Title: A Critical Review of "From Theory to Practice: Toward a Typology of Project-management Styles"

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Abstract: A paper titled "From Theory to Practice: Toward a Typology of Project-management Styles." is critically reviewed in this individual report.

A Critical Review of "From Theory to Practice: Toward a Typology of Project-management Styles"

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1 Summary

This research paper presents a framework for classifying projects by using a two-dimensional conceptual model. The driver behind this classification is the fact that different projects require different managerial approaches. The classification helps identify the appropriate managerial and practical implications associated with the project type. The author asserts that little attention has been paid to the project type and classification and the organizational and managerial implications based on this classification.

The dimensions used in the classification process are basically the project attributes or features that help differentiate it from others. The two dimensions used to classify projects are technological uncertainty at the initiation of the project and system scope. For each dimension, there are multiple levels. Four levels used for technological uncertainty are as follows:

- Low technological uncertainty (low tech)
- Medium technological uncertainty (medium tech)
- High technological uncertainty (high tech)
- Superhigh technological uncertainty (superhigh tech)

The following table illustrates differences between projects that are classified according to the technological uncertainty:

Project Type	**Level of Technology**	**Typical Projects & Examples**
Type A Low-Tech	No new Technology is utilized	Construction, Installation, Rebuilding a product. Bridges, Telephones
Type B Medium-Tech	Some new technology is utilized	Additional commercial model. Improvement of a product. Autos, TV.
Type C High-Tech	Integration of new, but existing technologies	New military system. New commercial family. F. 16, First VCR, Macintosh.
Type D 1.1.1.1.1 Super High Tech	Key technologies do not exist at project initiation	New system concept. Sidewinder, SR- 71, Eagle computer.

Table 1 Project types based on the technological uncertainty

Following the terminology of the Project Management Institute, the author has used three levels for the system scope, namely assembly, system and array whose detailed definitions will be given later. The main difference between different levels of system scope lies in the fact that the complexity of the final product / outcome obtained at the end of the project increases from assembly to array as the names of these three dimensions imply. An assembly can be thought of a subset of a system, that serves a well-defined function in this system or an independent product that performs a single function, such as a computer hard drive for the former and a compact disc player for the latter. On the other hand, an array is a collection of systems that serve a common purpose together, such as the highway system of a large city; each highway is a system itself while the entire highway structure makes an array.

The author has analyzed 26 projects that have been undertaken in the military or commercial market. The author has used quantitative and qualitative techniques to identify the issues related to the classification of projects based on the two dimensions, namely technological uncertainty and system scope. The results indicate that high technological uncertainty requires extensive testing and developments, a great deal of technical skills and a high level of communication between project members. Furthermore, high technological uncertainty causes the designs to be frozen at a later stage in the project due to uncertainties. The implications of system scope were that increased scope engenders formal administrative issues, such as increased planning, control and bureaucracy as well as the need for subcontracting. A combined move along two dimensions causes additional requirements. In the higher uncertainty / higher scope projects, integration of system engineering tools, such as design for manufacturability and testability, reliability testing, human factors engineering and so forth is important to ensure the success of such projects. Due to complexities involved in higher uncertainty / higher scope projects (that actually contain multiple micro level projects in nature), integration of different pieces, such as different micro-level projects becomes an issue. This might potentially increase the project duration. Configuration management tools, such as special software packages (Product Data Management Softwares) are needed to centralize all project decisions / data, store different versions of such data and ensure all project members who might even be distant from each others geographically are working off of the "latest" version. Risk management is another factor for higher uncertainty / higher scope projects. Understanding implications of risk on the entire project is important in the sense that proper project contingency plans are built for managing such risks and being prepared to minimize the adverse impact of risks on the success of projects.

The project type classified according to the scheme offered by this research helps organization adopt appropriate managerial attitudes and style for the selection of resources, the use of scientific tools / techniques and the establishment of the project organization.

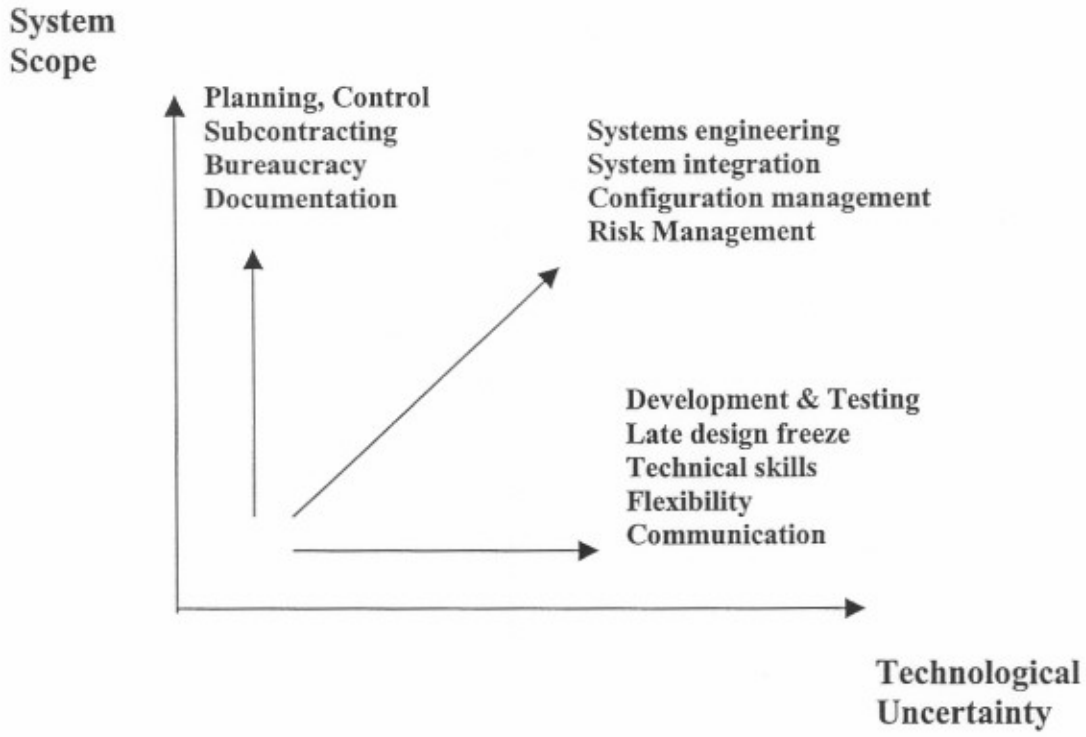

Figure 1: Managerial and Organizational Requirements along two dimensions (Adapted from [17])

2 Research Methodology

2.1 Data Sources and Collection

As mentioned earlier, the sample included 26 projects from various industries. Even though 29 projects have been approached, the lack of the required data from these projects has led the author to eliminate three of them. The data collection included the review of project documents, multiple interviews from each project and questionnaires. The 2-3 person research teams (who were actually pursuing a graduate degree in the management of technology program) have interviewed project team members at different levels, including project managers, functional and technical team members and customer representatives. Researchers were the ones who have conducted a similar analysis of a project from their personal experience.

Data were collected in the interviews and included details on the following items: Project mission, objectives, project organization, managerial procedures, planning and control methods, software packages, documentation, decision-making processes, information flow and communication patterns. These data helped shape the qualitative observations. A questionnaire was applied in order to collect quantitative data, either factual data or subjective (collected on a 1 to 7 scale, 7 representing the highest level / use / extent for the variable in question) data.

2.2 Data Analysis:

Qualitative data were analyzed through the use of a method of cross-case comparative analysis [8], [13] while descriptive statistics (mean and variance) were obtained through the analysis of quantitative data from the collected questionnaires. The following table illustrates the lowest and highest project type along each dimension for different variables that were quantified in the questionnaire. Furthermore, an ANOVA analysis was performed to see if there is a significant difference in each variable between different project types along each dimension. The last column on the following tables specifies the statistical significance difference.

	Technological Uncertainty			System Scope		
Variables	**Lowest**	**Highest**	**Statistical Signifacance ?**	**Lowest**	**Highest**	**Statistical Signifacance ?**
Resources						
Budget	Super High-Tech	High-Tech	No	Assembly	Array	No
Duration	Medium High-Tech	Super High-Tech	No	Assembly	Array	Yes
Labor Employed	Super High-Tech	Medium-Tech	No	Assembly	Array	No
Perc. Professionals	Low-Tech	Super High-Tech	Yes	Array	Assembly	No
Outcomes						
New Market	Low-Tech	Super High-Tech	No	Assembly	System	No
New Product Line	Low-Tech	Super High-Tech	Yes	Array	Assembly	No
New Technology	Low-Tech	Super High-Tech	Yes	Array	Assembly	No
Management						
Design Cycles	Low-Tech	Super High-Tech	Yes	Array	Assembly	Yes
Design Freeze Qtr.	Low-Tech	Super High-Tech	Yes	Array	Assembly	No
Number of Milestones	Low-Tech	Super High-Tech	Yes	Assembly	Array	Yes
WBS Utilization	Medium Tech	Low-Tech & Super High-Tech	No	Assembly	Array	Yes
Management. Mtgs.	Medium Tech	Low-Tech	No	Array	Assembly	No
Customer Mtgs.	Super High-Tech	Low-Tech	No	Assembly	Array	No
Computerized Planning	Medium & High-Tech	Super High-Tech	No	Assembly	Array	Yes
Computerized Control	High-Tech	Super High-Tech	No	Assembly	Array	No

Table 2: Quantitative data and the type of projects that scored minimum and maximum on each variable

3 Strengths of the Research Paper

Before explaining the strengths of this research paper, we need to define a "project". A project is defined as the set of interdependent activities with limited resources that need to be completed within a specified period of time to achieve a set of predefined goals and objectives. The definition itself implies that projects are risky and require proper management to ensure success. The question remains: "Is there a success-ensuring template for project management regardless of the project type?" This research actually recognizes the need for different managerial and organizational requirements depending on the project type. It also offers a classification scheme for different project types, that will lead to the determination of appropriate managerial and organizational requirements. The need for classification is detailed in the following paragraphs.

Managing projects involves processes of planning, directing and controlling resources. Therefore, managing a project requires careful balancing of technical, managerial and administrative processes with time, costs, human and other resources, all geared together to achieve the desired purpose [16]. Over the several decades that the concept of project management has existed, a collection of various techniques and managerial tools has been developed and came into use to help achieve projects' objectives in the most efficient way. However, projects may differ considerably in various aspects like size, time-span, complexity, industry, customers, and of course technology. Some projects incorporate well-established technologies, while others employ new and sometimes even experimental technologies that involve enormous uncertainties and risks. For example, constructing a new office tower or building a new bridge over a river can not be compared to the making of a new space vehicle or developing a new generation of computers, despite the fact that they are all large scale, are yet called projects and their management is called project management. This research considers technological uncertainty and system scope as the main parameters distinguishing various types of projects.

Another strength of this research is that real life projects (quite a large of projects) have been used to draw conclusion about the managerial and organization requirements of each project type. This fact only increases the credibility of results and usability of such results in other projects.

The variety of projects besides the quantity presents another strength for this research. Even though projects are from different industries, the classification scheme places each of them in a certain

category. Interestingly, when placed under a category, issues and problems encountered are similar regardless of the industry where projects were undertaken. The short description of each project as well as the category that it falls under is shown on Table 3.

Project Type	Projects
Low Tech - Assembly	None,
Low Tech – System	Construction of a swimming pool, Construction of a new building for a university department, Construction of a major new regional offices facility,
Low Tech – Array	Building and improving a highway system for a large urban area,
Medium Tech - Assembly	In-house development project of a special purpose new-type Lithium battery to be used for extensive periods under harsh conditions, Design and manufacture of a protective operator' s cabin for a heavy piece of equipment, In-house development project of an optical sensor for a fire-extinguishing system to be installed on a special-purpose vehicle,
Medium Tech – System	Company investment development of a surveillance vision system for a special environmental condition to be installed on a military platform , Development and installation of a computerized information system for data collection and data analysis on the performance, reliability problems, and maintenance of a large spread of military systems, A project of designing, building, and installing a new plant for the fabrication and mass production of advanced semiconductor microelectronic devices of a specific nature, A program to upgrade and improve a military aircraft,
Medium Tech – Array	A program that involved the improvement, overhaul, and the reorganization of an air flee that included aircraft, A program to design, develop, construct, and install a widespread communication network,
High Tech - Assembly	A self investment project of developing a software package to transform one language to another, A project to develop a collection of power-supply subsystems with specific requirements to serve a large electronic system, The development of a sensing subsystem that was part of an advanced weapon development system, In house development of a

	multiplexing unit for use in transatlantic cable telephone transmission,
High Tech – System	Development project of a new radar system, The improvement and upgrading of an existing weapon system for naval use, The development of an electronic warfare system for air combat use, Development of a fire control system for use on a military platform, A self -investment development of a vision and targeting system for use on a special purpose vehicle, A large program for the development of a new airborne platform including its structure, aerodynamics, avionics, control, and many of its subsystems,
High Tech – Array	None,
Superhigh Tech-Assembly	A project for the development of a new electronic and computing module that would become a part of the larger system,
Superhigh Tech – System	A program for the development of a new weapon system to be used by the Air force, The development of a completely new electronic system that had to function in an unknown communications environment with a "wide-band unfriendly" electromagnetic environment,
Superhigh Tech – Array	None

Table 3

4 Weaknesses

Some projects will not exactly fit to the classification scheme described in this paper. For example, there might be some that will fall somewhere between low technology and medium technology projects. The fact that each project will be assigned to a predefined category might lead to the incorrect assignment of a project to a category.

The differences between different categories along each dimension are not clear-cut and therefore, might lead to different results in the assignment process. For example, an array identified by one person might be classified as a system by another individual depending on the perspectives from which they are evaluating.

The author has identified major managerial and organizational requirements as illustrated by Figure 1. However, the author has not analyzed the existence of such practices in each project that was included

in the sample. He could have investigated the relation between these practices and the project success. These requirements are project-specific but how they impact the project still remains as a question. It is a weakness of this research study that the author has not backed the results with quantitative data about the effectiveness of these requirements on the project success.

Even though the study included a number of various projects from different industries, having a couple projects in the sample that include the implementation of an enterprise information system project, such as Enterprise Resource Planning Systems or Supply Chain Management Systems, would make the project list excellent. Given the fact that 70% of such information systems result exceed the budget or timeline, analyzing characteristics of such projects and comparing them with those of other projects that fall under the same category would give a good insight as to how different they are from others.

The organizational and managerial requirements by project type have been determined from qualitative observations. It is possible not to have captured some of the requirements since data providers might have missed to provide some of them due to the nature of the data collection, namely "open discussion"

5 Comparison with other researches in the literature

In the literature, there have been some studies [7], [15] that identify the critical factors in the successful project implementation. Some of these studies have not gone beyond presenting strong theoretical framework for the critical project success factors. Two of the factors identified in one of the empirical studies [15] are control mechanisms and adequate communication channels. In some sense, these two factors are the ones that are project dependent. In this paper, the appropriate control mechanisms and communication have been identified as the two issues that are dependent on the project type.

Earlier studies, such as [2], [5], [14], [18], [19], [20] have also made some distinction among projects based on technological differences. In all these projects in the project sample, the final outcome is a product or service to be used by a customer after the project is completed. However, [1] has investigated the success factors for projects of experimental nature or for the development of technological infrastructure.

The lack of specific distinction, between project types in the project management textbooks [3], [6], [9], [10], [11]. [12] has been observed during the literature search of this individual paper. Almost all textbooks present a general framework for different components of project management, such as budgeting, planning, controlling and so on. None of them tries to differentiate the project types based on different attributes and offer " project-specific recipes" for different topics. It is important that these texts need to address the problem of identifying specific solutions to organizational and managerial issues, depending on the project type. This study definitely fills the gap by analyzing various types of projects, categorizing them by using two dimension and presenting project type specific results.

In the literature, there have also been studies [4] that recognize technology "one of the biggest challenges in a project and one of the major uncertainties" surrounding technology projects. Using technological uncertainty as one of the classification factors in this study supports the above argument stated by the studies mentioned above.

6 Conclusion & Future Research

This study classifies projects according to two dimensions and identifies differences in managerial and organizational requirements between different project types based on the predetermined classification scheme. The results obtained in this study suggest that more systematic approaches / tools / methodologies are requirement as the technological uncertainty and system scope increase. In a future research, one might include other classification factors, such as industry or project size and almost repeat the same study. It will be interesting to conduct a similar study in just information technology projects where projects are of a large size and a very complex nature.

Project management is a wide-band activity. As this study suggests, it should not be handled in the same form for all kinds of projects. It requires a proper attitude, concept and philosophy. However, as the author indicated, it is needed to validate the results of this study through an empirical study. After such an empirical study that proves the positive impact of certain managerial and organizational requirements by project type, organizations will give more credibility to results. They will be more comfortable in incorporating such requirements into their infrastructure and therefore improve the likelihood of success in complex projects.

Finally, investigating practices and business processes in different projects for specific project requirements by project type, such as risk management and configuration management will be a useful follow-up study. Even though certain requirements might be existing in different projects, the way they are implemented or the tools / techniques used in the implementation of requirements might differ.

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