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Project Success: A Multidimensional Strategic Concept

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This article presents projects as powerful strategic weapons, initiated to create economic value and competitive advantage. It suggests that project managers are the new strategic leaders, who must take on total responsibility for project business results. Defining and assessing project success is therefore a strategic management concept, which should help align project efforts with the short- and long-term goals of the organization. While this concept seems simple and intuitive, there is very little agreement in previous studies as to what really constitutes project success. Traditionally, projects were perceived as successful when they met time, budget, and performance goals. However, many would agree that there is more to project success than meeting time and budget. The object of this study was to develop a multidimensional framework for assessing project success, showing how different dimensions mean different things to different stakeholders at different times and for different projects. Given the complexity of this question, a combination of qualitative and quantitative methods and two data sets were used. The analysis identified four major distinct success dimensions: (1) project efficiency, (2) impact on the customer, (3) direct business and organizational success, and (4) preparing for the future. The importance of the dimensions varies according to time and the level of technological uncertainty involved in the project. The article demonstrates how these dimensions should be addressed during the project's definition, planning, and execution phases, and provides a set of guidelines for project managers and senior managers, as well as suggestions for further research.

Introduction

What does project success mean? In an era when projects have become increasingly common in organizations, this question is more relevant than ever. In almost all cases projects are initiated

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to create change—to develop new products, establish new manufacturing processes, or create a new organization. Without projects, organizations would become obsolete and irrelevant, and unable to cope with today's competitive business environment. Thus, no matter what the motivation for the project, the question of project success is strongly linked to an organization's effectiveness and to its success in the long run. Yet, ironically, the conceptual understanding of project success is still in its early days—project success has not been typically linked to competitive advantage and winning in the market-place; and different people still perceive project success in different ways.[1] Project management literature has also been quite divided on this notion and, as of the time of writing, there are still no accepted frameworks for assessing project success.

What, indeed, does project success mean? Is there more than one way to evaluate project success, and should the same rule apply to all projects? One of the most common approaches to project success has been to consider a project successful when it has met its time and budget goals.[2] Although this may seem true in some cases—and appropriate in the short run when time to market is critical—there are many examples where this approach is simply not enough. Quite often, what seemed to be a troubled project, with extensive delays and overruns, turned out later to be a great business success. The construction of the Sydney Opera House. This project took three times longer than anticipated and cost almost five times higher than planned. But it quickly became Australia's most famous landmark, and no tourist wants to leave Australia without seeing it. Similarly, Microsoft's launch of its first Windows software suffered substantial delays and required a continuous flow of resources and additional staff. However, from the moment of its introduction, it became an enormous source of revenue for the company, and approximately 90% of all PCs in the world now use the Windows operating system. And prior to the development of its hit product, the Macintosh, Apple Computers had experienced the business disappointment of the Lisa computer. But Apple managers later acknowledged that, without the technologies developed and lessons learnt during the Lisa project, the Macintosh success would not have happened.[3]

So what does project success really mean—how can it be best defined to serve organizational interests most appropriately? This article is based on the proposition that projects are part of the strategic management in organizations: Their benefits are multifaceted, and their goals must be set in advance to better help the organization meet its short- and long-term objectives. The purpose of our empirically based research was to develop a multidimensional framework for the assessment of project success. Such a framework would be tied to the strategic management of the organization and to top-level decisions on project selection and project initiation. And the framework would help project managers and business organizations see the different values gained from project execution, and focus their day-to-day operations on the activities critical for business effectiveness. Because of the complexity and importance of the research question, we found it necessary to use a combination of qualitative and quantitative methods and two data sets. The article begins by briefly presenting the theoretical background and our research methods. We then describe our qualitative case research, supporting its findings in the quantitative section. We conclude with a detailed discussion and offer implications for management and further research.

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Theoretical background and research approach

Defining organizational effectiveness

Although studies of organizational effectiveness have been at the heart of organizational theory for many years,[4] most organizations have traditionally adhered to financial measures to evaluate and measure their success. Yet, as many studies have shown (e.g., Cameron[5] and Dvir, Segev and Shenhar[6]) such measures alone are insufficient indicators of organizational success in the long run. Financial measures alone worked well in the industrial era, where single-product, high variable cost firms were typical. However, they do not fit well with today's dynamic markets, multi-product firms, and high fixed cost environments.[7]

It was these limitations that led in recent years to the development of multi-dimensional models for measuring success at the corporate-level. Several famous frameworks such as The Balanced Scorecard,[8] Intellectual Capital,[9] and Success Dimensions[10] are being implemented by modern corporations trying to link strategic decisions to sustainable success. And more empirical studies are identifying additional, more refined measures of success.[11]

Ironically, however, the project management literature has been slow to adapt to similar concepts, and there is no agreement on a standard, or even an operative framework for assessing project success. As the following section illustrates, part of the problem is due to the current perception of project activity and, as a result, project measures have been diverse, limited, and often not connected to the business side.

Project success assessment

Clearly most projects are conceived with a business perspective in mind, and often with a goal which is focused on better results and organizational performance—more profits, additional growth, and improved market position. Several recent studies have indicated the impact of effective projects on firms' performance (e.g., Menke[12] and Ittner and Larcker[13]).

Ironically, however, when project managers and project teams are engaged in day-to-day project execution, they are typically not focusing on the business aspects. Their attention, rather, is operational—and their mindset is on "getting the job done." This mindset may help finish the job efficiently by not wasting time and money, yet it may lead to disappointing business results and even failure, when the job was not done effectively. Most project managers see their job as successfully completed when they finish the project on time, within budget, and to specifications. And in some cases, project managers would add, when the result pleases the customer.

This operational mindset is clearly reflected in the project management literature, which has traditionally used time, budget, and performance as the main indicators for project success. Any of these measures—or even all taken together—can lead to incomplete and misleading assessment. They may count as successful, for instance, a project that met time and budget constraints but did not meet customer needs and requirements,[14] or a project where the process of commercialising the final product proved very difficult. A few studies have suggested adding a new element to the notion of project success—client satisfaction and customer welfare.[15] DeCotiis and Dyer[16] have emphasized the importance of customer satisfaction, and Baker, Murphy, and Fisher[17] went one step further to include the level of satisfaction of four different stakeholders: the customer, the developer, the project team, and the end-user.

Success means different things to different people

Project success assessment may differ according to the assessor—as Freeman and Beale[2] (p. 8) noted:

> Success means different things to different people. An architect may consider success in terms of aesthetic appearance, an engineer in terms of technical competence, an accountant in terms of dollars spent under budget, a human resources manager in terms of employee satisfaction. Chief executive officers rate their success in the stock market.

This idea influenced the introduction of multi-dimensional frameworks for the assessment of project success which would reflect different interests and different points of view. Pinto and Mantel[18] for example, identified three aspects of project performance as benchmarks for measuring the success or failure of a project: the implementation process, the perceived value of the project, and client satisfaction with the result. Freeman and Beale identified seven main criteria used to measure project success, including technical performance, efficiency of execution, managerial and organizational implications (including customer satisfaction), personal growth, and manufacturer's ability and business performance. And Cooper and Kleinschmidt[19] addressed three dimensions of new product success: financial performance, the creation of new opportunities for new products and markets, and market impact.

More recent research has suggested new perspectives. Baccarini,[20] for example, has used a hierarchy of project objectives which include goal, purpose, outputs and inputs, and has suggested distinguishing between project success and product success. He contended that the project management team is responsible for producing the project output, but the determination of project purpose is beyond their responsibility. Needless to say, according to this framework, project success is detached from expected business results. Finally, Gardiner and Stewart[21] have suggested using the concept of net present value (NPV) to develop an ongoing monitoring tool for the assessment of project health.

The approach of this study

Shenhar, Poli, and Lechler[22] have suggested a distinction between two types of projects—operationally managed projects, and strategically managed projects. Operationally managed projects are focused on getting the job done and meeting time and budget goals, while strategically managed projects are focused on achieving business results and winning in the market place. Management teams in strategically managed projects spend a great deal of their time and attention on activities and decisions aimed at improving business results in the long run. They are concerned with customer needs, competitive advantage, and future market success, and rather than sticking to the initial plan, they keep making adjustments that will create better business outcomes. Such projects, however, are quite rare: many projects are still managed with an operational mindset, focusing on short-term results and delivery.

Projects in the future will become the engines that drive strategy into new directions

This study was initiated under the premise that today's rapid changes and global competition require organizations to be quicker, more responsive, and more competitive than ever. So projects must be perceived as powerful strategic weapons, initiated to create economic value and competitive advantage, and project managers must become the new strategic leaders, who must take on total responsibility for project business results. In today's rapid changing world, there is no time to share this responsibility in the previous way, where project managers were concerned with "getting the job done," while other managers were responsible for business aspects. Indeed, many projects are undertaken today in small, start-up companies, where the project team is involved in all business aspects, and there is no distinction between project success and product success. With increased pace and competition this trend will only accelerate, and it will become the norm in large organizations as well. Projects in the future will no longer be just operational tools for executing strategy—they will become the engines that drive strategy into new directions.

Our study was designed to develop a comprehensive framework for the assessment of project success as a strategic concept. Such a concept will drive project decision-making and execution to better business results, and yield improved organizational effectiveness. Based on the previous literature and our own observations, we, too, have perceived project success as a multidimensional concept, and our objective was to see what are the specific dimensions that make sense for different kinds of projects. We started our study with three major dimensions in mind: The first was related to meeting specified project goals such as time, budget, and performance and other requirements. The second was related to customer benefits, such as satisfaction, impact, and loyalty. And the third was related to the benefits derived by the performing organization, such as profits, market share, or growth. Our research goals were first, to test whether these are the actual major dimensions that have a role in defining project success, and second, to identify what are the specific measures that create each dimension. We were also concerned to discover how each dimension would be affected by different time frames and by different project types, as we discuss in the next section.

One size does not fit all

Does the same rule apply to all projects? Clearly, there are great differences among projects. Projects may differ in terms of technology, size, complexity, risk, and other variables. Yet much of the traditional project management literature has treated all projects as the same, assuming, that, *"a project is a project is a project."* Several studies have recently recommended using a more project-specific approach, and suggested distinguishing between different project types, and using different management styles to manage them.[23]

Following this line of thought, our research leads us to contended that for project success, as well, "one size does not fit all" – different success dimensions are relevant to different types of projects, and in different degrees of importance. To distinguish between projects, we have chosen to use the level of technological uncertainty at the moment of project initiation.[24] This classification, which has been shown to be one of the major independent variables among projects,[25] includes the following four levels:

1 Low-Tech Projects rely on existing and well-established technologies, such as construction, road building and "build to print" projects, where a contractor rebuilds an existing product;

2 Medium-Tech Projects rest mainly on existing, base technologies but incorporate some new technology or feature. Examples include industrial projects of incremental innovation, as well as improvements and modifications of existing products;

3 High-Tech Projects are defined as projects in which most of the technologies employed are new, but existent, having been developed prior to project initiation, such as developments of new computer families, or many defence developments;

4 Super High-Tech Projects are based primarily on new, not yet existent technologies, which must be developed during project execution. This type of project is relatively rare, and is usually carried out by only a few (and probably large) organizations or government agencies.

Once a framework for the assessment of project success is developed, it could be tested for different kinds of projects. Our intent was to see what role different success dimensions play for different kinds of projects, and whether all success dimensions are equally important for all projects. While not claiming that a single set of measures is universal for all projects, we hypothesize that each project would use specific measures in differing ways and with differing degrees of importance. This hypothesis is based on traditional arguments from classic organizational contingency theory, which contends that context and structure must somehow fit together if the organization is to perform well,[26] and that performance measures are influenced by various contingency variables, such as the technology employed and the external environment.

Research method and data description

Because of the complexity and importance of the research problem, we performed a two-stage study, involving a combination of qualitative and quantitative methods and two data sets. In the first stage we examined 15 projects to which we applied a multiple case study approach, focusing on the dynamics within single settings.[27] Specifically, we subscribed to the process of qualitative case study research as suggested by Eisenhardt[28]. The second stage involved collection of statistical data on 127 projects (in 76 companies) from a total number of 182 managers who were approached. Project managers who participated in our study were asked to classify their projects according to the level of technological uncertainty as previously described, and those in our quantitative research were asked to assess the success of their project on several initial measures. [Our research methodology, process of investigation, and measures studied is detailed in our Note on Methodology in Appendix A.] The fifteen case projects studied in the first phase are described in Table 1, and the demographic distribution of the projects in our quantitative research is summarized in Table 2.

Case study findings: major success dimensions across different project types

During the case study portion of our research, we were looking for typical success dimensions that our respondents would recognize as important across all projects. We sought to ascertain the nature of our originally perceived dimensions in the projects we studied, and how did different stakeholders saw their importance relative to other dimensions. As mentioned, the three dimensions that we started with were: (1) meeting time, budget, and other requirements, (2) impact on the customer, and (3) benefit to the performing organization. However, since different projects are launched for different purposes and with different expectations, we also examined the role of each dimension for different types of projects. Our observations on the three major success dimen-

Table 1. Case projects—descriptions and project classification

	Name	Level of tech. unc.	Project Description
1	SWB	Low-tech	the construction of a new building for a university social sciences department. The project was financed through a donation for this purpose, and included lecture halls, an auditorium, faculty and administrative offices, rest areas and service rooms
2	JHH	Low-tech	the construction of a major new regional office facility for a large utility company, including offices, service areas, large storage areas and provisions for further expansion
3	LBD	Medium-tech	an in-house development project of a special purpose new type Lithium battery to be used for extensive periods under harsh conditions
4	MDL	Medium-tech	the design and manufacture of a protective operator's cabin for a heavy piece of equipment. It included the building of physical as well as environmental protection
5	FBL	Medium-tech	design, build and installation of a new plant for fabrication and mass production of advanced semiconductor microelectronics devices of specific nature. Project involved clean rooms, energy systems, gas purification and vacuum systems and compressed air and evaporation systems, including construction of completely new process technology
6	BIS	Medium-tech	program of improvement, overhaul and reorganization of an air fleet including aircraft, weapon systems and ground and airborne support systems. The program consisted of several projects performed by different contractors
7	TAD	High-tech	self investment project, developing software package by transforming one language into another to yield a standard supplementary component in contractor's marketed products
8	MXE	High-tech	in-house development of a multiplexing unit for use in transatlantic cable telephone transmission, involving development of new equipment with digital technology, software and control
9	RBA	High-tech	development of new radar system, including new transmitter, receiver and antenna unit and use of some new miniaturization microwave technology
10	GWI	High-tech	improvement/upgrade of an existing weapon system for naval use. Many subsystems replaced, others overhauled and rebuilt with the aim of improving system performance and reliability
11	PAL	High-tech	development of electronic warfare system for air combat use, including RF receivers, antennas, signal processing and control units
12	BAT	High-tech	development of a fire control system for use on a military platform. The system included several sensing subsystems, a range finder, a control unit and central computer
13	TSM	High-tech	development of a vision and targeting system for a special purpose vehicle, involving Laser technology, optical system, stabilizing system and displays
14	ABR	Super High-tech	development of a new electronic and computing module as part of a larger system. Module involved use of untested new algorithms as well as some new technologies developed for the purpose
15	COR	Super High-tech	development of a completely new electronic system to function in an unknown communications environment with a "wide band unfriendly" electromagnetic spectrum. System required to analyse hostile signals and make "real-time" decisions as to how to handle threats. Project involved development of new algorithms and new hardware components and integration with several computers and operating stations

Table 2. Project demographics

Industry and project distribution	
Industry	**Number of firms**
Electronics	30
Aerospace	18
Construction	12
Mechanical	2
Chemical/ pharmaceutical/ bio-chemical	10
Project type	**%**
New product development	62%
Product modifications	15%
Construction	23%
Markets served	**%**
Consumer market	18%
Industrial market	21%
Government	61%
Level of project technological uncertainty	**Number of projects**
Low-tech	28
Medium-tech	44
High-tech	45
Super high-tech	10

sions are described below, followed by a discussion on how a fourth dimension (which was not part of our initial hypotheses) emerged.

The first dimension: meeting time, budget, and requirements goals

The first question we examined was the perception of our respondents toward meeting time, budget, and other project requirements. Not surprisingly, this dimension seemed critical to them all. Furthermore, most project managers were convinced that this was their major job—that their performance was assessed by how well they met their project's immediate goals, and above all, adhering to time-scales and budgets. As one project manager put it: "*my job is to be there in time, and my reputation in the past was that I can finish projects in time. I am not going to diminish this reputation here.*" However, as the following discussion demonstrates, while all saw time and budget as important, the emphasis on meeting these goals varied according to the project type. (Interestingly, meeting performance was virtually a non-issue for all respondents: almost all projects we studied seemed to have met their performance requirements.)

Projects involving low technology, however, were more likely to meet schedule and budget constraints than projects involving higher-level technologies. In low-technology projects, in fact, overruns were seen as almost intolerable: meeting time and budget was perceived as critical to success. (Over-runs in such projects did occur, however, but were attributed to factors that were beyond management's control. The university construction project (SWB), for example, suffered a 20% schedule overrun due to a government-imposed restriction on the importation of construction workers.) But overruns reached a much higher level in high- and super-high-tech projects, with two cases of almost 100% overrun. Such overruns were always a result of technical difficulties, and were much more likely to be tolerated than in lower technology type projects: in super-high-tech projects, they were even perceived as "most likely to happen". A notable case was the ABR project. This advanced project involved the development of a new electronic module based on a concept never tried before, and on several new technologies not existing prior to project initiation. The project took almost twice the time originally planned for, going through two cycles of resource planning—but both management and customer representatives felt that "the price was right," and that the benefit gained from the final result justified the time and budget overruns.

Overruns in super-high-tech projects were perceived as "most likely to happen"

The second dimension: benefit to the customer

The benefits customers gained from different types of projects tend to increase with technological uncertainty. Low-tech projects, for example, are simple in terms of technology, and in most cases the customer is just interested in a reasonably useful product to be used for traditional purposes. In such projects as JHH (building a regional office for a large utility company), and in SWB (a new university building), what the customer wanted was to meet their requirements with a standard solution at minimum cost. (In the SWB project the customer was also particularly interested in lower long-term maintenance, cleaning, and heating expenses.)

Medium-tech projects provide more than just a standard solution for customers. Such projects involve some novel element, often involving improvements or modifications to an existing product, or the production of new products in a well-established technological field. Cases studied in this category included the development of a new type of battery (LBD), the building of a protection cabin for a heavy piece of equipment (MDL), and the building of a new semiconductor plant (FBL). In each case the project was designed to solve a customer's problem and make life easier, safer, or more efficient. The battery was aimed at extending the operational period of the electronic equipment it powered, while the cabin protection was designed to enable the equipment to operate under severe conditions of battlefield. We found that customers in this category look for more than just a standard product: the project needs to yield a functional solution that both meets their needs and provides some benefit compared to previous generation products.

High-tech projects usually involve the development of new products based on a collection of new technologies. Such projects address new needs, or provide completely new solutions to previous problems. Among the projects we studied in this category were the development of a new command and control system for a military vehicle (BAT), the development of a new software package (TAD), the development of a new radar system (RBA), and the development of a new multiplexing fibre-optic system for a large communication network (MXE). We found that the end-customers in such cases were ready to accept higher risks, as well as higher prices, but sought substantial advantages and unique solutions for their problems. The command and control system, for example, enabled the customer to operate their systems during manoeuvres and under severe environmental conditions—a capability that was unheard of in previous product generations. Long distance companies purchasing the multiplexing system, meanwhile, were able to multiply their call capacity eight-fold as well as benefiting from increased signal quality and a gradual reduction of operating costs. Customers of high-tech projects expect unique solutions offering substantially increased capabilities and effectiveness.

Customers of super-high-tech projects expect quantum leap solutions and enormous advantages in effectiveness

Super-high-tech projects usually address very advanced needs, for which no technology or previous solution readily exists. The two projects we studied in this category were the development of the new electronic module based on a new concept (ABR), and the development of a receiving and processing system for use in a hostile and complex electromagnetic environment (COR). Such projects are obviously the most complicated and most risky of all, but when they are successful, they provide a quantum leap in effectiveness for their customers. The COR project granted customers an entirely new view of the electromagnetic spectrum, even simulating signals which may be developed in the future. Customers of super-high-tech projects expect quantum leap solutions and enormous advantages in effectiveness.

The third dimension: benefit to the performing organization

Typically the benefits of projects to the performing organization are focused on profits, market share, and other business related results. However the nature and expectations vary with project type. As low-tech projects include no technological uncertainty, they can be executed by many contractors, who normally operate in a highly competitive environment. The typical benefit an organization can expect from a low-tech project is reasonable profit, with relatively low margins. (In the SWB project, in fact, profit was nominal, but the contractor hoped to—and eventually did—get more work from the university once this project had been completed.)

Medium-tech projects are still relatively simple in terms of new technology. An organization undertaking such projects is usually looking to improve a previous product, or to increase its existing product line, without revolutionizing its technology. Such projects are the most common in industry, and their technical risk is reasonably low. The immediate benefits organizations are looking for are appropriate profits and possibly product diversification. Yet, as we shall see later, even in these projects, management often looked for benefits beyond profits.

High-tech projects are more risky than the previous two types, and have a high probability of over-runs, sometimes causing losses in the short run. When undertaking such projects an organization would look for the prospect of additional profits in the longer run, of increasing market share, but also of gaining the means for additional product lines or technological capabilities. For example, the MXE project almost forced the organization into bankruptcy: however, once completed, the project exceeded all expectations, creating an entire line of new prosperous businesses. A top manager described this project as: *"our roller coaster to the future."*

The risks are greater in super-high-technology projects, but so are the opportunities

Finally, super-high-tech projects are the most risky of all. Only a few organizations would be willing to embark on them: stakes are high, but so are opportunities. A successful project in this category would create leapfrog advantages for the performing organization, and although profits may sometimes come late, they would be high. The project manager of the COR project declared: *"the product of this project could feed us for the next ten years."* Such projects will produce entirely new products, establishing new product lines, or creating new markets, and will always result in creating new technological generations and core competencies.

The emergence of a fourth dimension: preparing the future

Examining what organizations gained from their project endeavours clearly revealed benefits of two kinds. One concerned immediate business results, such as profitability and market share, while the second involved longer term benefits, only to be realized in the future, sometimes long after the project has been completed, and often indirectly. This observation led us to the conclusion that we need to isolate a fourth dimension when considering project success—a dimension that relates to the future. This dimension addressed the question: how does the current project help prepare the organization for future challenges? As the following discussion shows, this dimension was also greatly dependent on project type, and had enhanced importance as technological uncertainty increased.

Low-tech projects are typically focused on short-term profits, although even in such cases, organizations would sometimes sacrifice profits for longer-term benefit, as in the SWB project.

In the most common medium-tech projects the immediate benefits organizations are looking for are appropriate profits and product line diversification. However, in many cases organizations are also expecting to gain higher diversification, increased capabilities, and other long-term benefits. In both the MDL and BIS projects, for example, upper management were looking to diversify their product portfolios. In the FBL case (the semiconductor plant) the perceived benefit was gaining the required experience to enable the organization to compete subsequently in additional, more complex bids. In the LBD project the goal was to establish strong ties with the customer and become his primary source of development in this line of work. Its manager expressed it as follows: "*We need this customer. He is big and reliable, and good relationships with him will serve us in many ways, some are still not known at this time.*"

Many high-tech projects are initiated for reasons beyond immediate profit. High-tech project organizations, in the long run, are planning new generations of products or adding new product lines. They hope to enter new markets, gain command of a new technology, and gather substantial reputation. All these can be seen as ways of creating new opportunities for the organization—ones that are beyond short-term profit. For example the BAT project's 100% overruns seemed at first to be money lost, but the product eventually generated from the project later became one of the most profitable in the organization's history—as one of its managers said: "*it was all worth it!*" And, as in occasional cases, the GWI project was initiated with a loss in mind, but it enabled the organization to enter a unique product sector.

Obviously, the risks are greater in super-high-tech projects, but so are the opportunities, many of which will have longer-term impacts. Exploiting revolutionary ideas and building not-yet-existing technologies, successful projects in this category can create leapfrog advantages for the performing organization, typically in the long run. In the two cases we studied, the products produced were considered breakthroughs—ones that did not exist before, and which could bring enormous benefits to the initiating organization over many years. Such projects can enable the organization to seize control in areas that were only theoretical so far. For example, the ABR project was seen as a breakthrough of this nature, and described by senior management as, "*… really first of its kind in the world. It explores the theoretical boundaries of mathematics, and proves things that were previously only imaginable in theory. With this technology, we will be able to do many additional things in the future.*" The benefits characterizing such projects are leapfrogging, breakthroughs and long run leadership.

Quantitative analysis: supporting case study results

Using evidence from the literature, as well as our own observations during the qualitative part, we developed a list of thirteen specific measures with which project success could be assessed. This list is described in the right side of Table 3, and it also includes a fourteenth measure–assessment of overall project success. Our goal during the quantitative part was to test the behaviour of these measures in our second database of 127 projects. Specifically, we asked the following questions:

1 How would these measures be assessed for each project, and what is the relationship between the measures?

2 Can they be grouped into major success dimensions?

3 How would such dimensions vary with time and across different levels of project uncertainty?

Appendix B includes the detailed description of our analysis, which included correlation coefficients between the fourteen success measures (Table 5), and the results of a principal components factor analysis (Table 6), which we performed to see if the thirteen initial measures could be grouped into major subgroups. The factor analysis resulted in four groups of measures as described on the left side of Table 3.

Table 3. Emerged four success dimensions

Success dimension	Measures
1. Project efficiency	Meeting schedule goal
	Meeting budget goal
2. Impact on the customer	Meeting functional performance
	Meeting technical specifications
	Fulfilling customer needs
	Solving a customer's problem
	The customer is using the product
	Customer satisfaction
3. Business success	Commercial success
	Creating a large market share
4. Preparing for the future	Creating a new market
	Creating a new product line
	Developing a new technology

These results confirmed our observations during the qualitative part, namely, the existence of four distinct success assessment dimensions, rather than the three hypothesized at the beginning of the study. The first dimension includes only two measures: meeting schedule, and budget goals, and was titled as "Project Efficiency." The second dimension includes meeting functional requirements, meeting technical specifications, fulfilling customer needs, solving a customer's problem, customer using of product, and customer satisfaction. This dimension can clearly be related to the customer, and we titled it "Impact on the Customer." The third dimension includes the measures of commercial success and creation of a large market share, and was titled "Business Success." And finally, the fourth dimension includes the measures of new market creation, new product line creation, and new technology development. Since this measure is clearly related to the future, we titled it "Preparing for the Future."

This analysis revealed at least two notable points.

- The "Project Efficiency" dimension only includes two of the traditional three measures of time, budget, and performance. As can be seen in Table 3, meeting functional performance, and meeting technical specifications are part of the second dimension, which relates to the customer.
- The impact on the performing organization can further be divided into two distinct dimensions—one relates to the shorter-term business results, and the other to the preparation for the future, as was found earlier in the case study portion.

Projects at the higher end of the uncertainty dimension… build new capabilities and create opportunities for the future

We have also assessed how each of the four dimensions may vary with technological uncertainty. The detailed results are also included in Table 7, including descriptive statistics of the importance project managers assigned to each of the dimensions, for each project type, and analysis of variance results. We found that the importance of project success dimensions clearly varies with technological uncertainty. Specifically, the importance of meeting time and budget constraints is reduced with increased uncertainty, while the impact the project has on the customer increases when moving from low tech projects into projects of higher uncertainty. The most notable increase can be observed for the fourth dimension of "preparing for the future," which strongly increases with technological uncertainty. This result emphasizes the difference between lower and higher technology projects, with projects at the higher end of the uncertainty dimension being more likely enacted to build new capabilities and create opportunities for the future.

Discussion and implications

The purpose of this research was to develop a conceptual framework for the assessment of project success and to identify the major dimensions with which to measure success in various projects. We were also interested in seeing how different success dimensions would change with different project types. Since success is such a broad and complex concept, we used a combination of two research methods and two data sets. The major implications and contributions of our study can be summarized as follows.

First, while many previous studies have been based on traditional thinking, focusing on meeting time, budget, and performance goals, we approached this study with the premise that projects are part of the strategic activity of the organization, and they must be executed with its short- and long-term objectives in mind. Few project management studies have used this kind of approach, most being focused on the operational view, which suggests that projects should be judged by the way they were executed. Furthermore, according to our approach, project managers should act strategically, with their activities focused on business needs and on creating competitive advantage with winning products. Thus assessing project success would relate to both parts—performance during execution, as well as to success of the end result. With this mindset we do not distinguish, as do past studies, between *project* success and *product* success—we see both parts of the same framework. The concepts we have developed in this study provide such a framework. This framework could be helpful not only to all parties—project managers and teams, and to top management, but also throughout the entire life cycle of the project—selection, definition, and execution.

The second contribution of this study is in identifying the specific major dimensions for the assessment of project success. As we have seen, project success is a multi-dimensional concept, and it cannot be assessed on a single- or even two-dimensional measure. A project may provide an efficient solution to a customer requirements, yet be considered as a failure by the performing organization in terms of business success. Some projects may seem successful in the short-term, but turn out to be less so in the long run—and obviously vice versa. Indeed, a long time may pass before success can be fully evaluated, or until initial expectations are met. Our study shows that to compound for these complexities, project success assessment should consider at least four major dimensions. While additional dimensions may be relevant in some cases, the generalization of our findings would view the four major dimensions as follows:

Success dimension 1—project efficiency (meeting constraints)

This is a short-term dimension expressing the efficiency with which the project has been managed. It simply tells us how did the project meet its resources constraint—was it finished on time, and within the specified budget? This is the immediate dimension with which a project can be assessed—even during execution. Although success in this dimension may indicate a well-managed, efficient project, it may not suggest that this project will be considered a success in the long run, and benefit the organization later. However, with increased competition and shorter product life cycles, time to market, (time from initial concept to market introduction) becomes a critical competitive component. Thus success in this dimension will often help the company's business, and so enhancing a project's efficiency and leading to early product introduction may be adding to product competitiveness.

Some organizations may find it beneficial to consider additional measures of efficiency. For example, the number of engineering changes before final design release, the costs of materials and tooling, efficiency and yield of production ramp, etc. Other measures may involve efficiency of purchasing (time to get orders out and materials in), reliability (inverse number of prototype failures), safety measures (number of accidents or injuries) etc. However it is worth remembering that all these measures relate only to the successful implementation of project execution—they do not necessarily mean product success.

Success dimension 2—impact on the customer

The second dimension relates to the customer, addressing the importance placed on customer requirements and on meeting their needs. As our results indicate, meeting performance measures, functional requirements, and technical specifications are all part of this second dimension, and not, as previously assumed, part of meeting the project's efficiency dimension. Meeting performance has clearly a great impact on the customers who will, above all, assess how the product is serving their needs. Within this framework, meeting performance objectives is one of the central elements. From the developer's point of view, this dimension also includes the level of customer satisfaction, the extent to which the customer is using the product, and whether the customer is willing to come back for future generations of the product or for another project. Obviously, the impact on the customer is one of the most important dimensions in assessing project success.

Success dimension 3—business and direct success

The third dimension addresses the immediate and direct impact the project may have on the organization. In the business context, did it provide sales, income, and profits as expected? Did it help increase business results and gain market share? This dimension may also apply to projects not aimed at building new products. Internal reengineering projects,[29] or the development of new manufacturing processes, are examples of this sort, and this is the dimension in which such an assessment should be made. It will include measures of new process performing time, cycle time, yield, and quality, all of which assess the project's direct impact on the performing organization.

In a wider sense, this dimension may also apply to non-profit organizations. A government organization, such as the taxation department, for example, which plans to improve its services by shortening processes and serving more customers in less time, may initiate a project or process reengineering. Similarly, a fund raising organization would want to measure its success in implementing a new campaign. The effectiveness of these projects will be measured with the third dimension, which would assess the direct impact that the project had on the organization.

Success dimension 4—preparing for the future

The fourth dimension addresses the issue of preparing the organizational and technological infrastructure for the future. It is the longest-term dimension, involving questions of how organisations prepare for future opportunities. Did we explore new opportunities for further markets, ideas, innovations, and products? Did we build new skills that may be needed in the future? Did we develop enough new technologies and core competencies? And are we prepared to make a change, and create the future in our industry, or are we able to adapt quickly to external challenges, unexpected moves of competitors, or market and technology surprises?

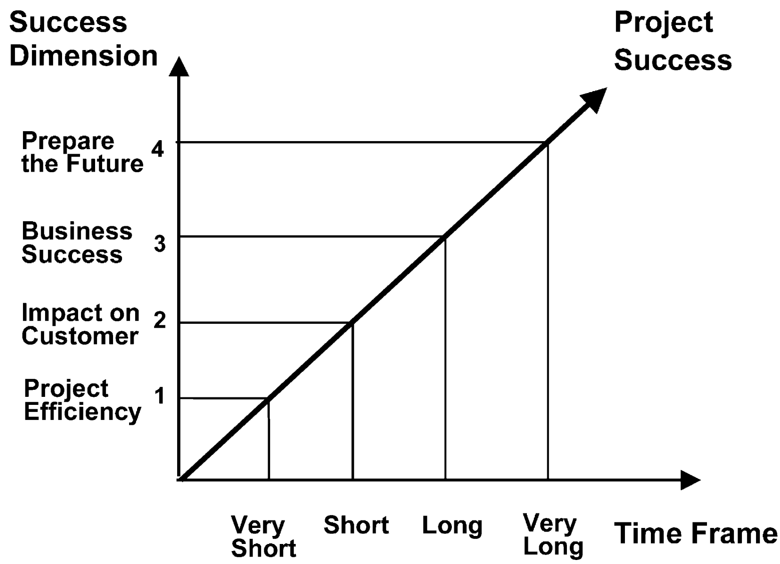

Figure 1. Time frame of success dimensions

Different dimensions are more important at different times with respect to the moment of project completion

The third contribution of our study is in observing the dynamics of the success assessment framework and the changing nature of success measurement with its short- and long-term implications. Our interviews have shown that:

- The first dimension can be assessed only in the very short-term, during a project's execution and immediately after its completion.
- The second dimension can be assessed after a short time, when the project has been delivered to the customer, and the customer is using it. Customer satisfaction can be assessed within a few months of the moment of purchase.
- The third dimension, direct success, can only be assessed after a significant level of sales has been achieved—usually one or two years.
- The fourth dimension can only be assessed after a longer time, of probably two, three, or five years.

The conceptual time frames of the different success dimensions are described in Figure 1.

The relative importance of each of these dimensions is time dependent. Different dimensions are more important at different times with respect to the moment of project completion. As many of our interviewees have indicated, in the short-term and particularly during project execution, the most important dimension is project efficiency: in fact, it is the only one that can be assessed or measured at this time. Meeting resource constraints, measuring deviations from plans, and looking at various efficiency measures, may be the best way to monitor the project progress and control its course. Once the project is completed, however, the importance of this dimension starts to decline. As time goes by, it matters less and less whether the project met its original resources constraints—in most cases, after about one year, it is completely irrelevant. In contrast, after project completion, the second dimension—impact on the customer and customer satisfaction—becomes more relevant. The third dimension, business and direct success, can only be felt later. It takes usually a year or two until a new product starts to bring in profit or establish market share. And finally, preparing for the future can only be recognized and assessed much later. The long-term benefits from projects will affect the organization only after three or even five years. The relative importance of the four dimensions as a function of time is described in Figure 2.

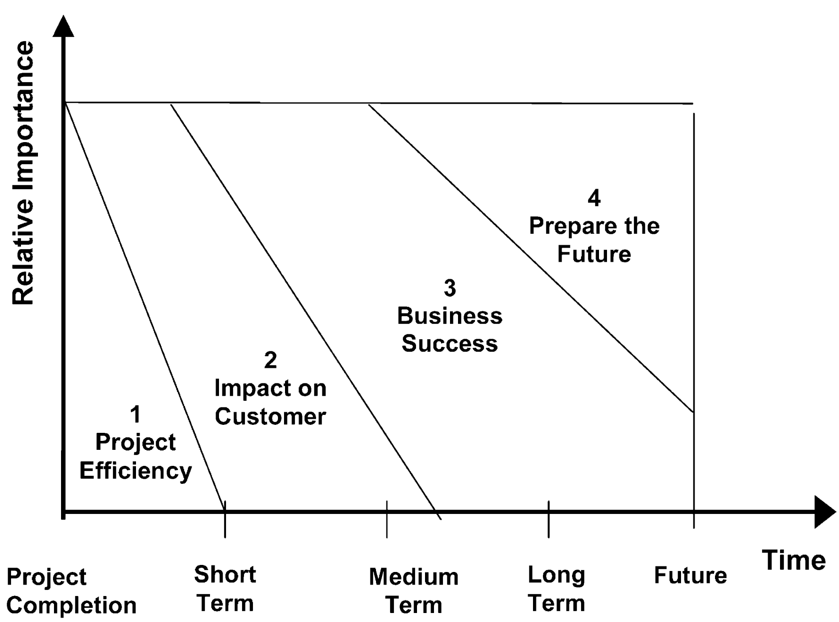

Figure 2. Relative importance of success dimensions is time dependent

Finally this study has demonstrated that project success dimensions depend on project type. In contrast to previous studies which distinguished projects by goals (e.g., new product development, re-organization), we have used levels of technological uncertainty to distinguish between projects, and shown that the level of project technological uncertainty affects the importance of success dimensions. For the lower-uncertainty projects, efficiency may seem relevant and important, but such projects are not launched to create new technology or infrastructure in the long-term. Their immediate success relies on meeting time and budget goals, and their expected profits are usually determined in advance. The importance of these measures changes when technological uncertainty is higher. For such projects, poor performance in the short-term and even limited business success may be compensated by long-term benefit, such as creating new markets or expertise in new technology, and preparing the infrastructure for additional products for the future. And clearly, customer satisfaction and business success are important to all types. The relative importance of the four dimensions as they are distributed among various levels of technological uncertainty is described in Figure 3.

Our study may have significant implications for managers and organizations at large. We suggest that management should adopt a multi-dimensional approach to the concept of project success. It should try to specify project objectives as early as possible, and focus managers and team member attention on the project's expected results. If organizations are planning to achieve some strategic benefits from a project, they should incorporate these benefits as predetermined measures to assess project success. They must look both at the short-term and the long-term benefits of the project, judging its performance on the outcomes of all dimensions. They should also weigh different success dimensions differently, according to different project types. For example, a high-tech project will be mainly assessed on its business and long-term effects, rather than the short-term concerns of meeting time and budget performance. Conversely, it is very

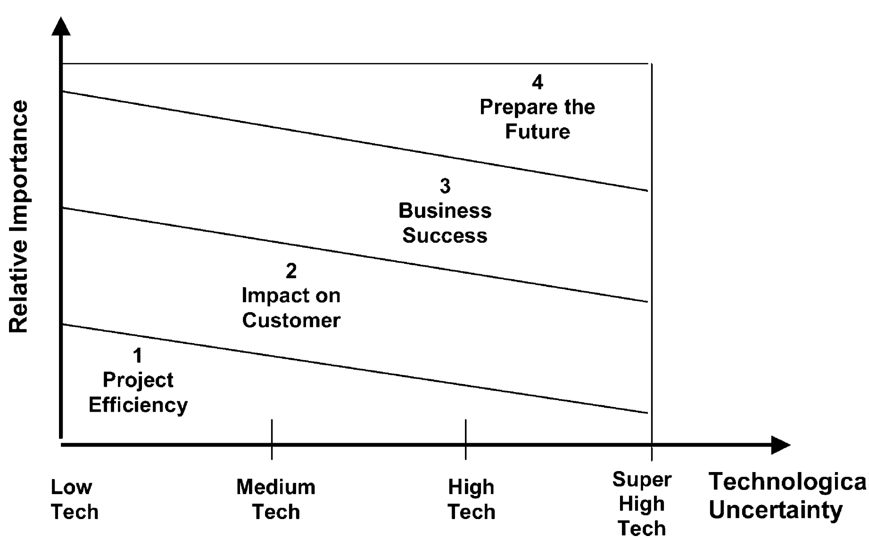

Figure 3. Relative importance of success dimensions is project-type dependent

unlikely that a low-tech construction project will help the organization to develop new technology or create new opportunity—but it must be completed on time and within budget, to ensure the predetermined level of profits is achieved. Management must identify success measures prior to project initiation, and commit the organization's resources to it. Table 4 provides a description of the likely success dimensions for different project types and the typical expectations from each dimension.

Table 4. Description of success dimensions for various project types

Success dimension	Project type: level of technological uncertainty			
	Low-tech	**Medium-tech**	**High-tech**	**Super high-tech**
Project efficiency	Critical	Important	Overruns acceptable	Overruns most likely
Impact on customer	Standard product	Functional product, added value	Significantly improved capabilities	Quantum leap in effectiveness
Business success	Reasonable profit	Profit, return on investment	High profits, market share	High, but may come later Market leader
Preparing for the future	Almost none	Gain additional capabilities	New product line, new markets	Leadership—core and future technologies

Organizations… should weigh different success dimensions differently, according to project type

Project success planning should become an integrated portion of organizations' strategic thinking and strategic management. Project success dimensions should be determined as part of the strategic goals of the organization, and prior to project initiation, and should be incorporated into the top-management decision-making upon project initiation. Managers and project teams will have to be evaluated based on the performance of all dimensions, rather than only the short-term ones, and during project execution, project teams will be attuned to achieving these various short and long run dimensions. Each project would thus be focused on its specific dimensions: short-run efficiency for low uncertainty projects, or longer term opportunities for high uncertainty projects, where the organization may be ready to suffer over-runs and even less immediate business success, to enjoy far-reaching benefits and infrastructure for the future. This framework will help create the business perspective for project management, and will hopefully lead to projects being more strategically managed in the future.

It is important to note, however, that the framework developed in this research may not be universal, and might not fit all kinds of projects. The final value added of our study may be the awareness that project and top managers may develop towards the need to identify specific success dimensions for each individual project according to its goals, technology, business model, strategy, and markets. In essence, projects must be part of the strategic thinking and the assessment of their success must be aligned with such thinking.

Conclusion

Project management is a multi-faceted, multi-dimensional concept. To assess a project's success, one needs to understand the distinct dimensions and address different timeframes—from very short to very long. Each project has its own specific dimensions, and their relevant importance will vary.

Additional studies are needed to further establish the validity of the multi-dimensional concept, and to address additional questions. For example, as we know, success of a project means different things to different people, and so the point of view of the assessor should also be a variable for additional studies. We should be able to measure the importance that various parties are assigning to different success dimensions. Similarly, additional typologies may be considered—for example, does market uncertainty or project complexity have an impact on assessing its success—and some of these questions will most likely be the subject of subsequent studies. However it is clear that both planning for and measuring project success can be complex and subtle matters, as well as being of strategic importance.

Appendix A.

Note on research methodology

As described in the text, we chose to perform a two-stage study which involved a combination of qualitative and quantitative methods and two data sets. The first stage involved a case study research on 15 projects and the second a statistical analysis study on 127 projects. The fifteen case study projects were part of the larger sample of 127 projects, although this seemed to add only an insignificant bias to our findings.

All the projects studied were either completed within the recent year, or were in their last quarter before completion. Data collection was performed in Israel in the mid 1990s in firms operating in the military or the commercial market. The projects studied were in a wide variety of industries (e.g. electronics, aerospace, computers, chemical), and had significant ranges in budget (from $40,000 to $2.5B), project duration (from 3 months to 12 years), markets served, and project purpose.

Caution should be exercised in generalizing the results of this study, since the projects studied here were not randomly selected and may not be representative of all projects in general, or in other parts of the world. However, Israeli industry is closely coupled to Western culture, either in Europe or the US, and many of the organizations involved in our study are subsidiaries or partners of American companies: there is no reason to suspect that the study was biased in any significant way.

Data collection for the first part (case study) was multi-faceted, and included in-depth interviews, conducted by teams of two or three, involving at least three people from each project. In addition to the project managers we interviewed members of the project management team, functional team members involved in the project, project managers' supervisors, and customer representatives. To strengthen our research validity, (and as is often required by qualitative studies) we insisted that investigators interact with their subjects on their own turf, namely at the project site

Interviews involved open questions on the project mission and objectives, the motivation and the expectations from the project of the different parties involved: the contractor, customer, and user. Data were also obtained on success of the project as perceived by the different parties, and as compared to their initial expectations. Finally, we obtained data on specific goals and achievements such as meeting time and budget goals, meeting technical and functional requirements, fulfilling customer needs, and achieving various business-related results.

The qualitative case data of this study was processed through a method of cross-case comparative analysis, and, as required by this method, was highly iterative, with continuous comparison of data and theory. This method as described by Eisenhardt[28] (p. 533) "forces investigators to look beyond initial impressions and see evidence through multiple lenses."

Based on the experience gained in previous studies, we prepared for the case study part of our research a list of thirteen specific measures to account for the interests of various parties (see the right side of Table 3). This list formed the basis for a structured questionnaire used during the quantitative part. During this phase respondents were asked to rate the importance they attached to each of these measures on a seven-point assessment scale from "very low" to "very high." They were also asked to use a seven-point scale to rate the degree of success they perceived in each of these thirteen measures, as well as in a fourteenth measure, an assessment of the project overall success.

Data analysis in this part involved calculating the descriptive statistics and Pearson Correlation coefficients between the fourteen measures we studied. We also performed a factor analysis on these measures to identify whether they could be clustered as groups of typical measures, strongly related to each other, and thus can be described as separate success dimensions. These statistics are presented in Appendix B.

Appendix B.

Appendix B contains Tables 5–7.

Table 5. Correlation coefficients of success measures[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Meeting functional performance													
2 Meeting technical specifications	0.439***												
3 Meeting schedule goal	0.277**	0.287**											
4 Meeting budget goal	0.310***	0.312***	0.604***										
5 Fulfilling customer needs	0.470***	0.340***	0.128 a	0.107									
6 Solving a customer's problem	0.256**	0.522	0.071	0.097	0.262**								
7 The customer is using the product	0.249**	0.240**	0.255**	0.208*	0.217*	0.379***							
8 Customer satisfaction	0.527***	0.482***	0.423***	0.408***	0.595***	0.288**	0.345***						
9 Commercial success	0.075	0.096	0.260**	0.225*	0.010	0.154 a	0.203*	0.246*					
10 Creating a large market share	−0.164 a	−0.116	−0.023	−0.111	−0.102	0.082	0.010	−0.053	0.412***				
11 Creating a new market	−0.101	−0.066	0.108	0.017	0.043	0.201*	−0.065	0.119	0.349***	0.644***			
12 Creating a new product line	−0.023	−0.040	−0.036	−0.042	0.054	0.242**	−0.069	0.070	0.156 a	0.401***	0.576***		
13 Developing a new technology	−0.064	−0.237**	−0.047	0.001	−0.166	0.053	−0.261**	−0.066	0.040	0.210*	0.294**	0.495***	
14 Total success	0.339***	0.357***	0.422***	0.373***	0.390***	0.370***	0.432***	0.634***	0.341***	−0.063	0.794	−0.018	−0.061

[a] $p<0.1$, $*p<0.05$, $**p<0.01$, $***p<0.001$.

Table 6. Factor analysis results[a]

Success Measure	Factor 1	Factor 2	Factor 3	Factor 4
Meeting functional performance	**0.694**	0.401	−0.279	0.123
Meeting technical specifications	**0.572**	0.401	−0.161	−0.105
Meeting schedule goal	0.115	**0.872**	0.169	−0.030
Meeting budget goal	0.227	**0.834**	0.017	0.060
Fulfilling customer needs	**0.727**	0.058	0.019	−0.042
Solving a customer's problem	**0.555**	−0.161	0.174	0.406
The customer is using the product	**0.499**	−0.024	0.492	−0.345
Customer satisfaction	**0.678**	0.431	0.195	−0.011
Commercial success	0.002	0.386	**0.730**	−0.038
Creating a large market share	−0.055	−0.158	**0.701**	0.422
Creating a new market	−0.008	0.125	0.550	**0.650**
Creating a new product line	0.096	−0.017	0.146	**0.825**
Developing a new technology	−0.085	0.019	−0.118	**0.822**
Eigenvalue	3.435	1.456	1.239	2.575
Variance percentage explained	24.6	11.2	9.5	19.8

[a] Note: Factors with Eigenvalues greater than 1.0 were rotated using a varimax solution.

Table 7. Importance of success dimensions for various project types[a]

Success dimension	Level of technological uncertainty (# of cases)				ANOVA	
	Low-tech (28) Mean	Medium-tech (44) Mean	High-tech (45) Mean	Super high-tech (10) Mean		
	S.D.	S.D.	S.D.	S.D.	df	F
Project Efficiency	5.44	5.32	5.35	4.80	3, 112	0.60
	1.47	1.20	1.30	1.34		
Impact on the Customer	5.60	6.28	6.23	6.21	3, 78	2.97*
	1.11	0.67	0.77	0.68		
Business Success	5.57	5.13	5.61	5.56	3, 85	1.23
	1.33	1.62	1.48	1.37		
Preparing for the Future	2.73	4.34	5.36	5.33	3, 87	10.19**
	1.87	1.53	1.09	1.36		

[a] *$p<0.05$, **$p<0.01$.

References

1. A. Belout, Effects of human resource management on project effectiveness and success: toward a new conceptual frame-

work, *International Journal of Project Management* **16**, 21–26 (1998).
2. M. Freeman and P. Beale, Measuring project success, *Project Management Journal* **1**, 8–17 (1992).
3. F. Guterl, Design case history: Apple's Macintosh, *IEEE Spectrum* 34–43 (1984).
4. P. S. Goodman and J. M. Pennings, *New Perspectives on Organizational Effectiveness*, Jossey-Bass, San Francisco (1977).
5. K. S. Cameron, Effectiveness as paradox: consensus and conflict in conceptions of organizational effectiveness, *Management Science* **32**, 539–553 (1986).
6. D. Dvir, E. Segev and A. J. Shenhar, Technology's varying impact on the success of strategic business units within the Miles and Snow typology, *Strategic Management Journal* **14**, 155–162 (1993).
7. D. J. Lemak, W. W. Austin, J. C. Montgomery and R. Reed, The ABCs of customer-centred performance measures, *SAM Advanced Management Journal* **61**, 4–13 (1996).
8. R. S. Kaplan and D. P. Norton, *The Balanced Scorecard*, Harvard Business School Press, Boston (1996).
9. L. Edvinsson and M. S. Malone, *Intellectual Capital*, HarperCollins, New York (1997).
10. D. Dvir and A. J. Shenhar, Measuring the success of technology-based strategic business units, *Engineering Management Journal* **4**, 33–38 (1992).
11. A. C. Maltz, *Defining and Measuring Organizational Success: A Multidimensional Model*, Stevens Institute of Technology, Hoboken NJ (2000).
12. M. M. Menke, Managing R&D for competitive advantage, *Research Technology Management* **40**, 40–42 (1997).
13. C. D. Ittner and D. F. Larcker, Product development cycle time and organizational performance, *Journal of Marketing Research* **XXXIV**, 13–23 (1997).
14. R. Atkinson, Project management: cost, time and quality, two best guesses and a phenomenon. Its time to accept other success criteria, *International Journal of Project Management* **17**, 337–342 (1999).
15. C. S. Lim and M. Z. Mohamed, Criteria of project success: an exploratory re-examination, *International Journal of Project Management* **17**, 243–248 (1999).
16. T. A. DeCotiis and L. Dyer, Defining and measuring project performance, *Research Management* **16**, 17–22 (1979).
17. B. N. Baker and D. Fisher, Factors affecting project success, in D. I. Cleland and W. K. King (eds), *Project Management Handbook*, Van Nostrand, New York (1988).
18. J. K. Pinto and S. J. Mantel, The causes of project failure, *IEEE Transactions on Engineering Management* **EM-37**, 269–276 (1990).
19. R. G. Cooper and E. J. Kleinschmidt, New products: what separates winners from losers, *Journal of Product Innovation Management* **4**, 169–184 (1987).

20. D. Baccarini, The logical framework method for defining project success. *Project Management Journal* 25-32 (1999).
21. P. Gardiner and K. Stewart, Revisiting the golden triangle of cost, time and quality: the role of NPV in project control success and failure, *International Journal of Project Management* **18**, 251–256 (2000).
22. A. J. Shenhar, M. Poli and T. Lechler, A new framework for strategic project management, in T. Khalil (ed.), *Management of Technology VIII*, University of Miami, Miami, FL (2000).
23. A. J. Shenhar, One size does not fit all projects: exploring classical contingency domains, *Management Science* **47**(3), 394–414 (2001).
24. A. J. Shenhar and D. Dvir, Toward a typological theory of project management, *Research Policy* **25**, 607–632 (1996).
25. D. Dvir, S. Lipovetsky, A. J. Shenhar and A. Tishler, In search of project classification: a non-universal approach to project success factors, *Research Policy* **27**, 915–935 (1998).
26. R. Drazin and A. H. Van de Ven, Alternative forms of fit in contingency theory, *Administrative Science Quarterly* **30**, 514–539 (1985).
27. R. K. Yin, *Case Study Research: Design and Methods*, Sage, Beverly Hills, CA (1984).
28. K. M. Eisenhardt, Building theories from case study research, *Academy of Management Review* **14**, 532–550 (1989).
29. M. Hammer and J. Champy, *Reengineering the Corporation*, Harper Business, New York (1993).