Improving PM: Linking Success Criteria to Project Type

A paper presented to the Southern Alberta Chapter, Project Management Institute, Symposium "Creating Canadian Advantage through Project Management", Calgary, May 1996.

Aaron J. Shenhar, Professor of Technology Management and James J. Renier Visiting Chair, Center for the Development of Technological Leadership, University of Minnesota, MN

R. Max Wideman, Fellow PMI, AEW Services, Vancouver, BC

Introduction

The purpose of modern project management is to conduct a successful project. If the meaning of success was generally agreed, and this could be related to a satisfactory project typology, this relationship would significantly help those responsible for formulating projects. It would be especially constructive for those contemplating projects for the first time.

Historically, project management responded to the need to create civil and building works of some complexity. In the 1950s project management achieved greater prominence when the planning and control concepts were applied to much more complex projects such as those of the US navy and, subsequently, NASA space projects. In the last couple of decades, project management has emerged as a business process tool with broad application in the corporate world. It is seen as the management approach of choice for dealing with an ever-shifting business environment, rapid technological change, and the vicissitudes of stiff global competition.

Today, it is even more of a truism that "Projects come in all shapes and sizes!" We have a much improved understanding of project management tools and techniques, and this decade has focused on the importance of the behavioral and organizational aspects of projects. Yet relatively little focus has been given to the ***meaning*** of success. Even less, one suspects, are measurable success criteria identified and tailored to the type of project at the time of formulation.

In days gone by, the old axiom "On time, on budget" and (for the more advanced thinkers) "conformance to requirements" was deemed the mark of success. Yet the literature is rife with examples of projects that were either completed late or finished over budget, and were still considered successful. Less well documented are all those projects that were completed on time and within budget but stand as a monument to ineptitude.

Clearly, the old adage of on time, on budget and (even) conformance to requirements are not, of themselves, satisfactory success criteria. The reality is that the notion of "success", and "project success" in particular, is a much more complex issue. The purpose of this paper is to demonstrate the most important dimensions of success and how these relate to different types of project.

What is Success?

As noted in the Introduction, success is more than just "on time, on budget and conformance to requirements". Success means (gaining) advantage, superiority, victory, accomplishment, achievement, added value. But all of these are perceptions, so how can they be related to project work?.

Over the years, this intriguing question has been studied by a number of project management authors such as Ashley, Lurie, and Jaselskis[1]; Baker, Murphy and Fisher[2]; De Wit[3]; Dvir and Shenhar[4]; Hayfield[5]; Morris and Hough[6]; Pinto and Slevin[7] ; and others.

For example, in 1988 Pinto and Slevin concluded from their research work that "Project success is a complex and often illusory construct, but nonetheless it is of crucial importance to effective project implementation" and "Project success is suggested to have two major components: issues dealing with the project itself and issues dealing with the client." In addition, Pinto and Slevin stressed "... the necessity of developing an adequate program in terms of knowing when to determine project success."[8]

The Project Management Institute attempted to capture this concept in 1987 when it defined project management as the art of directing resources to meet objectives, but included the goal of "participant satisfaction".[9] In PMI's latest version of A Guide to the Project Management Body of Knowledge (Exposure Draft - 1994) the term "participant" has been broadened by the use of the word "stakeholder".[10] In the Draft, "stakeholder" has been given a very broad definition, namely: "Individuals and organizations who are involved in or may be affected by project activities." Presumably, that includes not just the project activities but the facility or product resulting from those activities.

Indeed, as long ago as 1980, Burnett and Youker, in analyzing the project environment, identified a process called "stakeholder mapping". That is, mapping out which people or groups have a stake in the project's success or failure.[11] These people ranged from the project's owners and sponsors to those who might be marginally (yet critically) affected by the project.

If a project is to be perceived as successful, then its stakeholders must be satisfied. Since this encompasses a wide range of people, they may not all be equally satisfied but at least they should be satisfied in some degree, or in the majority. For public or competitive projects, this is a major consideration. It is typically the driving force behind a strenuous public relations effort and an imaginative public launch and promotion of the facility or product upon project completion.

Scope of Recently-Completed Study

Projects are launched for a variety of reasons: to construct buildings or infra-structure, to establish manufacturing processes, to upgrade existing products, or to build defense related systems for example. No matter what the motivation for the project, the question of project success is strongly linked to the organization's effectiveness and its well-being in the long run. Yet, there is still no generally agreed framework with which project success is being measured and assessed. Indeed, the conceptual understanding of the notion of project success is still in its infancy.

In a recent study, Shenhar, Dvir and Levy have developed a universal framework for the assessment of project success.[12] In this view, ***project success is seen as a strategic***

management concept where project efforts must be aligned with the strategic long-term goals of the organization. The intent is to establish appropriate expectations of both top management and the project team prior to project initiation. These expectations then provide a baseline for both the project launch decision and the inevitable trade-off decisions required of project management during the project. Surprisingly, a documented baseline such as this is frequently missing from most projects.

From a large and detailed project database, two data sets were collected in two separate phases. In the first phase, sixteen projects were subjected to a multiple case-study qualitative approach focusing on the dynamics within single settings (Eisenhardt[13]; Yin[14]). In the second, detailed questionnaires were sent to project managers and quantitative data collected on 127 projects. The industries concerned included electronics, computers, mechanics, aerospace, chemical and construction. They also involved various technologies such as electronics, computing, materials, mechanical, chemical and bio-chemical, optical and electro-optical, semi-conductors, aeronautical, and construction. Projects ranged in value from $40,000 to $2.5 billion, and in duration from three months to twelve years.

All projects studied were classified by their managers according to their initial level of technological uncertainty (Shenhar[15]). Information was also collected on the project mission and objectives, the motivation for, and the expectations from, each project. The perceptions of success from the perspectives of the contractor, the customer and the user was also obtained and compared to their original expectations..

Dimensions of Project Success

Initially, thirteen separate success criteria were identified, plus an overall project success assessment. These included: functional performance; meeting technical specifications; meeting schedule goal; meeting budget; fulfilling customer needs; solving a customer's problem; the extent to which the customer is using the product; customer satisfaction; commercial success; creating a larger market share; creating a new market, creating a new product line; and developing a new technology.

Pearson Correlation coefficients between all fourteen measures were determined and studied. A not surprising result was the high correlation between the measure of total success and customer satisfaction. A factor analysis was then performed to ascertain the possibility of distinct success dimensions by which managers perceived project success. This revealed four distinct primary categories (Principal Success Criteria) as seen at project completion. These are described as follows.

1. **Internal Project Objectives (efficiency during the project)**
   - How successful was the project team in meeting its schedule objectives?
   - How successful was the project team in meeting its budget objectives?
   - How successful was the project team in managing any other resource constraints?

2. **Benefit to Customer (effectiveness in the short term)**
   - Did the product meet its specified requirements of functional performance and technical standards?
   - What was the project's impact on the customer, and what did the customer gain?

- Does the customer actually use the product, and are they satisfied with it?
- Does the project's product fulfill the customer's needs, and/or solve the problem?

3. Direct Contribution (in the medium term)

- Has the new or modified product become an immediate business and/or commercial success, has it enhanced immediate revenue and profits?
- Has it created a larger market share?

4. Future Opportunity (in the long term)

- Has the project created new opportunities for the future, has it contributed to positioning the organization consistent with its vision, goals?
- Has it created a new market or new product potential, or assisted in developing a new technology?
- Has it contributed additional capabilities or competencies to the organization?

These Principal Success Criteria are summarized in Table 1. A cursory examination of these Principal Success Criteria reveals that they are clearly time-dependent. This time relationship is shown in Figure 1.

It is also not difficult to infer that, for a given project, its perception of success may change with time. This would depend on the elapsed time since project completion. For example, a project could have its principal focus on creating future opportunity (Category 4). Such a project is unlikely to be viewed as successful until such time as those opportunities have actually materialized.

It would be interesting to look at various industries to determine appropriate intervals corresponding to "Short", "Medium" and "Long" Term. Some sort of yardstick would also be needed for comparison between similar types of project. The duration of the project execution phases might provide such a yardstick.

Correlation with Type of Project

Here again we have some difficulty. Just as there is no generally agreed framework against which project success can be classified, there is equally no satisfactory framework for the classification of projects themselves. Typically, projects may be grouped by the standard industry or business sector, and its subsets, such as construction, consulting services, resource industries, or manufacturing. The problem with this grouping is that any industry may be involved with projects such as construction, that have a high degree of similarity with other industries also involved with construction projects. Alternatively, one industry may encompass projects ranging from, say, manufacturing to research and development, and these represent entirely different areas of project management application.

Clearly, the "industry sector" classification is unsuited to our purpose. Projects are essentially unique undertakings, and their range in objectives, size, complexity and variety of technological content is almost limitless. They are not, however, confined by industry boundaries. What is required, therefore, is a classification system that is independent of industry but brings together project management commonalities, while differentiating between areas of project management application.

Success Category	Measurable Success Criteria
Internal Project Objectives (Pre-completion)	- Meeting schedule - Within budget - Other resource constraints met
Benefit to Customer (Short term)	- Meeting functional performance - Meeting technical specifications & standards - Favorable impact on customer, customer's gain - Fulfilling customer's needs - Solving a customer's problem - Customer is using product - Customer expresses satisfaction
Direct Contribution (Medium term)	- Immediate business and/or commercial success - Immediate revenue and profits enhanced - Larger market share generated
Future Opportunity (Long term)	- Will create new opportunities for future - Will position customer competitively - Will create new market - Will assist in developing new technology - Has, or will, add capabilites and competencies

Table 1 – Principal Success Criteria

In January, 1995, Shenhar reported on his four-year study of the project database mentioned earlier.[16] Subsets of the database were used for more detailed examination to establish a project typology. In these, up to 100 parameters were identified and examined for relevance and suitability. The resulting recommendations are simple.[17]

The research postulates a two dimensional project typology consisting of project management scope versus technological uncertainty. Within this typology, the primary considerations which emerged from the research can be separated into identifiable subsets. Along the Project Management Scope dimension are three types; Assembly, System and Array. The Technological Uncertainty dimension was categorized into four types: Established, Mostly Established, Advanced, and Highly Advanced projects.

Each of these are described in the next section.

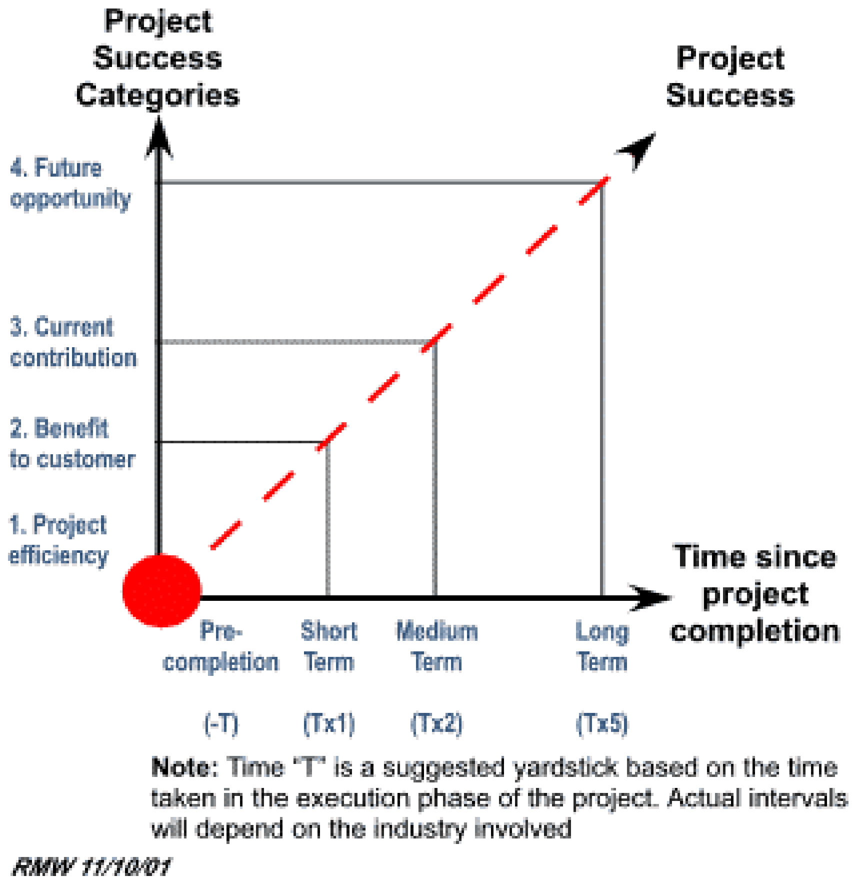

Figure 1 – Time Dependency of Project Success
(I.e. Success varies with time)

Project Classification System Description

The proposed Project Classification System is shown diagrammatically in Figure 2. Understanding the labels along each dimension of this figure is important.

The three levels of complexity are as follows.

Level 1 - Assembly. This represents a project consisting of a collection of components and modules combined into a single unit. A typical assembly may perform a well defined function within a larger system, thus constituting one of its subsystems. Alternatively, it can be an independent self-contained product that performs a single function of a limited scale. A computer's central processing unit, its display screen, or its printer are three separate examples of the former, while radios, washing machines or a single family home are examples of the latter.

Level 2 - System. This represents a project consisting of a complex collection of interactive elements and subsystems within a single product, jointly performing a wide range of independent functions to meet a specific operational mission or need. Examples include radar, computer work stations, any form of transportation vehicle, or multiple-use high-rise buildings.

Level 3 - Array. This represents a program, rather than a single project, where program is taken to mean a series of related projects designed to accomplish broad goals and to which the individual projects contribute. Often, arrays are dispersed over wide geographical areas, or over an extended period of time, and consist of a variety of project systems. Examples include any of a city's infrastructure, inter-airport airside control, or any of the national defense systems.

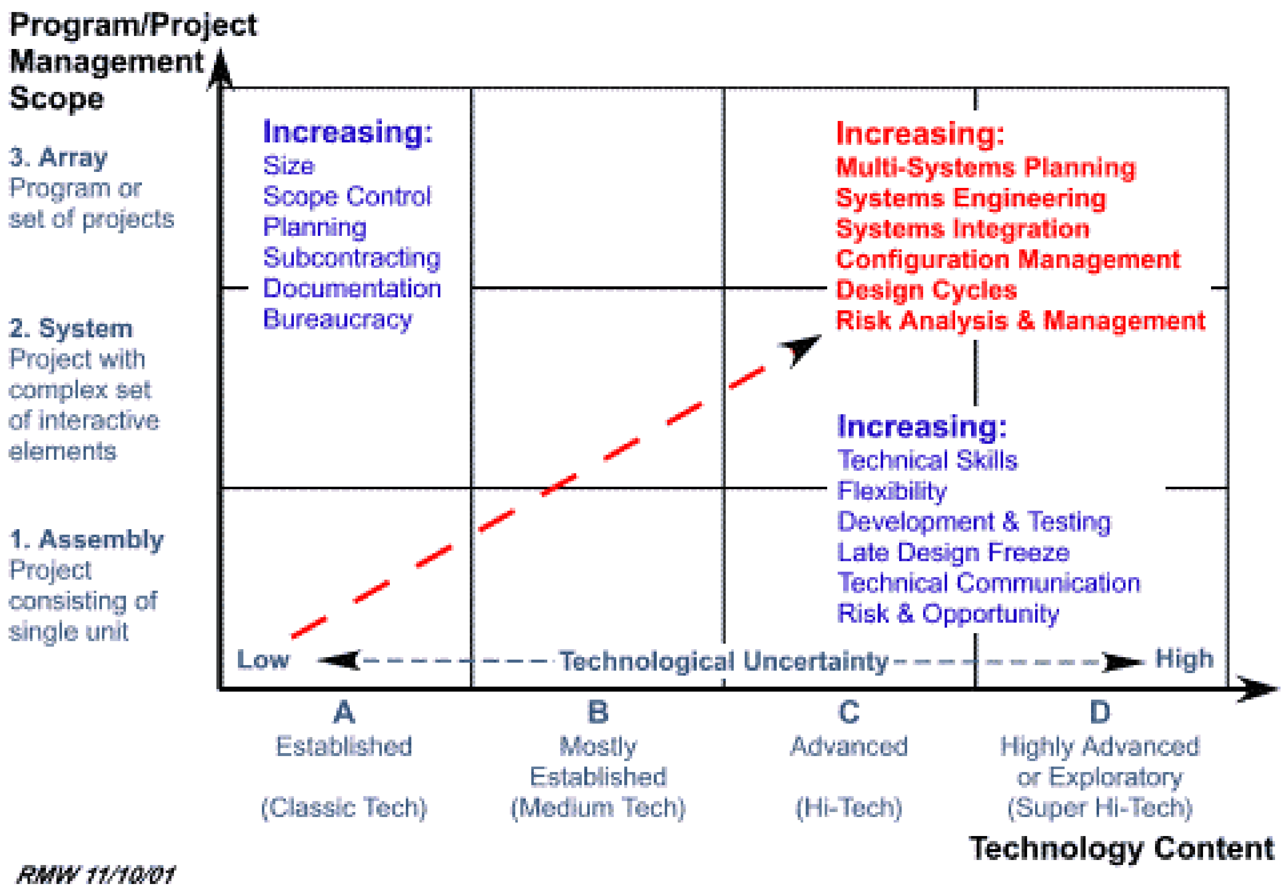

Figure 2 - 4x3 Classification Matrix

The four levels of Technological Uncertainty depend on the technology content of the project. The respective project types are as follows.

Type A - Established Technology. These projects rely on existing and well established base technologies to which all industry players have equal access. Although such projects may well be very large in scale, no new technology is employed at any stage. The majority of projects in the construction and road building industries fall into this category.

Type B - Mostly Established Technology. Often referred to as Medium-Tech, these projects are similar to Type A, but involve some new technology or feature. While the majority of the work has relatively low uncertainty, the new feature provides market advantage but also a higher degree of uncertainty. Examples include many industrial projects of incremental innovation, as well as improvements and modifications to existing products.

Type C - Advanced Technology. Often referred to as High-Tech projects, these are projects in which most of the technologies are employed together for the first time. However, the individual technologies already exist, having been developed prior to project initiation. Defense industry projects typically fall into this category.

Type D - Highly Advanced Technology. Such projects require exploratory development and may be referred to as Super High-Tech. They call for the incorporation of technologies which are not entirely existing, are emerging, or the solutions may even be unknown at the time of project initiation. Project execution therefore involves technology development, testing and selection from among alternatives. Research and development projects fall into this category.

From Figure 2 it will be noted that a number of variables may be associated with each dimension. Interestingly, when progressing along both dimensions simultaneously (i.e. diagonally) a third set of variables emerges, as is also shown in the figure.

Correlating Success with the Classification System

To test the proposition that project success varies with the type of project, a qualitative study was conducted. Sixteen projects were selected from the available database, three of them Established Technology; four Mostly Established Technology; seven High-Tech; and two Super-High-Tech. The study showed that almost all projects seemed to meet performance requirements.

Meeting resource constraints in the established technology projects was better than in the high-tech projects. In fact, overruns were almost intolerable in the established technology projects as this was perceived as critical to success. This did not mean that such projects did not suffer from overruns. Overruns in these projects were attributed to factors beyond the control of project management.

For example, this occurred in a University Construction project. The project suffered from a 20% schedule overrun due to a government-imposed restriction on the importation of construction workers. In contrast, in the high- and super-high-tech projects, overruns reached a much higher level, and in two cases almost 100%. Such overruns were always as a result of technical difficulties. They were, however, much more tolerated than in the lower technology types. Indeed, they were even perceived as most likely to happen in the super-high-tech projects.

A notable case was a new electronic and computing module. In this advanced project, the module was based on a concept that had not been tried before, as well as on several new technologies which had to be developed during the course of the project. The project took almost twice the time originally planned for, and it went through two cycles of resource planning and replanning. Yet, 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.

The nature of other success dimensions also varied with project type. The benefits customers gained from different types of project tend to increase with the technology uncertainty. However, the risk of shortcomings, or even failure, also increases.

To illustrate, established-technology projects (Type A) use existing means and well-practiced technology as in standard construction work. Usually, there are many contractors that can do the work and competition for the work is high. What the customer is interested in is an acceptable product to be used for traditional purposes. Study examples included the building of a regional office for a large utility company, and the addition of a swimming pool to an existing resort. What the customers wanted in these cases was to have their requirements met through standard solutions at relatively minimal cost. In the case of a new university social sciences department building, the contractor's profit was marginal but the contractor did gain access to subsequent work.

Mostly-established-technology projects (Type B) provide more than the standard solution for customers. These involve some element of novelty, modifications or improvement to an existing product, or some new product in an established technological field. The study included the development of a new type of battery, the building of a special protective cabin for a heavy piece of equipment, and the building of a new semiconductor plant. In each case the project was designed to solve a customer's problem to make life easier, more safe, or more efficient. In the improvement, overhaul and reorganization of an air fleet project, the sponsor was seeking to diversify its portfolio. All the customers in this category were looking for more than just a standard solution. The solution had to be functional, meeting their needs, and provide some added benefit.

High-tech projects (Type C) usually involve the development of new products based on a collection of new technologies. Such projects provide completely new solutions to previous problems, or address new needs for new customers. The development of a new command and control system for a military vehicle, the development of a new software package, the development of a new radar, and the development of a new multiplexing fiber-optic system for a large communication network, are all examples of high-tech projects examined in the study. Customers of these projects, in striving for substantial advantages and unique solutions, were ready to accept higher risks as well as higher costs. Indeed, in improving and upgrading an existing weapon system for naval use, the contractor contemplated an initial loss in order to gain access to a unique product line. In the case of the new multiplexing fiber-optic system, its development almost lead the organization into bankruptcy. Nevertheless, these projects provided substantially increased capabilities, effectiveness or competitiveness.

Super-high-tech projects (Type D) are those designed to meet very advanced needs for which no technology or previous solution readily exists. The development of the new electronic module based on a new concept, mentioned earlier, and the development of a receiving and processing system for a hostile and complex electromagnetic environment, both fall into the super-high-tech category. Such projects are obviously the most complicated and risky of all. When these projects are successful, they provide a quantum leap in effectiveness and enormous advantages for their customers.

Table 2 summarizes some of the quantitative findings of the research for different types of project. It shows typical characteristics for each of the four types of project identified and how these relate to each of the four success categories.

Figure 3 shows a conceptual relationship between the relative importance of a given success category and the type of project. It reflects the findings that for traditional technology projects, meeting project objectives of time and cost and satisfying the customer in the short to medium term are the most important considerations. At the other end of the scale, long term future opportunity plays a much larger role.

Project Type / Success Category	A Established Technology (Classic-Tech)	B Mostly Established (Medium-Tech)	C Advanced (Hi-Tech)	D Highly Advanced or Exploratory (Super Hi-Tech)
Internal Project Objectives (Pre-completion)	Critical	Important	Overruns acceptable	Overruns most likely
Benefit to Customer (Short term)	Standard product	Functional product with added value	Significantly improved capabilities	Quantum leap in effectiveness
Current Contribution (Medium term)	Reasonable profit	Profit. Return on investment	High profits. Market share	High, but may come much later Market leader
Future Opportunity (Long term)	Almost none	Gain additional capabilities	New product line. New markets	Leadership in core and future technologies

Table 2 – Success Characteristics of Various Types

Additional research is required to ascertain to what extent the complexity of the program/project management inherent in the project has on the selection and consequent success of each project type.

Conclusions

The research confirms that project success is a multi-dimensional concept. It cannot be assessed based on a single, or even two dimensional measure. A project may provide an efficient solution to the customer's requirements, yet be considered a failure by the performing organization in terms of business success. Similarly, some projects seem successful in the short-term, but may turn out to be less-successful in the longer run, and vice versa. In some cases, a long time must pass before the original expectations can really be met and success evaluated.

The research revealed four primary categories of project success. These are:

1. Internal Project Objectives (efficiency during the project);
2. Benefit to Customer (effectiveness in the short term);
3. Current Contribution (in the medium term); and

4. Future Opportunity (in the long term).

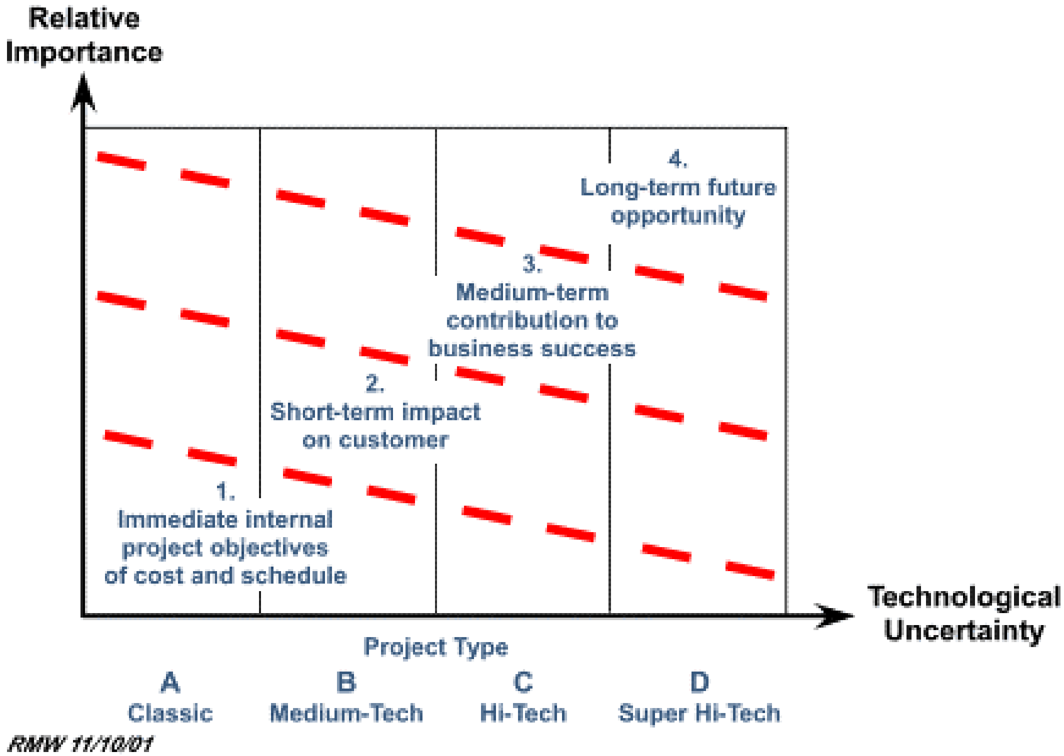

Figure 3 – Success-Project Relationships
(Time-based success criteria are project dependent)

The research also showed some correlation between these term-based primary success criteria and particular types of project. To make this assessment, available project data was classified into four project types, namely:

Type A - Established Technology;
Type B - Mostly Established Technology;
Type C - Advanced Technology; and
Type D - Highly Advanced Technology

When viewed in this light, it was observed that the relative importance of the different categories of success varied with technological uncertainty, i.e. the project type. Specifically, the importance of meeting time and budget constraints is reduced with increasing uncertainty, while the impact the project has on the customer increases when moving from established technology to projects of higher technology, i.e. those of higher uncertainty.

It is suggested that the four primary categories of project success, the four project types and, potentially, the three levels of project management complexity, provide a valuable framework for developing Principal Success Criteria. These success criteria should be agreed upon by the project's stakeholders at the time of project formulation, bearing in mind the type of project in question. Such criteria will provide substantive and appropriate guidance in the further formulation of the project. They will also provide a positive reference baseline for the inevitable project management trade-off decisions required during the course of the project process and a baseline for post-project review. Therefore, the following should become an established project management practice:

As part of every project's front-end planning, and incorporated into its documentation, stakeholder agreement should be reached on the project's principal (and measurable) success criteria having regard to its project type.

Footnote

Wideman has subsequently labeled these principal success criteria as ***"Key Success Indicators"*** – see the PM Glossary for a full definition.

[1] Ashley, D.B., C.S. Lurie & E.J. Jaselskis, Determinants of Construction Project Success, Project Management Journal XVIII, 2, 1987, pp69-79.

[2] Baker, B.N., D.C. Murphy & D. Fisher, Factors Affecting Project Success, Project Management Handbook (ed D.I. Cleland & W.R. King, Van Nostrand Reinhold, NY, 1983, pp669-685.

[3] de Wit, A., Measuring Project Success: An Illusion, Proceedings, Project Management Institute, 1986, pp13-21.

[4] Dvir, D. & L. Dyer, Measuring the success of technology-based strategic business units, Engineering Management Journal, 4, 4, 1992, pp33-38.

[5] Hayfield, F., Project success and failures, Proceedings of the 8th World Congress on Project management, Internet, Rotterdam, 1985.

[6] Morris, P.W.G., & G.H. Hough, The preconditions of success and failure in major projects, Technical Paper #3, Major Projects Association, Templeton College, Oxford, 1986.

[7] Pinto, J.K. & D.P. Slevin, Project Success: Definitions and Measurement Techniques, Project Management Journal #19, Project Management Institite, 1988, pp67-75.

[8] Pinto, Jeffrey K., and Dennis P. Slevin, Project Success: Definitions and Measurement Techniques, Project Management Journal, vol xix, No. 1, Project Management Institute, Upper Darby, PA, 1988, pp70-71.

[9] Wideman, R. Max, Project Management Body of Knowledge, Project Management Institute, Upper Darby, PA, 1987, Glossary of Terms, p22.

[10] PMI Standards Committee, A Guide to the Project Management Body of Knowledge (Exposure Draft), Project Management Institute, Upper Darby, PA, 1994, p3.

[11] Burnett, Nicholas R., and Robert Youker, Analyzing the Project Environment, World Bank, Washington, DC, 1980, EDI Course Notes CN-848, p4.

[12] Shenhar, Aaron J., Dov Dvir, and Ofer Levy, Project Success: A Multidimensional, Strategic Concept, Research paper, University of Minnesota, MN, June 1995.

[13] Eisenhardt, K.M., Building theories from case study research, Academy of management Review, 14, 1989, pp532-550.

[14] Yin, R.K., Case Study Research: Design methods, Beverly Hills, CA: Sage Publishing, 1984.

[15] Shenhar, A.J., From low to high-tech project management, R&D Management, 23, 3, 1993, pp199-214.

[16] Shenhar, A. J., Contingent Project Management: A Classical Concept in a New Arena, U. of Minnesota, Minneapolis, MN, 1994 (Working paper)

[17] Shenhar, A. J., Some Projects are More Equal: Toward a Typology of Project Management Styles, U. of Minnesota, Minneapolis, MN, 1995 (Working paper).