Направление «Менеджмент»

Профиль «Управление проектами» **Код - 053**

Время выполнения задания – 180 мин.

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Introduction

The article pursues two objectives: first, to investigate if project management practices, tools, and techniques are used in groups or clusters; and second, to investigate if and how practice varies among different types of projects. There are many ways to group or categorize project management practices. For example, PMBOK Guide *(*PMI, 2008) presents practices, tools, and techniques grouped in Knowledge Areas and Process Groups.

Is there a single best way to classify project management tools into Knowledge Areas? The idea of grouping the tools in such a way, was developed by teams working on previous versions of the PMBOK Guide as a way of classifying elements of project management knowledge for presentation in the document. This article aims to empirically identify a structure that underlies the actual practice of project management by investigating patterns in the use of project management practices, tools, and techniques. Practitioners most likely use their tools in groups. The study of their collective practice suggests that practitioners use toolsets according to some rationale, for special functions or specific purposes. The objective of the present research is to empirically explore the existence of these specialized toolsets as they are used by the community of project management practitioners. The article compares the levels of toolset use between project types, illustrating how the toolsets can be useful in providing an overall high-level view for the study of practice in a condensed format.

Regarding the second goal of the article, to investigate if and how practice varies among different types of projects, there is a general recognition that project management is practiced differently in various contexts.

The variations among different types of projects are among the most significant found in the overall study. For this reason, the authors have chosen to present the comparisons among four types of projects. The research questions are:

• Are project management practices, tools, and techniques used in clusters or groups?

• Does the level of use vary by project type?

Literature Review

Within the project management literature, research on practices focuses primarily on small and specific groups of practices. Several studies compare a larger number of practices, but most often in a specific context. This research on practice does not allow for comparative evaluation of the relative use of the whole body of practices. There have been few studies examining differences in project management practice between industries, project types, and contexts.

The study by Papke-Shields et al. (2010) is of particular interest because it not only examines a wide range of practices and their contextual variation, but also the grouping of practices into the *PMBOK® Guide* (PMI, 2008) Knowledge Areas. The approach taken in the article uses principal component analysis (PCA) to identify groupings that are found in practice. The two approaches are complementary. However, the approach adopted here allows for the identification of groupings that are used in practice that may or may not correspond to the conceptual groupings found in predefined Knowledge Areas. If groupings are found that are similar to predefined categories, this can constitute a validation. If other groupings are found, this opens up opportunities for development outside of the predefined categories that may be closer to

[1] На основе статьи Besner C., Hobbs B. An Empirical Identification of Project Management Toolsets and a Comparison Among Project Types. // *Project Management Journal*, V.43, No5, p. 24-46 (2012).

real practice.

Methodology

The Survey Instrument

The research is based on a survey, which collects data on four categories of variables:

1. Respondent demographics (position, education, experience, etc.)
2. Organizational context (geographic region, size, industry, project management maturity, etc.)
3. Project characteristics (size, complexity, etc.)
4. Project practice (extent of use of project management specific practices, tools, and techniques).

The questions relative to the first three categories of variables are very straightforward. The measure of project management practice is discussed in the following subsection. The questions on respondent demographics are used primarily to ensure that respondents are in fact experienced project practitioners. Project practice is investigated through the analysis of the fourth category of variables—project practice. Contextual variation in practice is investigated through the analysis of variations in practice relative to organizational and project characteristics.

The Measure of Project Practice

The description of practice is provided by survey data on the intensity of use of 108 well-known project-specific tools and techniques. The assumption is that by indicating which tools and techniques they actually use in their day-to- day work, project management practitioners provide a description of their practice — what they actually do when they manage projects.

A total of 108 practices, tools, and techniques specific to project management have been preselected by the authors based on the criteria that the practices be (1) project-specific, (2) well-known, and (3) specific practices as opposed to general processes. Later in the research the list of practices, tools, and techniques was used for the toolsets' creation and their level of usage estimation (see Appendix A – bold - for the toolsets' names and ordinary type – for the tools) . For each tool or technique, the respondents answered the following question using a 5-point Likert scale:

• How extensively do you use this tool or technique?

The Dataset

Data has been collected from 2,339 practitioners worldwide through a web-based questionnaire, in three phases, in 2004, 2007, and 2009, respectively. Of the 108 practices, tools, and techniques, 18 are only part of phase 1, leaving 90 tools common to phases 2 and 3. Subsamples by phase are used when appropriate. Globally, results were found to be very stable from one phase to the other. The respondents were mostly between 30 and 50 years old (71.6%). Their current primary role and the average number of years of experience in this role were as follows: team member (9%; 8 years); project manager (50%; 8 years); program manager/director (31%; 5 years); and other (12%; 6 years).

The respondents presented next industries: business and financial services (15% of the sample), engineering and construction (14%), information technology and telecommunication (44%), computer software and data processing project (9%); and a variety of other project types (18%). The unit of analysis in the first part is "extensiveness of use of 108 tools" and in the second part is "extent of use of 19 toolsets."

Identification of the Groups of Practices, Tools and Techniques, or "Toolsets"

Each of the 108 tools, techniques, and practices identified in this research is not used in complete isolation from all the others. In practice, the use of many tools is linked one to the other to form groups of tools that are referred to in this research as "toolsets." When one tool of the set is used, the other tools of the set have a greater chance of being used at the same time or in the same context.

For example, a work break- down structure (WBS) is mostly used at the beginning of a project and could be part of the "initial planning" toolset, but it could also be used at the end of a project to verify whether all project content was duly delivered. Grouping tools into toolsets in such a fashion that each tool is part of only one toolset produces a simplified representation of

reality, but such a model based on toolsets that are specific and distinct greatly simplifies the representation and the interpretation of project management practice. Another important consideration is that as many tools as possible be included in the toolsets; leaving few "orphan tools" not included in any toolset. A procedure was developed and applied to the data to identify toolsets. Following the description of the toolset identification procedure, the characteristics of the resulting toolsets are examined and discussed.

PCA, a classic data reduction technique, and a panel of 45 experts, were employed together with researchers' judgment in the identification of 19 toolsets. The results of PCA were enhanced in a multistep process to include as many tools as possible, including those that were only part of phase 1.

The number of components to extract was determined using the "eigenvalues greater than one" Kaiser Criterion (Fields, 2000). The original PCA produced 14 groups, accounting for 63% of the total variance. Factor loading was set to 0.5 but was on some occasions lowered to 0.46 in order to include more items when interpretation of the enriched component appeared clearly comprehensible. Both orthogonal rotation (varimax) and non-orthogonal rotation (oblimin) were tested, and the exact same set of factors was found. This result substantiates the robustness of the groupings.

The 14 toolsets identified by PCA incorporate 60 of the 90 tools. Therefore, 30 tools were left as orphans (i.e., not incorporated in a toolset by PCA). The use of PCA allowed the identification of 14 useful unrelated toolsets but left 37% of the variance unexplained, leading to an incomplete representation of practice. Considering the objective to reduce the data without losing valuable information, diversity, and completeness of actual practice, an effort was made to incorporate these orphans in the 14 toolsets already identified or to group them in new toolsets.

Toolset Enhancement Process

A panel of 45 experts, was invited to propose groups of tools from the list of 90 tools. The directive was to make groups based on how their uses were correlated and not make conceptual groupings on another basis.

1. Each member of the panel of experts was asked to group the tools, with no restriction on the number of toolsets or the number of items per toolset.

2. The frequency with which the experts grouped each pair of tools together was computed. Agreement between the experts was defined to be more than 10 experts suggesting the same pair. The result was mapped on a matrix of 90 rows by 90 columns.

3. The pairs of tools identifiable from the PCA results were mapped on a similar matrix. The superimposition of the matrices produced an interesting match of clouds of pairs.

4. All the orphans from the PCA that were matched by expert agreement with a tool composing one of the 14 toolsets were identified. These were treated as suggestions by the experts for enhancing the 14 toolsets identified through the PCA.

5. Each "expert suggestion" was tested by calculating a new Cronbach's alpha (an indicator, which shows the level of "expert suggestion" reliability) for the enhanced toolset. If the alpha increased following the inclusion of the orphan item, this item was incorporated into the toolset; if not, the item was left as an orphan. Six tools (items) were added in this way to one or another of the 14 toolsets.

6. The enhancement of the 14 original toolsets left 24 orphans (30–6). A second PCA procedure was applied on the orphans alone. Researchers' judgment together with the PCA results led to the creation of four additional toolsets. One of these new toolsets was combined with one of the 14 original toolsets (baseline change management). This resulted in the identification of a total of 17 toolsets.

7. 4 tools were left as orphans, the last two formed the 15th toolset of the original PCA, but was rejected because of the lack of their reliability.

8. The final set of 17 toolsets is complemented by two additional toolsets, the 18th and 19th, that could only be identified a posteriori (the data related to them was only collected during the first phase of the research: the 18th toolset is associated with cost estimation; the 19th toolset

is associated with quality management). Nine tools from phase one was left as orphans.

The Toolsets Identified

The composition of each toolset can be found in Appendix A. The toolsets identified acceptable reliability. The data covers the entire range of the 5-point scale on which it is measured. The means and the standard deviations are shown in Table 1. The skewness and kurtosis measures are all between minus 1 and plus 1, which are very good values, confirming normality.

Toolsets	Name	Use Level	Standard Deviation	
1	Risk management	2.71	1.07	10
2	Basic project management software	2.95	1.04	3
3	Advanced project management software	1.91	0.91	19
4	Multiproject management	2.32	0.94	13
5	Databases	2.10	1.06	16
6	**Initial planning**	3.27	0.85	1
7	Bidding and fixed-price contract	2.72	1.05	5
8	**Business case definition**	2.94	0.86	4
9	Business benefits measures	2.12	0.99	15
10	**Baseline change management**	2.76	0.86	7
11	Network planning	2.13	0.95	14
12	Financial evaluation	2.71	1.16	8
13	**Team management**	2.37	0.79	12
14	**Variable-price contract**	1.96	0.90	18
15	Project closure	2.95	0.96	2
16	Monitoring progress	2.81	0.87	6
17	Project analysis	2.68	0.82	11
18	Cost estimation	2.42	0.92	17
19	Quality	2.09	0.89	9

The toolset model includes most of the 108 tools; only 13 “orphans” are left out of the model. The output of the initial PCA produced 14 uncorrelated toolsets, but as a consequence to the subsequent enhancement process, the toolsets are no longer independent. Table 2 shows the 12 pairs of toolsets correlated above 0.60; they are reproduced under and above the diagonal. In practice, several toolsets are linked one with the other. The first 4 toolsets in Table 2 are highly interconnected conceptually and practically, and are correlated one with the other.

	Baseline							
Toolsets	**Change Management**	**Project Closure**	**Initial Planning**	**Progress Monitoring**	**Risk Project**	**Management Analysis**	**Initial Planning**	**Progress Monitori**
Baseline change		0.65	0.67	0.73	0.6	0.61		
Project closure	0.65		0.67	0.61	0.61		0.61	
Initial planning	0.67	0.67		0.6		0.63		
Progress	0.73	0.61	0.6					0.64
Risk management	0.6	0.61						
Project analysis	0.61		0.63					
Databases		0.61						
Team man-ment				0.64				

Table 2: Correlations between toolsets >0.60.

The Toolset Descriptions

The combination of the toolsets content, resulted from the first steps then was formed as a basis for the next task fulfillment: estimation of each toolset average level of use and its elements in particular (Appendix A). Presenting items according to their level of use allows a better understanding of the extensiveness of practice, because they can vary a great deal.

Comparing Toolsets With the Content of the *PMBOK® Guide*

As far as one of the most widely spread project management standards is PMBok, so there is necessity to compare the level of use of project management tools regards knowledge areas and toolsets (see table 3).

Research Results		***PMBOK® Guide***		
Toolsets	**Use**	**Knowledge Areas**	**Process Groups**	**Treatment**
Initial planning	3.27	Several	Initiating	Extensive
Project closure	2.95		Closing	Extensive
Basic PM software functionality	2.95	Time and Cost	Planning and Controlling	Extensive
Business case definition	2.94	Integration	Initiating	Summary
Bid and fixed-price contracts	2.81	Procurement		Extensive
Progress monitoring	2.76	Time and Cost	Monitoring and Controlling	Extensive
Baseline change management	2.72	Scope, Time, and Cost	Monitoring and Controlling	Extensive
Financial evaluation	2.71		Initiating	Summary
Project analysis	2.71		Initiating	Summary
Risk management	2.68	Risk		Extensive
Cost estimation	2.42	Cost	Planning	Extensive
Team management	2.37	Human resource		Extensive
Multiproject management	2.32	Out of scope	Out of scope	Out of
Network planning	2.13	Time	Planning	Extensive
Business benefits measures	2.12		Initiating and Controlling	Summary
Databases	2.10	Risk and Cost		Summary
Quality	2.09	Quality		Extensive
Variable-price contract	1.96	Procurement		Extensive
Advanced PM software	1.91	Time and Cost	Planning and Controlling	Extensive

Table 3: A comparison of the toolsets with the content of the *PMBOK® Guide*.

In Table 3, the toolsets are presented in decreasing order of extent of use. A summary attempt has been made to evaluate the relative importance of the tools from each toolset within the *PMBOK® Guide* by estimating the extent of treatment.

We should say that the evaluations are of too general a nature to support recommendations, but these results should provide some food for thought for those involved in producing and updating project management standards.

Comparing Practice Between Project Types

Nowadays, few studies have taken a broad perspective when comparing practice between project types of different industries. The next step of our research is to define the significant differences among (a) the contexts in which different types of projects are fulfilled (see table 4) and (b) among toolsets used by project type.

The significant differences in practice among the project types are revealed. The toolsets are listed in decreasing order of extent of use in the entire sample in the table 5. The first column of each project type gives the rank of the toolsets for the particular type; the column with the plus, minus, or equal sign indicates the differences in use.

Project Types		**Business and Financial Services**	**Engineering & Construction**	**IT & Telecom**	**Software Dev-ment**
Contextual Variables	***N***	**188**	**176**	**569**	**12**
Organizations in the private sector		=	=	=	=
International projects		–	=	=	+**
Internal business		+*	–	=	=
Organizational size		–*	–*	+***	=
Project size		–	+**	=	–***
Level of project definition		=	+**	=	=
Degree of complexity		=	+*	=	–***
Degree of innovation		=	–	=	=
Degree of similarity of projects		=	=	=	=
Projectized structure		=	+*	=	=
Project part of program		=	–*	=	=
Participation in Initiation/concept phase		=	–	=	=
Number of phases in which the practitioner is involved		=	–**	=	+***
Maturity		=	=	=	=

*0.100 > p > 0.049. **0.05 > p >0.01. ***p < 0.01.

Table 4: Significant differences in the contexts in which different types of projects are found.

Project Types		**Business and Financial Services**	**Difference**	**Engineering & Construction**	**Difference**	**IT & Telecom Project**	**Difference**	**Software Development**	**Difference**
Toolsets	***N***	***188***		***176***		***569***		***120***	
Initial planning	1	1	=	2	-**	1	+***	1	=
Project ending	2	3	=	3	=	3	+*	3	=
Basic PM software functionality	3	5	-**	4	=	2	+***	2	=
Business case definition	4	2	+**	10	-***	4	+*	4	=
Bid and fixed-price contracts	5	9	-***	1	+***	7	=	7	=
Progress monitoring	6	6	=	6	=	5	=	6	=
Baseline change management	7	10	-***	5	=	6	+**	9	=
Financial evaluation	8	4	=	9	=	10	=	5	-**
Project analysis	9	7	=	8	=	9	=	10	=
Risk management	10	8	=	11	=	8	+**	8	=
Cost estimation	11	12	=	7	+***	12	=	N/A	N/A
Team management	12	11	=	16	-***	11	+**	12	=
Multiproject management	13	13	=	13	=	13	=	13	=

Network planning	14	16	-**	14	+**	14	=	15	=
Business benefits measures	15	14	=	18	=	15	=	17	=
Databases	16	15	=	15	+***	17	=	14	=
Quality	17	17	-*	12	+***	16	=	N/A	N/A
Variable-price contract	18	18	-*	17	+***	19	=	11	-*
Advanced PM software use	19	19	=	19	-*	18	=	16	=
*0.100 > p > 0.049. **0.05 > p > 0.01. *** p < 0.01.									
Table 5: Differences of toolset use by project type.									

Conclusion

The description of practice is provided by survey data on the intensity of use of 108 well-known project-specific tools and techniques. The assumption is that by indicating which tools they actually use, project management practitioners provide a description of their practice. The specificity of the present research is that the description of practice here is based on quantitative data, whereas most other investigations of project as practice are based on qualitative data. The received results can contribute to the enrichment of the descriptions of practice emerging from the qualitative stream of research.

This article addresses two research questions:

1. Are project management practices, tools, and techniques used in clusters or groups?
2. Does the level of use vary by project type?

Regards the first question, the results indicated that practices, tools, and techniques are used in clusters or groups, referred to as "toolsets" in this article. This result has implications for both managers and researchers. The task of those responsible for the management of project management practice in an organization is greatly simplified because instead of managing more than a hundred individual practices, they can manage practices in a much smaller number of groups. This facilitates activities related to training and competency development and to the selection, development and continuous improvement of project management practice. Toolsets are used in many different contexts, each with its particular management problems, for which project management practices have been adapted.

From a research point of view, the identification of clusters of practices provides an insight into the dynamics of project management as it is practiced in reality. This opens up opportunities for future research into the evolution of practice within organizations by asking how clusters of practice emerge and develop over time.

The answer for the second question is received through the identification of significant differences in the extent of use of toolsets among practitioners working on different types of projects. The results show significantly different and contrasting patterns of practice among the four types of projects examined here.

The results have implications for both managers and researchers. For practitioners the results provide detailed information on the ways in which practice varies from one type of project to another. This information allows them to make informed choices adapted to their context.

For researchers, the results here contribute to the contingent approach to project management. It is widely accepted that practice varied contextually. This research provides both a validation of this approach and much more detail than was

previously available.

From a methodological perspective, the results point to the need to develop methodologies to deal with the multidimensional nature of contextual variation.

The results presented in this article are exploratory. As is often the case with exploratory research, the results open up many avenues for future research. In addition, the results of exploratory studies such as this require replication.

Appendix A: List of Toolsets With Their Content

	Average Use		Average Use
Toolset: Risk management	**2.68**	**Toolset: Databases**	**2.10**
Risk management documents	2.91	Database of historical data	2.23
Ranking of risks	2.84	Database for cost estimating	2.17
Contingency plans	2.77	Database of lessons learned	2.08
Assignment of risk ownership	2.70	Database of risks	1.91
Graphic presentation of risk information	2.17		
		Toolset: Initial planning	**3.27**
Toolset: Basic PM software functionality	**2.95**	Kick-off meeting	3.74
Gantt chart	3.59	Milestone planning	3.47
PM software for task scheduling	3.52	Scope statement	3.40
PM software for monitoring of schedule	3.06	Work breakdown structure	3.32
PM software for resource scheduling	3.0	Project charter	3.04
PM software for monitoring of cost	2.56	Responsibility assignment matrix	3.01
PM software for resource leveling	2.51	Communication plan	2.92
PM software for multiproject scheduling	2.36		
		Toolset: Bidding and fixed-price contract	**2.81**
Toolset: Advanced PM software functionality	**1.91**	Contract documents	3.29
PM software for multiproject resource	2.21	Fixed-price contract	3.06
PM software Internet access	2.19	Bid documents	2.86
PM software for issue management	2.00	Bid/seller evaluation	2.60
PM software for project portfolio analysis	1.84	Contractual commitment data	2.26
PM software linked with ERP	1.65		
PM software for scenario analysis	1.57		
Appendix A: (continued**)**		Assigned project sponsor	3.29
Toolset: Multiproject management	**2.32**	Needs analysis	3.12
Program master plan	2.60	Business opportunity/problem definition	3.11
Project priority ranking	2.54	Business case	3.07
Project portfolio analysis	2.28	Project mission statement	2.70
Organizational capacity analysis	2.26	Updated business case at gates	2.37
Multi-criteria project selection	2.25		
Graphic presentation of portfolio	1.98		
Toolset: Business benefits measures	**2.12**	**Toolset: Project closure**	**2.95**
Financial business benefits metrics	2.22	Client acceptance form	3.06
Medium-term post evaluation of success	2.18	Project closure documents	3.06

Nonfinancial business benefits metrics	1.97
Toolset: Baseline change management	**2.72**
Change request	3.48
Baseline plan	3.16
Change control board	2.87
Rebaselining	2.69
Configuration review	2.40
Management reserve	2.39
Recovery schedule	2.06
Toolset: Network planning	**2.13**
Critical path method and analysis	2.63
Network diagram	2.25
Probabilistic duration estimate (PERT	1.85
Critical chain method and analysis	1.78
Toolset: Financial evaluation	**2.71**
Cost/benefit analysis	2.83
ROI, VAN, IRR, or payback	2.58
Toolset: Team management	**2.37**
Self-directed work teams	2.66
Team-building event	2.63
Project website	2.38
Project war room	2.24
PM community of practice	2.18
Team development plan	2.16
Toolset: Variable-price contract	**1.96**
Contract penalties	2.24

Lesson learned/post-mortem	2.93
Customer satisfaction surveys	2.92
Quality plan	2.78
Toolset: Progress monitoring	**2.76**
Progress report	3.86
Stage gate reviews	2.76
Project scorecard/dashboard	2.67
Monitoring critical success factors	2.64
Trend report	2.39
Earned value	2.25
Toolset: Project analysis	**2.71**
Requirements analysis	3.47
Feasibility study	2.71
Stakeholder analysis	2.62
Value analysis	2.04
Toolset: Cost estimation	**2.42**
Bottom-up estimating	3.04
Top-down estimating	3.02
PM software for cost estimating	2.18
Parametric estimating	2.04
Life cycle cost (LCC)	1.98
Toolset: Quality	**2.09**
Quality inspection	3.16
Control charts	1.81
Cause and effect diagram	1.74
Pareto diagram	1.70
Cost-plus contract	2.17
Gain-share contract	1.49

Вопросы для размышления:

1. В чем заключается проблема, цель и методология исследования статьи? Имеет ли данная статья практическую значимость?
2. Проанализируйте результаты оценки уровня использования наборов инструментов, выявленных в статье (см. приложение А)? На ваш взгляд, какие из инструментов являются наиболее востребованными и почему?
3. В чем, по вашему мнению, состоят различия в применении проектного инструментария в зависимости от типов проектов, контекста, условий реализации и отраслей экономики?
4. Если бы вы гипотетически участвовали в каком-либо проекте, то какие инструменты, выявленные в статье, были бы для вашего проекта наиболее полезны и почему?
5. Приведите примеры нескольких проектов (три или четыре), при реализации которых, предпочтения в выборе проектного инструментария могли бы быть отданы тем или иным группам инструментов в зависимости от типа проектов (критерии типов проектов выбираются самостоятельно автором). Обоснуйте ваш выбор.