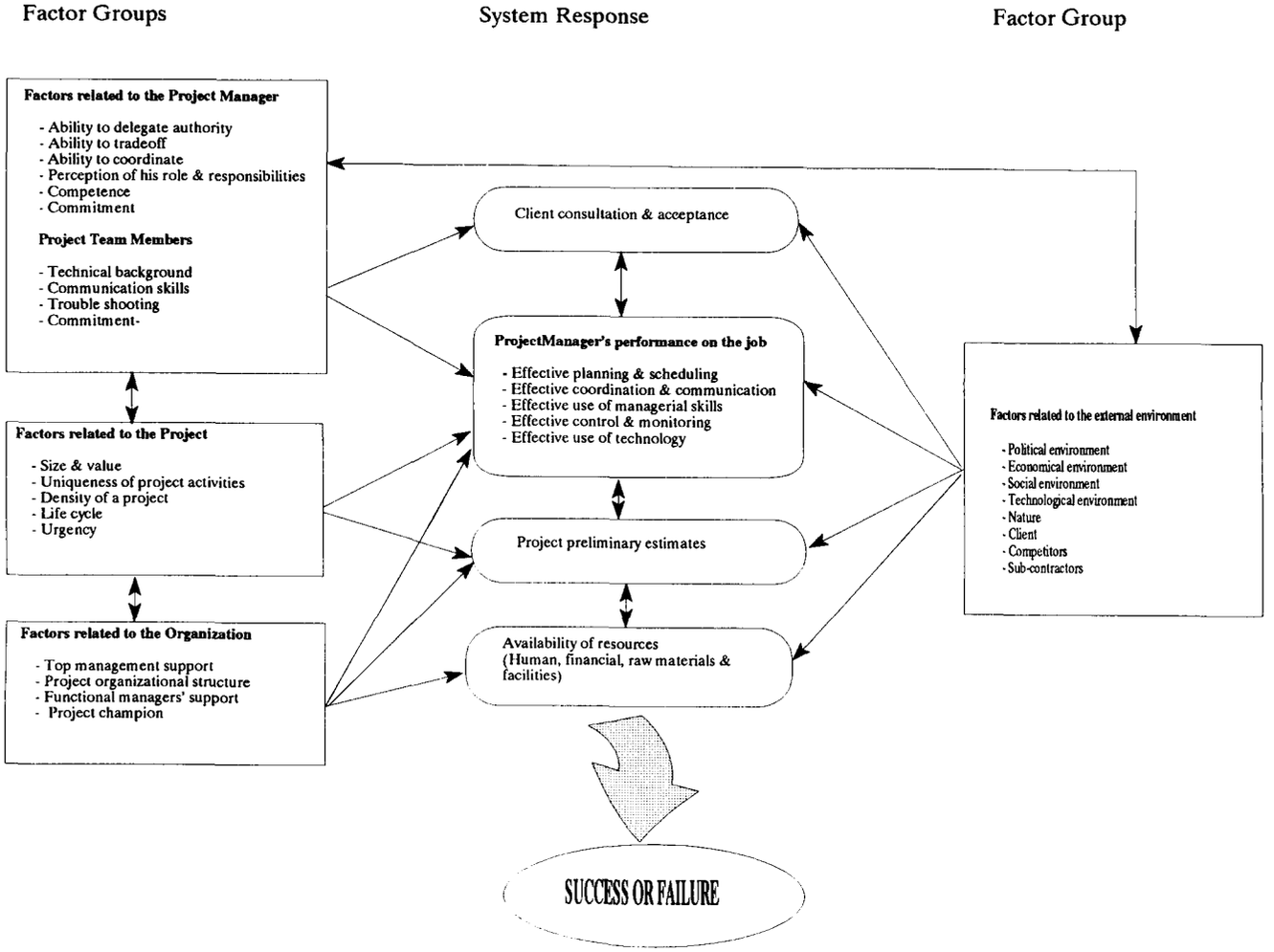

Figure 1

framework to their specific situations and include the factors that were found to be critical for their project's success. As will be explained in the next section, many project managers and managers involved in projects find this framework to be a better tool for understanding critical success factors.

Factors related to project

Project characteristics have long been overlooked in the literature as being critical success factors whereas they constitute one of the essential dimensions of project performance. Among the few studies, Morris and Hough[11] identified schedule duration and urgency as critical factors. Many projects, however, fail due to several other factors inherent in projects. In *Figure 1*, we list six of these characteristics: the size and the value of a project, the uniqueness of project activities (vs. standard activities), the density of a project network, project life cycle and the urgency of a project outcome. In a recent study by Tukel and Rom,[6] it was found that the durations of many large-size projects, those with more than 100 activities, exceed their deadlines. There are usually penalties imposed on projects when deadlines are exceeded. Monetary penalties and "loss of credibility" are the most common ones. Thus, if the project lifespan is being used as a measure to evaluate project performance, one should be cautious about the size of a project and the effectiveness of the penalties. Not only the number of activities but also the familiarity of the organization with the type of project being undertaken is critical. The project manager's performance on the job can be heavily influenced by the uniqueness of the activities. The more standard activities a project has, the easier it is for project managers to plan, schedule and monitor their projects. Another characteristic which needs to be emphasized is project density. This is defined as the ratio of total number of precedence relationships to the total number of activities.[6] The allocation of resources, especially man hours, is affected by the density. Due to the resource constraints, project managers are often forced to use overtime, which jeopardizes budget performance, or are forced to delay activities competing for the same resource, which results in delays in project completion times.

Finally, a characteristic worth mentioning is the urgency of a project. This is defined as the need to implement the project as soon as possible.[7] In many cases project performance criteria are not met because of the urgency of a project. Projects which start after natural disasters are typical examples. In these situations, not enough time is allocated for planning and scheduling projects, and as a result projects are more likely to exceed budgets and be perceived as failures.

Factors related to project manager and team members

Many factors related to the skills and characteristics of project managers and team members are proposed for the successful completion of projects. In their recent study, Pinto and Slevin[7] demonstrated the importance of selecting project managers who possess the necessary technical and administrative skills for successful project termination. They showed that the project manager's commitment and competence become most critical during the planning and termination stages. The competence of the team members is also found to be a critical factor during the implementation stages. Note that these factors not only affect project performance but they also have an impact on client satisfaction and project acceptance. For example, a project manager's marketing skills influence the client's attitude towards the project outcome.[27] Similarly, well established communication channels between the project manager, the organization and the client are necessary for the acceptance of the project outcome by the client.

Factors related to organization

One of the most critical factors for the successful completion of projects is top management support.[6] The support is usually strongest if there is a project champion and this champion is from the top management. He helps project managers understand and achieve the project objectives which are specified by the client and/or top management. Top management usually controls a project manager's access to resources which are supervised by functional managers. The level of support provided by the functional manager is usually determined by the level of support from top management. If the project is part of the functional department, then the availability of resources is not usually an obstacle, because the functional manager is usually also the project manager. But for projects with matrix organizational forms, or for projects with pure project forms, acquiring adequate resources can be a difficult job. It requires negotiating skills and positional power within the organization. Clearly, full support from the organization for the project helps to facilitate and implement strategies for the successful completion of projects.

Factors related to external environment

This last group consists of factors which are external to the organization but still have an impact on project success or failure. A number of environmental factors, such as political, economic, and social, as well as factors related to the advances in technology or even factors related to nature affect project performance, either positively or negatively. In an empirical study by Pinto and Slevin,[7] it was found that most of the environmental factors affect projects during the planning stage of a project's life-cycle. Yet some of the factors affect a project at all phases of the life-cycle, such as weather conditions and social environment. Sometimes these factors are so influential that they cause a project to be terminated at the implementation stages. In their book, Morris and Hough[11] gave many illustrations of governments being influential external factors and showed how crucial the public attitude towards a project could become.

Note that if a client is from outside the organization, he should also be considered as an external factor influencing the project performance. For functional projects, however, clients are usually part of the organization, such as top management. In such cases, factors related to the client can be grouped under the factors related to the organization. There might be additional external factors affecting project success, such as competitors in the market or subcontractors. They should also be listed with this group. Any factor in this group might influence the availability of resources and thus the project manager's performance on the job. Client consultation and acceptance are also influenced by the environmental factors. Competitors in the market, for example, might affect the marketing of the project to the client. Similarly, the client might be the reason for ineffective consultation, which could lead to project failure.

The intermediate effects of factor groups

The grouping of critical factors would not be sufficient to show how projects succeed or fail because of these factors. The factors in each group can be considered to be input-related factors affecting the project implementation. They often do not directly affect project outcome. Several factors in the groups can come into play simultaneously and cause new obstacles. A system can respond to these obstacles in many ways. In addition, these obstacles can also cause further problems during project implementation, which in turn might cause projects to fail. A set of possible system responses is given in the proposed framework (see *Figure 1*). For example, a project manager's performance on the job is being affected by the factors related to the organization, especially top management support, by the project manager's ability to implement a project, by technological, economic and social factors, and by the factors related to the project such as its size, value and urgency. As a result, by analysing the cause–effect relationship given in the framework, project managers would be able to identify and eliminate the factors that have a negative effect on their performance.

Similarly, project managers who perceive themselves as "marketers" consult their clients often and arrange meetings where team members participate to identify client's requirements. These activities result in the client's acceptance of the project outcome, which is then perceived as a success.

Analysis of the critical success factors identified in the literature

First, we analysed the results of a recent nationwide survey conducted by Tukel and Rom.[6] As part of the survey, project managers were asked to identify critical factors for the successful completion of their projects. In the survey, five common success factors from the literature were listed and the project managers were asked to list any other factor(s) specific to their projects. The following six factors were included in the study:

- top management support,
- client consultation,
- preliminary estimates,
- availability of resources,
- project managers performance,
- others (asked to specify).

The reader is referred to their paper[6] for further details about the questionnaire and the detailed analysis of responses including descriptive statistics and multi-variable analysis.

A total of 91 responses were analysed using SAS.[28] The distribution of the responses by industry is as follows: 31% construction; 25% management information system (MIS); 21% manufacturing; 16% utilities; 16% environmental; 12% defence and 18% other industries, including educational, healthcare and pharmaceutical. Note that the sum of the percentages exceeds 100 because project managers might work with more than one industry. We first rank the factors according to various project attributes. The results are given in *Tables 3–8*. The ranking is done by sorting the factors according to the frequency of the responses received. The factor(s) which was most frequently chosen is ranked as first, followed by the second most frequently chosen factor and so forth. For example, in *Table 3*, top management support is found to be most important factor (1) for construction projects and the sixth factor (named "others") is found to be the least important (6). Note that if more than one factor has the same frequency of responses, they are ranked the same. For example, in *Table 3*, client consultation and top management support both have the highest response rate in MIS and consequently both of them are ranked as (1). A frequency analysis was also done to determine if there is a statistically significant relationship between project attributes and success factors. The numbers in parenthesis in each table show the statistical significance of the relationship (P value of less than 0.1).

Table 3 gives the ranking of success factors in each industry. In most of the industries, top management support and the availability of resources are ranked the highest. As is demonstrated in *Figure 1*, the availability of resources is directly related with top management support for the project. Thus, having both of these factors at the higher ranks at the same time is not surprising. What is surprising is that the factors which are related to the project managers usually ranked lower. One explanation for this is that many project managers do not perceive the true importance of their role as a manager for the successful completion of projects. They usually have a tendency to relate project success to factors that are out of their control. Furthermore, when we investigated the responses to the sixth factor, (named "others") we found that most of them are again related to the organization's attitude towards the project. A few responses were related to the technology used during the implementation of projects. Finally, in customer-oriented fields like MIS and utilities, client consultation is found to be an important factor.

Tables 4, 5 and *6* give the ranking of the factors according to the criteria used to measure success, the organizational structure and project size, respectively. It seems that whichever criterion is used to measure project success, even if it is quality, the organizational factors related to technical aspects of project management (availability of resources) are still the dominant factors on the list.

Table 3 The ranking of critical success factors for each industry

Factors/industry	Top mgt. support	Client consultation	Preliminary estimates	Availability of resources	PM performance	Others
Construction	1	5	4	3	2 (0.06)	6
Defense	3	5	4	1	2	6
MIS	1	1 (0.004)	4	3	5 (0.04)	6
Utilities	2	2	4	1	4	6
Environmental	3 (0.01)	3	5	1 (0.03)	2	–
Manufacturing	2	5	3	1	4	6
Others	1	5	3	2	4	6

–No responses received

Table 4 The ranking of the criteria used to measure success vs. factors determined to be critical (independent of industry)

Factors/measure	Top mgt. support	Client consultation	Preliminary estimates	Availability of resources	PM performance	Others
Cost	2	4	5	1 (0.05)	3 (0.05)	6
Time	2 (0.05)	5	4	1	3	6
Quality	1 (0.06)	5 (0.02)	4 (0.001)	1	3 (0.07)	6
Client satisfaction	2	3 (0.001)	5	1	4	6

Table 5 The ranking of critical success factors according to the organizational structure (independent of industry)

Factors/org. structure	Top mgt. support	Client consultation	Preliminary estimates	Availability of resources	PM performance	Others
Pure	2	3	3	1	3	6
Functional	2	3 (0.03)	4	1	5	6
Matrix	1	5 (0.04)	4	2	3	6

Table 6 The ranking of the critical success factors for moderate and large size projects

Factors/project size	Top mgt. support	Client consultation	Preliminary estimates	Availability of resources	PM performance	Others
≤ 100 activities	2	3 (0.06)	5	1	4	6
>100 activities	2	5 (0.04)	4	1	3 (0.02)	6

Surprisingly, even when the criterion is client satisfaction, the availability of the resources and top management support are the top-ranked factors, not client consultation during the implementation of a project, as we expected. Note that there is a statistically significant relationship between client satisfaction and client consultation.

The same ranking pattern appeared in *Tables 5* and *6*. When the project has a matrix organizational form, top management support is necessary, easing project scheduling and resource allocation problems. It was also observed that project size has no notable effect on the criticality of the factors.

We continued the analysis by arranging these factors into two groups: factors related to the organization and factors related to project managers. Our attempts to organize factors specified as "others" into meaningful groups were unsuccessful because of dissimilar responses. Thus, we formed three groups: organizational factors, project manager-related factors and others. The group with organizational factors dominated all the others (*Tables 5* and *6*). Again, the results did not change due to changes in project attributes.

To summarize, the results of the survey indicate factors related to organizations are most critical for project success. In addition, the analysis suggests that factors related to project managers' performance are not as critical. However, one should keep in mind that the respondents to this survey are exposed to only a few members of critical factor groups. This motivated us to conduct a follow-up survey to investigate the impact of the new scheme.

Analysis of the critical success factors/groups in the framework

A questionnaire consisting of two sections and a total of 10 questions was prepared (Appendix I). The first section includes questions about the project organization and attributes and the second section includes the four factor groups from the framework. Project managers are asked to choose the best answer for the questions in the first section and asked to mark all the critical factors which apply to their situation in the second section. Thus, there are 49 possible responses by each respondent. Copies of the questionnaire were sent to project consultants for comments and possible changes. The final form was mailed to 200 project managers whose names were selected from the Project Management Institute directory. A total of 57 responses were received, resulting in a response rate of 28%. The following analysis was done using SAS.[28]

Descriptive statistics and frequency analysis. The distribution of the respondents across industries and the average response rate to the questions in the first section are summarized in *Table 9*. The highest percentage of respondents are from manufacturing, where product development projects are common. The second highest number of respondents are from a variety of different industries (considered as "others") including healthcare, education and the pharmaceutical industries. The following common project characteristics were noted: projects usually have less than 100 activities (moderate sized) and were handled within a functional department. Quality and client satisfaction are common measures used for the evaluation of projects.

Next we analyse the critical success factors and the groups that they belong to. The project managers are first asked to identify groups that are critical for their projects' success. Then, they are asked to identify critical factors specific to their situation. A set of factors is listed under each group. They are warned that the list under each group is a subset of a complete group and if their most critical factors are not in these lists they can add them to the related group. As will be demonstrated shortly, project managers responded to this questionnaire quite differently than to the previous study. It is important to note that our purpose here is not to make a direct comparison with the previous survey results because the questions in these two studies are quite different. Rather our purpose is to show that our new scheme provides more complete and reliable information.

The three most commonly chosen factors in each group are identified for further analysis. There is a total of five groups and 15 factors. Similar to the previous frequency analysis, we ranked the 15 factors independent of the group that they belong to and reported the six factors with the

Table 7 The most critical success group according to the organizational structure (independent of industry)

Factors/org. structure	Organization	Project manager	Others
Pure	✓		–
Functional	✓		–
Matrix	✓		–

Table 8 The most critical success group according to the industries

Industry/factors	Construc.	Defense	MIS	Utilities	Environm.	Manufacturing	Others
Organization		✓	✓	✓	✓	✓	✓
Project manager	✓						
Others	–	–	–	–	–	–	–

Table 9 Descriptive statistics for the follow-up survey

Industry	Average response rate (%)	Organizational structure	Average response rate (%)	Success measure	Average response rate (%)
Construction	17.0	Pure	16.9	Cost	55.5
Defense	4.0	Functional	62.2	Time	42.6
MIS	12.9	Matrix	24.5	Quality	59.3
Manufacturing	40.7			Client satisfaction	59.2
Environmental	6.2				
Other	24.0				

Table 10 The ranking of critical success factors for each industry

Factors/ industry	Size and value	Density	Urgency	Coordinate	Competence	Commitment	Tech. background	Commun.	Commitment	Top mgt. support	Org. structure	FM support	Economic	Technology	Client
Constr.		(0.09)		2			1 (0.09)	4					4 (0.02)	4 (0.08)	2 (0.009)
Defense															
MIS	3			3	(0.08)			3	1	1				3	
Utilities															
Envirn.															
Manuf.	(0.08)			1	1 (0.004)	4 (0.05)	4	4		1					(0.08)
Others			4 (0.04)	2			2	4	6	1					

Table 11 The ranking of the criteria used to measure success vs. factors determined to be critical (independent of industry)

Factors/ criteria	Size and value	Density	Urgency	Coordinate	Competence	Commitment	Tech. background	Commun.	Commitment	Top mgt. support	Org. structure	FM support	Economic	Technology	Client
Cost				3	6		3	2	5	1					
Time				1	(0.03)	4 (0.03)		1 (0.07)	4	3		(0.08)			
Quality		(0.03)		2	6 (0.008)		3	3	5	1 (0.04)		(0.01)	(0.02)	(0.05)	
Client satisfaction				1			1	4	6	1		(0.08)			4 (0.001)
Others			3	3			2	3	3	1					

Table 12 The ranking of critical success factors according to the organizational structure (independent of industry)

Factors/ org. struc.	Size and value	Density	Urgency	Coordinate	Competence	Commitment	Tech. background	Commun.	Commitment	Top mgt. support	Org. structure	FM support	Economic	Technology	Client
Pure	5			2	5	2 (0.04)	1 (0.08)	2							
Functional		(0.01)	4 (0.1)	2			4 (0.01)	3		1				4	
Matrix	(0.05)	4 (0.03)		4		(0.008)	1 (0.07)	6		1					3 (0.02)

Table 13 The ranking of the critical success factors for moderate and large size projects

Factors/ project size	Size and value	Density	Urgency	Coordinate	Competence	Commitment	Tech. background	Commun.	Commitment	Top mgt. support	Org. structure	FM support	Economic	Technology	Client
≤ 100 activities				2			4	3	6	1				4	
>100 activities		(0.05)		3		1	2 (0.01)		4	4	6 (0.002)				

highest responses. The ranking of the critical success factors for each industry is given in *Table 10. Tables 11–13* summarize the results for the same three project attributes (independent of industry): the criteria used to measure project success, the organizational structure and the project size.

The most critical success factors for each industry (*Table 10*) are quite different from the ones reported in *Table 3*. Although top management support is still one of the most critical success factors, many project manager-related factors are also found to be critical, such as coordination and competence. Furthermore, factors related to project team members, such as technical background and commitment, became the most critical factors for construction and MIS projects. Environmental factors such as technology, economy and the client are also found to be critical and have a statistically significant relationship with construction projects. Note that because of the low response rate in defense (4%), no ranking was done. However, respondents indicated government as the critical success factor, which confirmed the findings of a study by Morris and Hough.[11]

The results in *Tables 11–13* also show a noticeable shift in ranking from organizational factors towards factors related to project managers and team members and even towards the factors related to projects. For example, when the project is done within a functional department, the urgency of a project becomes a critical factor for the project's success, which supports the finding that functional projects usually have low priority within the functional department unless they are urgent. Similarly, the size, value, and the density of a project are critical factors for projects with pure organizational structure and for projects with matrix form, respectively. In *Table 13*, an expected result is obtained. For large projects, the most critical success factor is the commitment of team members. Since large projects usually have longer life spans, team members' commitment to the project becomes vital. Surprisingly, none of the respondents identified the availability of resources as one of the critical success factors.

We also investigated whether a project manager's technical background is important to the attributes of projects he undertakes and which success factors are more important for him. We discovered that all of the respondents in manufacturing and in construction have strong technical backgrounds and they are involved in both large and small size projects. We found a strong statistical relationship (P value = 0.007) indicating that the managers with strong technical backgrounds (97% from manufacturing and construction) are more commonly involved in projects with pure or matrix form but not in projects with functional form. Although we could not find a statistical relationship between the managers' technical backgrounds and whether they consider managerial skills to be the most important success factors, we found a strong statistical relationship (P value = 0.004) between the managers' technical backgrounds and their competence on the job.

Finally, we formed five factor groups and analysed the responses. Note that all possible responses are included in this analysis, not only the most common three factors as was the case in *Tables 10–13*. *Tables 14* and *15* reveal interesting results. Organizational factors are dominated by factors related to project environment and project managers. For each industry a project manager's performance on the job and the team members' technical background and commitment are most critical for project success. Environmental factors are vital, especially for MIS (technology) and construction (economic and weather) projects.

Table 14 The ranking of the critical success groups according to the organizational structure (independent of industry)

Groups/ org. str.	Project	PM	Team	Organization	Environment
Pure	4	1 (0.04)	3	4	2
Functional	2	3	3	5	1
Matrix	2	2 (0.008)	2	5	1

Table 15 The ranking of the critical success groups according to industries

Groups/ industr.	Project	PM	Team	Organization	Environment
Construction	4	2	3	–	1 (0.001)
Manufacturing	3	1 (0.05)	2	4	5
MIS	3	1	–	–	1
Others	2	1	2	2 (0.07)	5

Discussion and future research directions

What might be the explanation for this considerable change in the criticality of success factors? One of the explanations we offer is the way the success factors are introduced to the respondents. The new scheme we developed in this paper (*Figure 1*) presents the factors in a more systematic way. Factor groups are formed which helped respondents understand the overlooked dimensions of project success such as project attributes and project environment. *Figure 1* is a comprehensive representation in that it demonstrates the interaction between the factors, how the system would be affected by these factors and whether the outcome is a success or a failure. This scheme seems to help respondents understand, for example, that the availability of resources is a consequence of many organizational factors affecting the system, and these factors should be identified first.

The empirical study which was developed based on our framework justified many of our conjectures about the practicality and superiority of our new scheme. Many neglected members of the factor groups emerged. The survey results demonstrate that project managers' managerial skills, team members' commitment and their technical background, project attributes and environmental factors are as viable and can be as critical as the organizational factors, although the criticality of these factors varies between industries. While in MIS and in manufacturing projects project managers' managerial skills are the most critical factors, environmental factors take the lead in construction. Many statistically significant relationships between critical success factors and project characteristics are identified. This is useful to project managers in analysing a particular factor in detail. Furthermore, these relationships explain interaction among factor groups (see *Figure 1*). For example, it was found that when project size and value are critical factors, the project has a matrix organizational form. Similarly, when time is used to measure project success, then a project manager's skills and communication between the team members become critical.

One last explanation we offer for the change in the success factors are the rapid changes now occurring in the

business environment. These changes obviously affect the project attributes and the way we manage projects. And they, furthermore, affect the criticality of the factors. Some critical factors might be disappearing due to new technology, whereas factors related to other project attributes might be becoming critical. The framework we suggest here provides a tool for understanding and adapting to these changes.

Today more and more project managers consider quality to be the most important objective.[6] Quality can be assured by identifying and eliminating the factors that cause poor project performance. Thus, project managers need better understanding of critical success/failure factors and how to measure them. In this paper, we emphasized the importance of understanding the factors and interactions between them. We expect to see additional future research concentrating on the cause–effect relationship between critical factors and on measurement techniques.

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Appendix

Survey questions

Section 1

In what industries would *most* of your projects be classified?

- construction
- defense/aerospace
- information systems
- manufacturing
- utilities
- environmental
- other (specify)

Would most of your projects have:

- less than or equal to 100 activities
- more than 100 activities

How are your projects tied to the organizational structure?

- the project is separated from the rest of the parent firm
- it is part of a functional division of the firm
- it is a pure project organization overlaid on the functional division of the parent firm (matrix form)

Which *criteria* do you use to measure your project success (or failure)?

- cost
- time
- quality
- client satisfaction
- other (specify)

Section 2

Please mark the factors that you consider to be the *most important* factors for the successful implementation of your projects (note that if your factors are not listed below, please identify the group that they belong to and add them to the areas provided below):

Factors related to the project:

- The size and the value
- Uniqueness of the project activities
- Density of the project network (independencies between activities)
- Project life-cycle
- Urgency

Factors related to the project manager:

- Ability to delegate authority
- Ability to tradeoff
- Ability to coordinate
- Perception of his role and responsibilities
- Competence
- Commitment

Project team members:

- Technical background
- Communication
- Trouble shooting
- Commitment

Factors related to the organization:

- Top management support
- Project organizational structure
- Functional managers' support
- Project champion

Factors related to the environment:

- Political environment
- Economic environment
- Social environment
- Technological environment
- Nature
- Client
- Competitors
- Sub-contractors

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