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Title:

A study of project categorisation based on project management complexity

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Abstract

This study explores the use of project complexity categorisation as a means of understanding and applying the competencies required to manage projects across a portfolio of project types including projects of an innovative nature. The data for this study includes one hundred and twenty project descriptions and ratings of complexity by project managers of their current (or most recent) project according to project management complexity factors developed to support global project management competency standards. The data was collected as part of a global study into project management competence, complexity and behaviours conducted over the course of 2005 and 2006. This paper also includes an analysis of the validity of self assessment of project complexity against the project management complexity factors. This component relied on fifty-five self ratings that were subsequently assessed by a workplace assessor as part of a face-to-face interview. Themes explored include the notion that complexity categorisation is influenced by the type of project being managed, the industry the organisation operates in and whether the project is internal or external to the organisation. Understanding the complexity of projects is the first step to understanding how to match the most effective group of competencies to projects with varied complexity drivers within a portfolio.

Introduction

As project management becomes an increasingly popular means of managing the activities within organisations, the variety of project types being managed is expanding. By their very nature, projects tend to deal with innovation of one type or another and a portfolio of projects within an organisation is likely to include a mixture of organisational change, information technology (both entirely new IT and upgrading of existing IT), product development and business process re-engineering. With the increase in variety of project type, an understanding of the project mix within the portfolio is ever more important to ensure the right projects are being completed and the right people are managing them.

According to Crawford, Hobbs and Turner (Crawford et al., 2004a) there are two main reasons why organisations need to be able to categorise their projects. The first is to develop and assign appropriate competencies to undertake projects successfully (to do them right). The second is to prioritise the projects within an investment portfolio to maximise return on investment (to do the right projects). Crawford et al go on to state that the two key reasons organisations use categorisation systems are;

- “1. To assign priority for resources, align projects with strategy, and optimize benefits from the portfolio of projects undertaken.*
- 2. To develop appropriate competencies within the organization and to assign those competencies to the projects” (Crawford et al., 2004a,5).*

There has been a significant amount of research over the past twenty years into project categorisation (Florice and Miller, 2001, Shenhar, 1998, Shenhar and Dvir, 1996, Turner

and Cochrane, 1993) however much of this research has been focused on categorising projects by project attribute (Crawford et al., 2004a). In their research into the categorisation of projects Crawford et al. (2004b) summarised the attributes used to categorise projects, found in the literature and revealed through focus groups with participating organisations, into a list of thirty-five attributes. These included

- Nature of work
- Client/customer
- Complexity
- Cost
- Size
- Strategic importance
- Risk level
- Organisational benefits
- Deliverables
- Priority
- Contract type
- Impact
- Funding source
- Familiarity
- Project phase
- Resources
- Technology
- Clarity of goals/objectives
- Time
- Discipline
- Geographical location
- Time critical
- Risk type
- Sector
- Organisational involvement
- Technological uncertainty
- Customer involvement
- Client relationship
- Payment terms
- Key project success factor
- Stage in project life cycle
- Project manager
- Risk control
- Market uncertainty
- Regulatory/compliance

Complexity is listed as one of the most common attributes used to categorise projects, but, as Crawford et al (2004) point out, while some organisations treat complexity as a single attribute, others define complexity using multiple characteristics to create a composite attribute. Attributes commonly used to signify complexity include project scope, technical complexity, and number of functions or skills involved. The questions this raises include “what is complexity?” and “how do we assess it?”. It is important to differentiate at this point which type of complexity is being referred to, technical complexity (driven by the complexity of the technology, processes or products of the project) or project management complexity (how difficult the project is to manage because of its context and component parts such as strategic importance to the organisation or relative cohesion of the stakeholders involved).

The first globally developed project management standard to include a comprehensive project management complexity measurement tool is the project manager standards developed by the Global Alliance for Project Performance Standards (GAPPS). The Crawford-Ishikura Factor Table for Evaluating Roles (CIFTER) provides a seven factor model on which the project management complexity of projects can be assessed. The research presented in this paper is the first global study to test use of the CIFTER as a means of categorising projects according to their project management complexity. This research explores the applicability of the CIFTER to a range of project types; variances in the nature of complexity across projects and industries; the variance of complexity factors influencing complexity ratings between industries and the accuracy of self assessment of project complexity using the CIFTER. As the CIFTER is an integral part of the GAPPS standards, a brief introduction to these standards and the process of their development provides a useful background to further discussion.

GAPPS – Project Manager Standards

The Framework for Performance Based Competency Standards for Global Level 1 and 2 Project Managers (Global Alliance for Project Performance Standards, 2006) was released in November 2006 by GAPPS. The standards were developed in a collaborative manner by members of GAPPS. These members include government qualification authorities from Australia, South Africa and New Zealand; industry including Motorola and Shell; academic institutions including the University of Technology, Sydney, ESC-Lille France, Athabasca University, and Middlesex University. A number of project management associations are members of GAPPS including associations in China, UK, USA, South Africa, Singapore and Japan.

The process for standards development began with research conducted by Crawford (Crawford, 2004b) which involved comparative analysis of all the major existing project management knowledge guides and standards. The purpose of this research was to identify the topics that were common across all the standards and knowledge guides as a means of informing the development of global standards. This analysis resulted in identification of forty-eight topics found across the guides and standards. These topics were then grouped by the members of a GAPPS working group into units (refer Figure 1). The rule for inclusion of units in the global standards for project managers was that

they should be relevant to project managers in “most projects most of the time” and on this basis it was determined that four of the units (those marked in grey in Figure 1) should not be included in the global standards for project managers (Crawford, 2004b, 11).

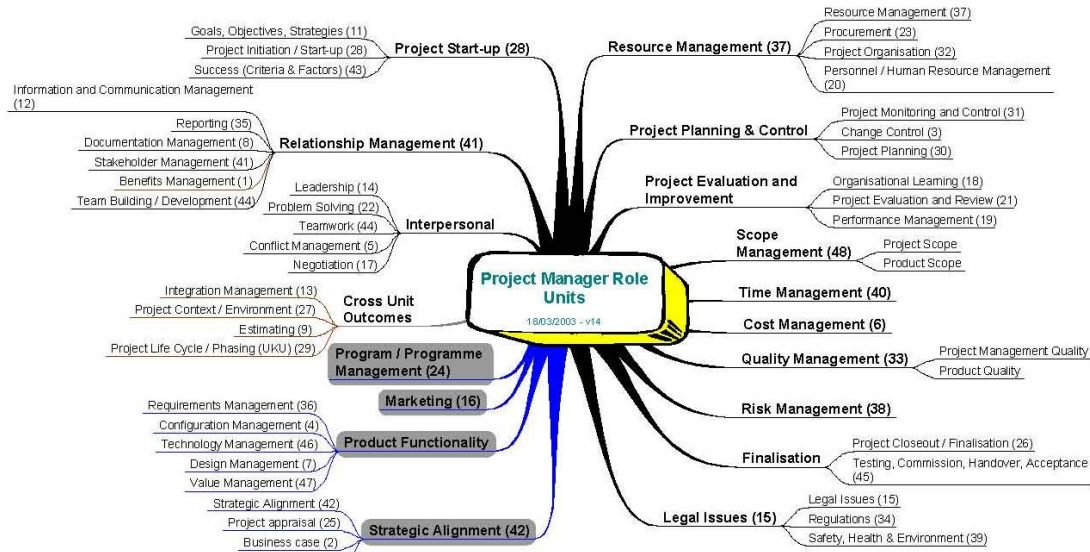


Figure 1 - Units developed from 48 Concepts / Topics

Units considered to be applicable only to some Project Managers in some contexts are shown shaded.

The second step in the process was to conduct a detailed analysis of the role of the project manager. This analysis resulted in the development of the CIFTER. The CIFTER enables projects to be systematically evaluated for their management complexity and is used to differentiate projects into three categories (i) below Global Level 1, (ii) Global Level 1 (G1) and (iii) Global Level 2 (G2). If a project is assessed as meeting the G1 complexity requirements, evidence from this project can be used to support an assessment against the standards at G1. If a project meets the G2 complexity requirements, evidence from this project can be used to support an assessment at the G2 level. Figure 2 below contains the CIFTER factors and ratings

Project Complexity Factor	Management	Descriptor and Points			
1. Stability of the overall project context		Very high (1)	High (2)	Moderate (3)	Low (4)
2. Number of distinct disciplines, methods, or approaches involved in performing the project		Low (1)	Moderate (2)	High (3)	Very high (4)
3. Magnitude of legal, social, or environmental implications from performing the project		Low (1)	Moderate (2)	High (3)	Very high (4)
4. Overall expected financial impact (positive or negative) on the project's stakeholders		Low (1)	Moderate (2)	High (3)	Very high (4)
5. Strategic importance of the project to the organisation or organisations involved		Very low (1)	Low (2)	Moderate (3)	High (4)
6. Stakeholder cohesion regarding the characteristics of the product of the project		High (1)	Moderate (2)	Low (3)	Very low (4)
7. Number and variety of interfaces between the project and other organisational entities		Very low (1)	Low (2)	Moderate (3)	High (4)

Figure 2 - Crawford Ishikura Factor Table for Evaluating Roles (CIFTER)

(Refer www.globalPMstandards.org and GAPPS, 2006)

The standards themselves were refined using widely accepted standards development processes, from the original 48 topics and 14 units, to a final set of six units. The performance criteria are identical, except for one unit, for both G1 and G2 Levels of the standards however the evidence requirements at each level differ. The rationale behind this is that the complexity of the project does not change what the project manager needs to do, but it may change how they need to do it. Since the purpose of performance based competencies is to describe 'what' needs to be done not 'how', having identical performance criteria at each level was deemed appropriate. The only difference is that for the Level G1 the unit titled Evaluate Project Performance is not required to be assessed. Table 1 below lists the units of competence required for both G1 and G2.

Table 1 - Comparison of Units of Competence for Global Level 1 and Global Level 2

<i>Global Project Manager – Global Level 1 Units of Competence</i>	<i>Global Project Manager – Global Level 2 Units of Competence</i>
Manage Stakeholder Relationships	Manage Stakeholder Relationships
Manage Development of the Plan for the Project	Manage Development of the Plan for the Project
Manage Project Progress	Manage Project Progress
Manage Product Acceptance	Manage Product Acceptance
Manage Project Transitions	Manage Project Transitions
	Evaluate and Improve Project Performance

Source: refer www.globalPMstandards.org and GAPPS 2006

As Table 1 above shows, the GAPPS standard for project managers has moved away from the nine knowledge areas found in the PMBoK®Guide and has adopted a structure that allows assessments to be conducted more easily without the need for translating or reordering the units, elements or performance criteria, to reflect the integrated and often recursive nature of the actuality of practice.

Research Aims

The primary aims of this research are to enhance understanding of varying levels of management complexity of projects and how project managers and others perceive the level of complexity of projects. The extent to which these perceptions and complexity categorisations are influenced by the type of project being managed, the industry the organisation operates in and whether the project is internal or external to the organisation are explored. The research is important in providing feedback for the development and use of global project management standards and in assisting organisations in categorising their projects in order to develop and appoint project personnel with the right competencies to manage them. Data drawn from self assessments, verified by workplace assessors, provide useful feedback to both researchers and practitioners on the validity and reliability of using self assessments in this context.

Research Methodology

Data for this research was collected as part of a wider study of project management competence conducted utilising demographic and project management specific instruments used in previous research by Crawford (2000, 2004a). The instruments were updated to reflect changes to the project management industry since they were created. Most changes are minor, the only exception being the replacement of the Australian National Competency Standards for Project Management with the newly released Global Framework for Performance Based Competency Standards for Global Level 1 and 2 Project Managers, and the addition of CIFTER Table, released by GAPPS in 2006.

Data was collected through a web-based questionnaire and included demographic details, project management experience, project management knowledge, project management practice, stressful situation appraisal and coping strategy selection and application. A range of statistical analysis tools were applied to the data sub-set including Pearson Correlations, Regression Analysis and Psychometric Stability tests including Cronbach Alphas.

Participants

Subjects for this study included experienced project managers (N=150) from eleven organisations that agreed to participate in the study. The sample included 119 males (79.3%) and 31 females (20.7%). The sample was geographically dispersed as indicated in Table 3 below. The four countries that contributed over half the sample population include Australia (25.3%), UK (15.3%), USA (13.3%) and China (8%).

Table 2 - Gender Analysis

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid f	31	20.7	20.7	20.7
m	119	79.3	79.3	100.0
Total	150	100.0	100.0	

Table 3 - Geographic Dispersment

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Australia	38	25.3	25.3	25.3
Bangladesh	3	2.0	2.0	27.3
Brazil	1	.7	.7	28.0
China	12	8.0	8.0	36.0
Germany	6	4.0	4.0	40.0
Greece	2	1.3	1.3	41.3
Hong Kong	2	1.3	1.3	42.7
India	3	2.0	2.0	44.7
Ireland	1	.7	.7	45.3
Japan	4	2.7	2.7	48.0
Malaysia	4	2.7	2.7	50.7
Mexico	1	.7	.7	51.3
New Zealand	10	6.7	6.7	58.0
Oman	2	1.3	1.3	59.3
Pakistan	2	1.3	1.3	60.7
Singapore	11	7.3	7.3	68.0
Spain	1	.7	.7	68.7
Thailand	3	2.0	2.0	70.7
UK	23	15.3	15.3	86.0

USA	20	13.3	13.3	99.3
Vietnam	1	.7	.7	100.0
Total	150	100.0	100.0	

Data Analysis

This paper reports on the analysis of a subset of the total data captured during this study. The data used includes, the *demographics*, gender and country of residence; six items from the project experience questionnaire including, *whether the majority of projects run by the subject were internal or external to their organisation, the level of authority the subject had as the project manager on their projects, whether the subject usually managed projects that were similar in nature or a wide variety of project types (degree of innovation), whether the project was well or ill defined, whether the project goals were well or ill defined and the perceived level of project management maturity of the organisation in which the subject was employed.* The measure of organisational project management maturity was a single item measure based on five levels of organisational maturity similar to those defined by the Software Engineering Institute’s Capability Maturity Model Integrated (SEI, 2006) where

- 1 = ‘Initial, Ad hoc & Chaotic’
- 2 = ‘Repeatable, PM System and Experience’
- 3 = ‘Defined, Organisation Wide PM System’
- 4 = ‘Managed, Stable and Measured Processes’
- 5 = ‘Optimising, Organisation Focused on Continual Improvement’

Project Complexity is measured using the seven factor CIFTER model described above (GAPPS). Each factor is rated on a four point scale as shown in Figure 2. The Cronbach Alpha score is acceptable for this sample (0.688). The desired minimal level as defined by Nunnally and Bernstein (1994) is 0.70 however industry practice allows 0.60 as minimally accepted. The corrected item-total correlation for Factor 6 – Stakeholder Cohesion is below 0.3 indicating that it is measuring something different than the scale as a whole. Removal of Factor 6 increases the Cronbach Alpha score to 0.733.

A total project complexity score was created by adding the scores from all seven factors outlined in the CIFTER. The total CIFTER score was used to categorise each project as either below Global Level 1 (scores less than 12), Global Level 1 (scores 12 to 18) or Global Level 2 (score 19 or more).

A second set of data was collected during a follow up study involving project management assessors conducting two hour face to face interviews with a subset of the candidates who participated in the online questionnaire research. During the interviews each assessor rated the complexity level of the two projects being described in the self assessment questionnaire using the additional information gained during the interview. These assessor rated complexity levels are compared with the self assessed levels to determine the accuracy of the CIFTER when used as a self assessment tool.

Results

Correlation Analysis

Three sets of bivariate correlations were conducted to assess the relationship between the variables. All correlations are conducted using a Pearson product-moment correlation with a two-tail test of significance. Table 4 below shows the results of the bivariate correlations for the independent variable GAPPS Level of Complexity and the dependent variables from the project experience questionnaire. Several significant correlations were found. A small correlation was found between the level of complexity and the level of goal definition and a medium correlation was found between complexity and project definition. In both cases lower levels of goal definition and project definition were related to a higher level of project complexity. Not surprisingly project definition and goal definition were positively correlated. The less project definition available the less goal definition reported.

Perceived organisational maturity was moderately correlated to project manager's authority. The higher the level of perceived organisational maturity the greater the authority of the project manager. There was also a moderate correlation with goal definition: the greater the perceived organisational maturity the clearer the goals for the project were. (Note: the scale for project manager authority, project definition and goal definition runs in the opposite direction to the scale for complexity and organisational maturity.)

Table 4 - Project Experience Correlations

	1	2	3	4	5	6	7
1 GAPPS Level of Complexity	1	.160	-.077	.185	.321(**)	.266(**)	-.017
2. Internal vs. External Project	.160	1	-.086	.153	-.099	-.127	.073
3. Project Managers Authority	-.077	-.086	1	-.039	-.029	.017	-.205(*)
4. Similarity of Projects	.185	.153	-.039	1	.157	.029	.033
5. Project Definition	.321(**)	-.099	-.029	.157	1	.468(**)	-.197
6. Goal Definition	.266(**)	-.127	.017	.029	.468(**)	1	-.363(**)
7. Organisational Maturity	-.017	.073	-.205(*)	.033	-.197	-.363(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

N= 97

The second correlation analysis to be conducted compared the seven individual factors of complexity from the CIFTER Table (GAPPS) with the six project experience measures. The less well defined a project was reported as being, the less stable the project context (Factor 1), the higher the financial impact (Factor 4) and the greater the number of interfaces (Factor 7) reported. Greater Stakeholder Cohesion (Factor 6) is related to external projects, clearer goal definition and greater perceived organisational maturity. Organisational maturity is also positively correlated with strategic importance – Factor 5. Factor 7, the number and variety of interfaces, is related to lower project and goal definition and greater variability in project type.

Table 5: Project Experience Measures and Complexity Factors

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
1. Internal vs. External Project	.052	.066	.149	.117	.163	.249(*)	.112
2. Project Managers Authority	-.024	-.058	-.153	-.206(*)	-.192	.118	-.089
3. Similarity of Projects	.009	-.142	.211(*)	.174	.288(**)	.043	.235(*)
4. Project Definition	.270(**)	.121	.125	.242(*)	.077	.119	.235(*)
5. Goal Definition	.176	.065	.125	.185	.077	.296(**)	.300(**)
6. Organisational Maturity	-.139	.035	.201(*)	.044	.217(*)	-.284(**)	-.064

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

N = 97

Finally the seven factors of the CIFTER table (GAPPS) were analysed to assess for any relationships between the factors. Strong relationships were recorded for all factors except for Factor 6 – stakeholder cohesion which is moderately correlated with Factor 1 – stability of the context but is not related with any significance to any of the other factors.

Table 6: Complexity Factors

	1	2	3	4	5	6	7
Factor1	1	.219(**)	.170(*)	.192(*)	.004	.381(**)	.202(*)
Factor2	.219(**)	1	.433(**)	.335(**)	.187(*)	.129	.357(**)
Factor3	.170(*)	.433(**)	1	.387(**)	.389(**)	-.001	.488(**)
Factor4	.192(*)	.335(**)	.387(**)	1	.387(**)	-.014	.344(**)
Factor5	.004	.187(*)	.389(**)	.387(**)	1	-.140	.528(**)
Factor6	.381(**)	.129	-.001	-.014	-.140	1	-.030
Factor7	.202(*)	.357(**)	.488(**)	.344(**)	.528(**)	-.030	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

N = 150

Regression Analysis

A standard multiple regression was conducted to explore the predictive power of each of the factors of the CIFTER in relation to the overall GAPPS complexity level. The sample size for this regression is 150. Sample size guidelines vary between authors, Stevens (1996) as quoted in (Pallant, 2005) states that the sample size should be at least 15 times the number of independent variables. On this basis, the minimum sample size for this study is (7 X 15) 106. An alternative formulation is suggested by Tabachnick and Fidell (2001) quoted in (Pallant, 2005) as being $N > 50 + 8 * m$ (m = number of independent variables). By this calculation the sample size for a regression analysis to be conducted is 105. The sample size for this regression of 150 is well in excess of both these recommendations and therefore a valid sample.

Table 7 below depicts the descriptive statistics for the regression analysis. The mean score for each of the factors is above two with factors five and seven having mean scores greater the 3. An analysis of the correlations shows that all factors except Factor 6 have a correlation greater than 0.3 and lower than 0.7. Factor 6's correlation is lower than 0.3 (0.194) however it is retained within the regression model.

Table 7 - Descriptive Statistics - Regression Analysis

	Mean	Std. Deviation	N
GAPPS Complexity Level	1.53	0.527	150
Factor1	2.49	0.833	150
Factor2	2.61	0.776	150
Factor3	2.39	1.015	150
Factor4	2.83	0.873	150
Factor5	3.39	0.775	150
Factor6	2.02	0.815	150
Factor7	3.06	0.861	150

The regression analysis shows that 71.3% of the variance in the GAPPS Complexity Level can be explained by the seven factors of the CIFTER table. Six of the seven factors of the CIFTER make a significant contribution to the GAPPS Complexity Level. Factor 7 – Number and Variety of Interfaces makes the largest unique contribution (beta = .319), followed by Factor 3 - Magnitude of legal, social, or environmental implications (beta = .241), Factor 4 – Financial Implications (beta = .216), Factor 5 – Strategic Importance (beta = .192), Factor 6 = Stakeholder Cohesion (beta = .171) and finally Factor 1 = Stability of the Context (beta = .133). Factor 2 = Number of Distinct Methods and Disciplines was the only factor to not contribute uniquely in any significant way.

CIFTER rating Self vs. Assessor Rating Analysis

Forty nine of the self assessed projects were compared with ratings made by independent assessors, of the same projects. The results show 83.67% of self ratings of the GAPPS Complexity Level are rated at the same level by the assessors.

Discussion

The results of this study demonstrate that overall the CIFTER is a valid instrument for assessing and categorising projects by complexity. The internal reliability analysis demonstrates a Cronbach Alpha of 0.688. However the internal reliability analysis and the correlation analysis show that Factor 6 – Stakeholder Cohesion may be assessing something different from that of the scale as a whole. Removal of Factor 6 increases the Cronbach Alpha score to 0.733. This is a point that should be considered by the GAPPS working groups when reviewing and updating the CIFTER.

Project and Goal Definition are significantly related to a number of the factors analysed in this study. Lower levels of project and goal definition are significantly related to the overall GAPPS Complexity Level and project definition is positively correlated to Factor 6 – Stakeholder Cohesion. Reflecting on the weak data found for Factor 6 project and goal definition may be better definition of this factor than Stakeholder Cohesion. As lower levels of goal definition and project definition may also be assumed to relate to more novel or innovative projects, this suggests support for a view that projects that are more innovative may also be perceived as more complex.

The regression analysis shows that 71.3% of the variance in the GAPPS Complexity Level scores can be explained by the seven factor CIFTER model. This is a significant portion of the variance and each of the factors except for Factor 2 (Number of Distinct Methods and Disciplines) make a significant unique contribution. These results provide additional support for the validity of the CIFTER and the predictive value of each of the individual factors.

Finally the analysis of the assessor and self ratings of forty nine individual projects shows that in 83.67% of cases the self assessed GAPPS Complexity Ratings were accurate. These results provide support for the CIFTER as a valid self assessment tool.

Further Research

As noted above, this paper reports on analysis of only a part of the data collected for the 150 participants in the study. One avenue for further research into management complexity of projects is ongoing data collection, increasing the number of participants and sample size. Most relevant to the issue of project complexity is analysis of project management competency, stressful situation appraisal and coping strategy selection and application to identify correlations with Complexity Ratings. This further analysis has significant potential value for practitioners by enhancing understanding of the nature and impact of complexity in projects, contributing to understanding of relationships between

aspects of project complexity and stress and to assist in the development and assignment of appropriately experienced and competent project personnel.

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