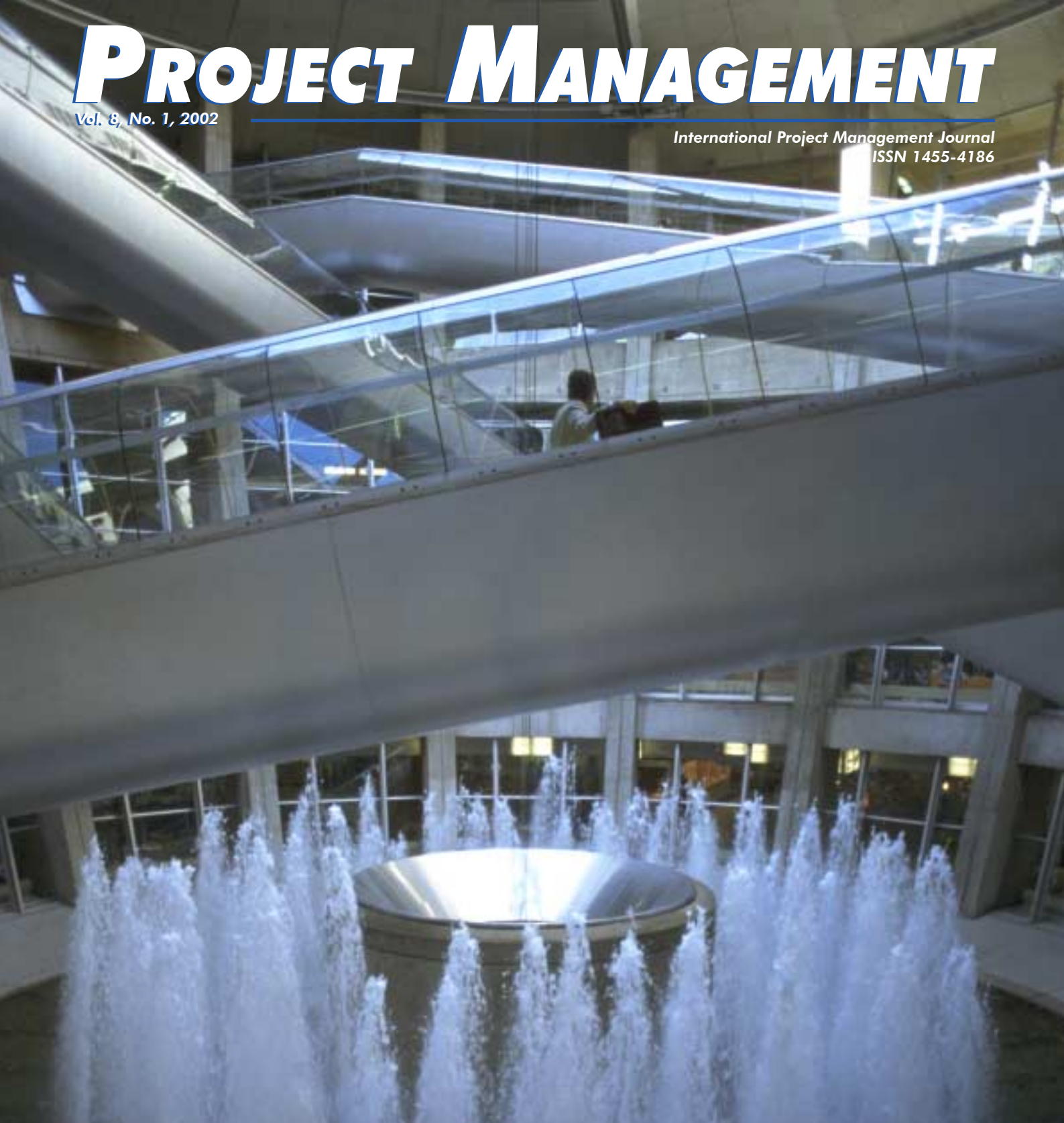
PROJECT MANAGEMENT

Vol. 8, No. 1, 2002

International Project Management Journal
ISSN 1455-4186



FRAMEWORK OF MISTRUST
HOLISTIC RISK MANAGEMENT
SUCCESFUL PROJECT MANAGER
MANAGING PROJECT INTERDEPENDENCIES

Publisher: Project Management Association Finland

Inquiries

Address submissions and inquiries to:

Karlos A. Artto, Editor-in-Chief

Helsinki University of Technology
P.O. Box 9500, FIN-02015 HUT, Finland
Telephone +358 9 451 4751
Facsimile +358 9 451 3665
E-mail: Karlos.Artto@hut.fi

More information about the journal can also be found from the Project Management Association Finland web site at: http://www.pry.fi/pmaf_mag.htm

Submissions

Manuscripts should be submitted to the Editor-in-Chief in electronic format by E-mail.

Journal Policy

Project Management, ISSN 1455-4186, is published by Project Management Association Finland (PMAF).

The mission of Project Management (PM) is to promote theory and practice in the field of project management and project-oriented business. It is the policy of PMAF to publish one issue of PM yearly, which will be distributed free of charge. In addition to the world-wide free distribution, the Finnish project management association includes the yearly issues in its publications list, which enables that individuals and organizations outside the distribution network can have single copies to be sent to them for a reasonable price. The main distribution channels comprise circulation arranged by national project management associations to their members and distribution to the attendants of international events on project management in cooperation with the arranging organization. The circulation of the journal is 5 000 copies. The aim of PM is to reach extensively interest of project management experts and professionals worldwide in any sector both in academic world and industry, and this way to extend communication between all different sectors of industries including the public sector, universities and research organizations.

The PM seeks articles on any aspects of project management for publication. In addition to reviewed academic articles, it welcomes papers of more practical nature. Authors are encouraged to submit the following types of original manuscript: summaries of research results; surveys on current practices; critical analysis and developments of concepts, theories, practices, methodologies, application or procedures; analyses of success or failure in the business context; and case studies. In the selection of research paper manuscripts for publication the primary importance will be based on the original contribution and novelty value and the extent to which they advance the knowledge on project management. In selecting application papers, it is required that the paper discusses recent advancements of project management in any industrial sector or public sector in terms of empirical applications, applicability, and practical utility. Papers are submitted in electronic format to the Editor-in-Chief.

Copyright notice

International Board of Advisors and Contributors

Table of Contents

Cover: Photograph by Aki Latvanne

Do Project Success Studies Contribute towards New Successful Project Management Practices?

Keywords: Project Success, Project Management, Project Portfolio Management, Business Management, Business Strategy, Strategic Management, Project Risk Management, Project Types, Project Classification

Karlos A. Artto,
Editor-in-Chief,
Project Management

Many articles in this issue of the Project Management discuss project success or measurement of how successful the investigated projects would be, or have been. Furthermore, also many other articles tend to suggest rethinking project management by extending the content of systematic project management to new areas. I believe that project success studies may serve as most effective contributors to adaptation of more and more successful project management practices in companies.

Project success studies often discuss the important aspect of the overall context where a single project occurs. This reflects the necessity of evaluating the success of any project in its contextual framework. The adaptation of viewpoints including the environment of a project and its stakeholders extend the evaluation of success beyond the traditional Iron Triangle of evaluating the project against the mere constraints of time, cost and scope. Adopting a wider perspective on success introduces the need to develop new project management practices at the level of single projects. This helps managing projects towards an outcome that would be considered successful in the overall contextual framework where the project occurs.

I find analogies between the wide success viewpoint that often considers projects in their business environments, and the recent project portfolio management research in my university that contributes to the management of projects by adopting the perspective of how an entire project-based organization is managed effectively (see Aalto et al. 2002, Artto et al. 2002, Artto et al. 2001,

Dietrich and Artto 2001, Dietrich et al. 2002, Elonen and Artto 2002, Hameri and Artto 2002, Ikonen and Artto 2002, Martinsuo and Dietrich 2002, Rintala et al. 2002). This research promotes project management towards companies' business management by aligning projects and their management to the organizational context of management of the whole corporation.

More and more review studies have been conducted recently that make an attempt to analyze existing knowledge and research in the field of project success (Deleslie 2001, Dyrhaug 2002, Poskela 2001, Saravirta 2001). A wide array of studies covering the well-known project failure theme relate indirectly to the success issue (Ingram 1998, Kharbanda and Pinto 1996, Kharbanda and Stallworthy 1983, Pinto 1997, Standish Group 1995). However, project failure studies consider issues that relate to non-successful outcomes, but such studies often fail to cover the conditions or activities that would strengthen occurrence of successful outcomes. This occurs as hedging against unfavorable outcomes does not often mean that such hedging would simultaneously enhance favorable outcomes. Furthermore, many recent project risk management studies have introduced the importance of managing potential favorable future business events rather than fighting against the unfavourable ones (Artto et al. 2000, Chapman 2000, Kähkönen and Artto 2000, Pitkänen 1999). Such studies often introduce the terms opportunity, uncertainty and ambiguity that better convey the aspects of favorable - or more successful - future business. In repetitive production environments, decisions on perfecting of future activities are based on measuring the past. I do not underestimate the value of such ex post measurement of risk/opportunity-related occurrences or successful business outcomes and their causes or drivers in project environments. However, unique projects are future-oriented vehicles that require the future success to be managed well before the point of time when the final outcomes become known. Analogously to the management of project risks, active management of future success with projects requires that effective estimating and decision making are in place.

The recent studies on project success provide insight on the alignment of a project with the underlying business purpose and business environment. According to Saravirta (2001) and Kotsalo-Mustonen (1996), the relevant success domains are related to: strategy (e.g. new competitive advantage, reference value); relationship (e.g. client satisfaction); situation (e.g. learning by doing, unlearning); product/service (e.g.commercial success, quality); and project implementation (e.g. cost, time, process quality). Furthermore, evaluation of success depends on the stakeholder and its perspective on the project. From Morris and Hough (1989) and Rouhiainen (1997) we can derive the following synthesis of what the important success domains are: 1) Technical performance, project functionality, client satisfaction, and technical and financial performance of the deliverable for the sponsor/customer; 2) Project management: on budget, on schedule, and to technical specification; 3) Supplier's commercial performance: commercial benefit for the project service providers; 4) Learning that project stakeholders acquire. Shenhar et al. (1997) introduce the following four dimensions of project success: project efficiency; impact on customer; business success; and preparing for the future. The success domains/dimensions in success studies are analogous to the four perspectives of Balanced Scorecard introduced by Kaplan and Norton (1992, 1996). The four perspectives introduced by Kaplan and Norton are: customer; financial; internal business process; and learning and growth. The scorecard can be used to derive objectives and measures from company vision and strategy, that finally can be derived further to project-specific objectives that are well aligned with business strategy.

Project success and success criteria vary by project type and by application area. For example, according to Brown and Eisenhardt (1995), important success factors of product development include cross-functional teams enabling cross-functional integration, effective internal and external communication, powerful project leader, and senior management support. Furthermore, the Brown and Eisenhardt discuss the important role of team tenure that reflects the effectiveness of the pattern of working together, the important role of gatekeepers as individuals who supply external information to the team, and the important role of team group process that enables effective internal and external communication within the team and with customers, suppliers, and other individuals in the organization. The recent project classification studies are valuable for increasing understanding not only on different project types and their characteristics, but also on different success criteria related to each type, and accordingly, different successful managerial practices with each project type (Crawford et al. 2002, Shenhar et al. 2002, Youker 1999).

Project success studies contribute to definition of new managerial areas for the management of projects and project portfolios. Existing project success studies introduce important business-oriented aspects for the management of projects from the perspective of management of an entire project-based organization. However, many studies still limit their views to the success and successful management of one single project only, without in-depth consideration of management of the organization's portfolio of projects as a whole.

Karlos A. Artto

Helsinki University of Technology (HUT), Finland
Department of Industrial Engineering and Management

P.O. Box 9500
FIN-02015 HUT
Finland

Tel +359 9 451 4751
Fax +358 9 451 3665
E-mail Karlos.Artto@hut.fi

References

Aalto T., Martinsuo M., Artto K. A., 2002. Project Portfolio Management in Telecommunications R&D: Aligning Projects with Business Objectives. In: Korhonen T. O. and Ainamo A. (eds.): Guide to High-Tech Product Development, Applications and Equipment, Kluwer Academic Press (Forthcoming)

Artto K. A., Dietrich P. H., Ikonen T., 2002. Industry Models of Project Portfolio Management and Their Development, PMI Research Conference 2002, Project Management Institute, Seattle, Washington, USA, July 14-17, 2002, pp. 3-13

Artto K. A., Kähkönen K., Pitkänen P. J., 2000. Unknown Soldier Revisited: A Story of Risk Management, 1st Edition, Project Management Association Finland, Helsinki, Finland, 114 p.

Artto K. A., Martinsuo M., Aalto T. (Eds.), 2001. Project Portfolio Management: Strategic Management through Projects, Project Management Association Finland, Helsinki, 176 p.

Brown S. L., Eisenhardt K. M., 1995. Product Development: Past Research, Present Findings, and Future Directions. Academy of Management Review, 20:2, pp. 343-378

Chapman C., 2000. Project Risk Management: The Required Transformations to Become Project Uncertainty Management, PMI Research Conference 2000, Project Management Institute, Paris, France June 2000, pp. 241-245

Crawford L., Hobbs J. B., Turner J. R., 2002, Investigation of Potential Classification Systems for Projects, PMI Research Conference 2002, Project Management Institute, Seattle, Washington, USA, July 14-17, 2002, pp. 181-190

Deleslie C. L. 2001. Success and Communication in Virtual Project Teams. Dissertation, The University of Calgary, Canada, 428 p.

Dietrich P. H., Artto K. A., 2001. Project Portfolio Application for a Public Sector Organization. PM Research Conference Vienna VIII, Austria, November 2001

Dietrich P., Järvenpää E., Karjalainen J., Artto K., 2002. Successful Management in Multi-project Environment, European Academy of Management EURAM, Stockholm, May 2002

Dyrhaug Q., 2002. A Generalized Critical Success Factor Process Model for Managing Offshore Development Projects in Norway, Doctoral Dissertation, Norwegian University of Science and Technology NTNU, Trondheim, Norway, 233 p.

Elonen S., Artto K. A. 2002. Project Portfolio Management - Managerial Problems in Business Development Portfolios, Fifth International Conference of the International Research Network on Organising by Projects IRNOP V, Renesse, The Netherlands, May 2002

Hameri A-P., Artto K. A., 2002. Successful Implementation of Complex Projects with Decentralised and Centralised Management Schemes, European Academy of Management EURAM, Stockholm, May 2002

Ikonen T., Artto K. A. 2002. Project Portfolio Management as a Means to Manage Important Systemic Connections Between Biotech Projects, 16th IPMA World Congress on Project Management, International Project Management Association IPMA, Berlin, June 2002

Ingram T. 1998. How to Turn Computer Problems into Competitive Advantage. Project Management Institute, 240 p.

Kaplan R. S., Norton, D. P., 1992. The Balanced Scorecard - Measures That Drive Performance,

Harvard Business Review, January-February 1992

Kaplan R. S., Norton D. P., 1996. The Balanced Scorecard - Translating Strategy into Action, Boston Massachusetts, Harvard Business School Press, 322 p.

Kharbanda O. P, Pinto J. K., 1996. What Made Gertie Gallop? Lessons from Project Failures, Van Nostrand Reinhold, USA, New York, USA, 368 p.

Kharbanda O. P., Stallworthy E. A., 1983. How to Learn from Project Disasters - True-life Stories with a Moral for Management, Gower Publishing Company, Hampshire, United Kingdom, 274 p.

Kotsalo-Mustonen A., 1996. Diagnosis of Business Success: Perceptual Assessment of Success in Industrial Buyer-seller Business Relationship. Helsinki School of Economics and Business Administration, Publications A-117, Dissertation, Helsinki, Finland, 252 p.

Kähkönen K., Artto K. A., 2000. Balancing Project Risks and Opportunities, Proceedings of Project Management Institute PMI'2000, Symposium and Seminars, Houston, Texas, PMI , September 2000, pp. 965-969

Martinsuo M., Dietrich P., 2002. Public Sector Requirements Towards Project Portfolio Management, PMI Research Conference 2002, Project Management Institute, Seattle, Washington, USA, July 14-17, 2002, pp. 361-370

Morris P. W. G., Hough G. H., 1989. The Anatomy of Major Projects - A Study of the Reality of Project Management, John Wiley & Sons, Chichester, 326 p.

Pinto J. K., 1997. Understanding Project Risk: Lessons from Past Failures, pp. 41-48, in: Kähkönen K. and Artto K. A. (eds.): Managing Risks in Projects, E & FN Spon, London, United Kingdom, 375 p.

Pitkänen P., 1999. Project Management Applications in Industry, Project Management Association Finland, Helsinki, 89 p.

Poskela J., 2001. Success and Relevant Measures in a Project Delivery Chain, Helsinki University of Technology, Department of Industrial Engineering and Management, Master's Thesis, Espoo, Finland, 118 p.

Rintala K., Poskela J., Artto K., Korpi-Filppula M., 2002. Information System Development for Project Portfolio Management, 11th International Conference on Management of Technology IAMOT, Miami Beach, Florida, March 2002

Rouhiainen P., 1997. Managing New Product Development Project Implementation in Metal Industry, Tampere University of Technology, Publications 207, Dissertation, Tampere, Finland, 293 p.

Saravirta A., 2001. Project Success through Effective Decisions: Case Studies on Project Goal Setting, Success Evaluation and Managerial Decision Making. Acta Universitatis Lappeenrantaensis 121, Dissertation, Lappeenranta University of technology, Lappeenranta, Finland, 286 p.

Shenhar A. J., Dvir D., Lechler T., Poli M., 2002. One Size Does Not Fit All - True For Projects, True For Frameworks, PMI Research Conference 2002, Project Management Institute, Seattle, Washington, USA, July 14-17, 2002, pp. 99-106

Shenhar A. J., Levy O., Dvir D., 1997. Mapping the Dimensions of Project Success, Project Management Journal, 28:2, pp. 5-13

Standish Group, 1995. Chaos - Study on Software Project Failures, http://www.standishgroup.com/chaos.html

Youker R., 1999. The Difference between Different Types of Projects, Proceedings of Project Management Institute Annual Seminars and Symposium, Philadelphia, PA

Management Roles for Successful IT Projects

Jan Terje Karlsen, Norwegian School of Management, Norway
Petter Gottschalk, Norwegian School of Management, Norway

Keywords: IT projects, Management Roles, Project Success

This paper presents empirical research aimed at identifying management roles for successful information technology (IT) projects. Leader, resource allocator, spokesman, entrepreneur, liaison and monitor are management roles evaluated in this research. The various dimensions of IT project success include project performance, project outcome, system implementation, benefits for the client organization, and benefits for the stakeholders. A survey was conducted in Norway to collect data on management roles and project success. Research results indicate that IT project success is significantly related to the importance attributed to the roles of project leader, resource allocator and spokesman. Collected data also indicate that managers of IT projects emphasize the internal management roles - leader and resource allocator - significantly more than the external management roles such as monitor and liaison.

Introduction

The functions or tasks within the IT department are organized of most organizations as IT projects (Murch 2000). IT management has largely been a project-driven exercise. Whether the goal is to design, install or re-engineer, technology initiatives are often driven by aggressive deadlines and periods of frequent change. To get the job done, resources must be identified and allocated, and activities must be properly organized and structured in accordance with business and technical requirements (Gray and Larson 2000). Information technology projects come in many shapes and sizes, e.g. feasibility studies, development projects, design projects, implementation projects, upgrade projects, migration projects and support services projects (Schwalbe 2002). The project management approach to solving IT problems and employing opportunities involves both leaders and end-users, and it defines activities, plans and milestones, and responsibilities (Kerzner 2001). In IT projects the project managers are important players in making the most of the potentials of IT.

The need for improved performance in information technology projects has been emphasized in both empirical and prescriptive research studies (Atkinson 1999, Thite 2000). Cost, time and quality have over the last decades become inextricably linked with measuring the success of project management (Pinto 1998). Atkinson (1999) suggests that the benefits for the client organization and stakeholders are just as important performance measures for information technology projects as the time-cost-quality criteria. In his article Thite (2000) discusses leadership as an important determinant of performance in information technology projects. This paper discusses an empirical research aimed at identifying successful management roles for managers of information technology projects. The following research question is addressed: What management roles can predict the extent of IT project success? This research is important because there are few studies of management roles in IT projects and there is also a lack of empirical research on measuring and explaining IT project success.

One criticism of many studies is the poorly defined success measures. In the present study we use a project-specific typological approach, a multidimensional criterion for assessing project success, and a multivariate statistical analysis method.

Management Roles

Today's complex project setting requires even greater skills in leadership and management than ever before. In the highly competitive arena in which most IT projects operate, whether internal or external, the requirement to produce results that exceed the client's expectations has become the norm. Within project management, the concept of leadership has been studied extensively (Cleland 1995, Smith 1999, Thoms and Pinto 1999). Thite (2000) investigated leadership styles in information technology projects, and he made a distinction between technical leadership and transformational leadership. As opposed to Thite (2000) and other literature about project leadership, the concept of management roles is applied in this article. Leadership style can be defined as a focus on attention, while management role can be defined as a focus on behav-

ior. Mintzberg (1990, 1994) introduced the concept of management roles in the 1970s.

Managers undertake activities to achieve the objectives of the organization. Mintzberg (1994) notes a number of different and sometimes conflicting views of the manager's role. He finds that it is a curiosity of the management literature that its best-known writers all seem to emphasize one particular aspect of the manager's job to the exclusion of the others. In sum, they perhaps cover all the aspects, but even so does this fully describe the whole task of managing (Gottschalk 2000). Mintzberg's role typology is frequently used in studies of managerial work and is genderless.

In the context of IT management, Grover et al. (1993) identified the relevance of six roles from Mintzberg's role typology; leader, resource allocator, spokesman, entrepreneur, liaison and monitor. In this present research the same six roles were applied, using the following role descriptions:

- Leader. As the leader, the project manager is responsible for supervising, hiring, training, organizing, coordinating and motivating a cadre of project personnel towards the project goal. Literature has emphasized the impact of this role on project personnel. This role is mainly internal to the project.
- Resource allocator. The project manager must decide how to allocate human, financial, and information resources to the project. This role emphasizes planning, organizing, coordinating and controlling project tasks and is mainly internal to the project.
- Spokesman. As a spokesman the project manager extends his/her contacts outside the project to other areas of the organization. This role emphasizes acceptance of the project within the organization. Frequently, he or she must cross traditional departmental boundaries and become involved in matters of production, distribution, marketing, and finance.
- Entrepreneur. The project manager identifies the users' needs and develops solutions that change business situations. A major responsibility of the project manager is to ensure that rapidly evolving technical opportunities are understood, planned, implemented, and strategically exploited in the organization.
- Liaison. In this role, the project manager communicates with the external environment. This communication includes exchanging information with IS/IT suppliers, customers, buyers, market analysts, and the media. This is an active, external role.
- Monitor. This role emphasizes scanning of the external environment to keep up with relevant technical changes and competition. The project manager identifies new ideas from resources outside the organization. To accomplish this, the project manager uses many resources including vendor contacts, professional relationships, and a network of personal contacts.

The six roles are illustrated in figure 1. Leader and resource allocator are roles internal to the IT project. Spokesman and entrepreneur are roles internal to the organization. Monitor and liaison are roles external to the organization.

Success Criteria

According to Pinto and Slevin (1988a), there are few topics in the field of project management that are so frequently discussed and yet so rarely agreed upon as that of project success. Baccarini (1999) found that a review of the project management literature provided no consistent interpretation of the term project success.

In this research, the success framework suggested by Atkinson (1999) was applied because it seems to cover success criteria suggested in the research literature (Baccarini 1999, DeLone and McLean 1992, DeLone and McLean 1997, Kerzner 1987, Pinto and Slevin 1988a, Pinto and Slevin 1988b, Thite 2000, Wateridge 1995). Atkinson's (1999) framework called "the square root" consists of four success criteria. First, there are cost, time and quality, which traditionally have been the easiest way to measure project success (Shenhar et al. 1997). The second success criterion is the information system, the third is benefits for the client organization and finally the fourth is benefits for the stakeholder community. In this research we have added a fifth success criterion in which the focus is on system implementation. Hence, we apply the following five success criteria for information technology project success:

- Project performance. This is the traditional evaluation criterion for project success consisting of time, cost and quality. The project has to be completed within the time schedule and within the financial budget, and the technical requirements have to be fulfilled.

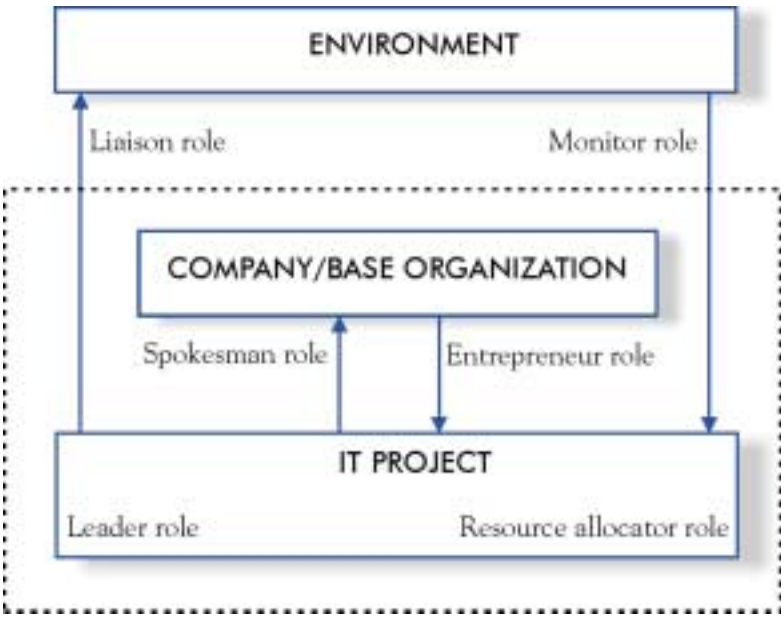


Figure 1. Management roles in IT projects

- Project outcome. This measurement is concerned with evaluation of the information system itself. Important dimensions include system maintainability, reliability, validity and information-quality use.
- System implementation. This is a criterion concerned with successful introduction, installation, training, use, and modification of the new information system. Important dimensions include actual use, and user acceptance.
- Benefits for the client organization. Important dimensions of this success criterion are improved efficiency and effectiveness, increased profits, achieving strategic goals, and organizational learning.
- Benefits for the stakeholders. Important dimensions of this success criteria are satisfied users, social and environmental impact, and personal development.

The five success criteria are illustrated in figure 2. Project performance and project outcome are success criteria internal to the project. Systems implementation and benefits for the client are success criteria internal to the organization. Benefits for the stakeholders are success criteria external to the organization.

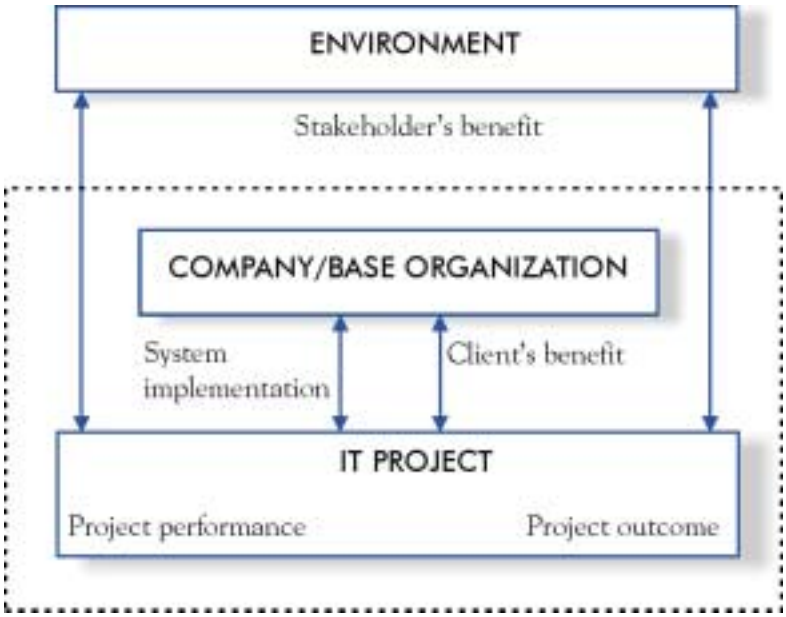


Figure 2. Success criteria for IT projects

Research Hypotheses

What kind of management skills are expected from project managers in today's competitive environment? According to Cleland (1995) and Zimmerer and Yasin (1998) the project manager must take a leadership role. Edum-Fotwe and McCaffer (2000) emphasize that leading is essential for project success. While Edum-Fotwe and McCaffer's (2000) perspective on leadership focuses on three levels - vision development, aligning people through communication, and motivating and inspiring subordinates, Thite (2000) highlights five transformational factors (attributed charisma, idealized influence, intellectual stimulation, inspirational motivation and individualized consideration) and three transactional factors (contingent reward, management-by-exception active and management-by-exception passive). According to Thite (2000), transactional leadership alone would lead to low project success, transactional leadership needs to be augmented with transformational leadership for high project success. Furthermore, Pinto and Slevin (1988b) found that troubleshooting and the project manager's ability to handle unexpected crises are critical success factors in the project execution phase. Hence, it is reasonable to hypothesize that project success depends on the leadership role. We propose the following hypothesis:

H1: Total project success is related to the importance of the leader role.

A characteristic of almost every project is scarcity of resources, such as human, financial and information resources (Meredith and Mantel 2000, Schwalbe 2002). This absence or shortage of resources makes the resource allocator role an important project management function. During the project period, the project manager frequently negotiates with the line organization about resource availability and utilization (Edum-Fotwe and McCaffer 2000). This management role also includes tactical activities such as planning and organizing of activities, which Pinto and Slevin (1988b) found to be critical for project success. Hence, we propose the following hypothesis:

H2: Total project success is related to the importance of the resource allocator role.

As a spokesman, the project manager has to take the end user's requirements seriously, build a trusting relationship, and focus on implementation and use of the information system. This role is emphasized by Ireland (1992) who directly relates it to the success of the project. Considering this management role, Smith (1999) argues that project success depends strongly on the end user's involvement and acceptance of the solution as implementation concerns. In another study of project success, Pinto and Slevin (1988b) found that client consultation and acceptance - a selling function - were of importance. Hence, we propose the following hypothesis:

H3: Total project success is related to the importance of the spokesman role.

The driving force behind project initiation involves the end users' needs (Davidson Frame 1995). As an entrepreneur, it is the project manager's role to identify the users' needs, and develop a fully acceptable solution. If articulating needs is done insufficiently, the project will be initiated on a poor foundation, and major problems will arise when implementing the system. This role is emphasized by Edum-Fotwe and McCaffer (2000), who state that the project manager is required to provide innovative solutions for both the product as well as the business processes involved in achieving the project's outcome. According to Pinto and Slevin (1988b), client consultation, a communication, listening, and feedback activ-

ity, and client acceptance are critical project success factors. Hence, we propose the following hypothesis:

H4: Total project success is related to the importance of the entrepreneur role.

Gilbert (1983) argues that management of stakeholders is an important project management activity. It includes establishing a trusting relationship between the project management and the stakeholders, which forms the basis for an exchange of information and resources. Management of stakeholders is also emphasized by Cleland (1986), who claims that project managers need to identify and interact with key institutions and individuals to reduce external risks. Hence, we propose the following hypothesis:

H5: Total project success is related to the importance of the liaison role.

The changing nature of the business environment during the project period makes the collection and analysis of relevant information critical. The managers are expected to broaden the scope of environmental scanning, and monitor the market for new technologies, markets and information. According to Rycroft and Kash (1999), the critical role of the manager is to monitor the possibility of major technological changes by looking for such indicators as technical community disintegration, foreign invaders, new technology waves, and climate changes. To identify new ideas or changes from sources outside the organization, a networking for interaction and communication with the market can be most helpful for the project manager (Kreiner 1995). Hence, we propose the following hypothesis:

H6: Total project success is related to the importance of the monitor role.

In figure 3 the paper's research model is presented. The model consists of six independent and five dependent factors which represent the basis for the proposed hypotheses.

Research Method

The Grover et al. (1993) instrument, which operationalized the management roles identified by Mintzberg and adapted them to the IT context, was used as a basis to investigate the roles of IT project managers. The rationale for choosing this instrument was based upon the high validity and reliability they and others have obtained within each of the managerial roles.

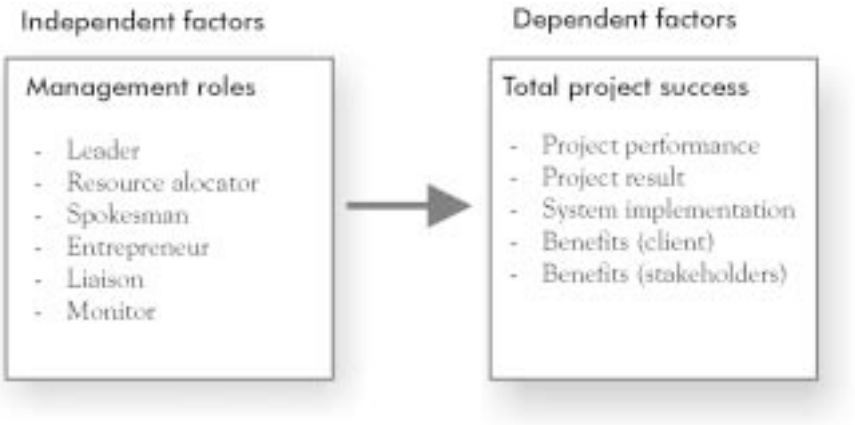


Figure 3. The research model

The present study consists of a survey conducted in Norway in 2001 to investigate the management roles. The research instrument contained forced-answer questions with a five-point Likert scale ranging from a high of 5 to low of 1. The respondents were asked to both rate the importance of each management role and the success criterion as it applies to the prevailing project.

A study sample of 673 companies was selected from the listing of members of the Norwegian Computing Society. It was assumed that these firms would tend to have project managers with job attributes consistent with our management role classification. Based on the availability of correct addresses, 591 questionnaires in English reached their destinations. Surveys with incomplete responses were deleted. After two mailings, a total sample of 70 was returned, each representing a specific project. The low response rate of 11.8 percent made us concerned about the non-response bias. After studying early and late responses, as well as responding industries, we have no reason to believe that there is any significant non-response bias. To examine the data for normality, skewness and kurtosis tests have been done, and destructive outliers have been excluded.

The measurement of project success by Atkinson (1999), extended with system implementation, was used as a basis to investigate project success related to the roles of project managers. The instrument contains thirty-eight items, divided into five predetermined success categories. To measure the reliability of each category of dependent variable, a factor analysis was employed.

The projects in our sample were performed in a variety of industries, including bank and finance, commerce and trade, manufacturing, service, transportation and public administration. The sample includes both projects that are characterized by routine work as well as research projects. The average size of each project in the sample was 14 participating persons (part or full time). 56% of the respondents were project managers. The study shows that 17.4% of the projects were carried out within a department, 29% were done across different departments, and 53.6% were organized as a new independent and temporary organization. Among the different project phases - initiation, planning, execution and termination - the data show that the users are the most deeply involved in the planning and execution phases of the project.

Data Presentation and Results

Table 1 shows the descriptive statistics for the independent variables of management roles, where the response scale ranged from 1 to 5 (1 = not important and 5 = very important). Means and t-tests (to assess statistical significance of the difference between two independent sample means) were used to examine the data from the survey. As we can see from the table, the internal project management roles, leader and resource allocator, are the most important. The management roles of monitor and liaison, which have a focus outside the project and client organization, are the least important roles. The table shows that there are twelve significant differences.

Variable	Mean	t-values				
		2	3	4	5	6
1 Leader	4.33	2.52*	2.44*	4.15**	7.26**	8.19**
2 Resource allocator	4.04		0.32	2.62*	5.06*	5.79*
3 Spokesman	4.00			2.07*	4.66**	5.55**
4 Entrepreneur	3.67				1.81	3.79
5 Liaison	3.37					1.48
6 Monitor	3.12					

Note: The statistical significance of the t-values is ** for p>.01 and * for p>.05

Table 1. Statistics for management roles

Construct	Measurement of Construct	Alpha
Project performance	Cost Time Quality Project process Technical requirements	0.820
Project outcome	Reliability The system works Technical performance Solving the given problem Availability Maintainability	0.755
System implementation	Make use of it Used extensively Meets its intended users needs Users involvement in implementation Minimal start-up problems Users satisfaction and acceptance of the system	0.724
Benefits (client)	Strategic importance Represent improved performance Increased efficiency Increased effectiveness Improved decision making Increased profit Organizational learning Makes desired information available	0.742
Benefits (stakeholders)	Contributed to personal development Positive social and environmental impact Stakeholders are positively affected Improved project management skills	0.600

Note: N=70

Table 2. Reliability of multiple item scales

Variable	Mean	t-values			
		2	3	4	5
1 Project performance	2.13	2.84*	1.13	0.29	-2.22*
2 Project outcome	1.93		-1.75	-2.23*	-5.33**
3 System implementation	2.03			-1.21	-4.67**
4 Benefits (client)	2.13				-3.54**
5 Benefits (stakeholders)	2.34				

Note: The statistical significance of the t-values is ** for p>.01 and * for p>.05

Table 3. Statistics for project success

The most interesting finding is that the leader role is significantly more important than all the other roles. From table 1 we can also observe that the two internal project management roles, leader and resource allocator, are found to be significantly more important than the two external roles, monitor and liaison.

Five multiple items scales were used to measure the construct for the dependent variable, project success, as listed in table 2. The variables exceed 0.60, and have an acceptable reliability. To improve the reliability of the fifth variable - benefits for the stakeholders - one item was deleted.

Table 3 shows the descriptive statistics for the dependent variable of project success, where the response scale ranged from 1 to 5 (1 = high success and 5 = no success). As we can see from the table, project outcome is the criterion which achieved the highest success, while benefits for the stakeholders is the criterion with the lowest success. The table shows that there are six significant t-values, indicating that project outcome is significantly more fulfilled than project performance, benefits for the client and benefits for the stakeholders.

Table 4 lists the correlation between the independent variables - management roles, and the dependent variables - project success criteria (see figure 3). The measurement of total project success includes all the five success criteria.

Hypothesis 1 predicts that total project success is related to leader role importance. The results presented in table 4 indicate a significant correlation between the independent and dependent variable ($r = .293$, $p = .014$). Thus, hypothesis 1 is supported. Consistent with our expectation, total project success is related to resource allocator role importance ($r = .259$, $p = .039$). Thus, hypothesis 2 is supported. It was hypothesized that total project success is positively related to spokesman role importance. This prediction is supported ($r = .341$, $p = .006$), hence hypothesis 3 is confirmed.

Further, our data analysis shows that success for the stakeholders is significant correlated to leader role importance ($r = .427$, $p = .000$), to resource allocator role importance ($r = .283$, $p = .032$), and to spokesman role importance ($r = .317$, $p = .016$). A significant correlation between successful system implementation and spokesman

Success criteria/ management roles	Leader	Resource allocator	Spokesman	Entrepreneur	Liaison	Monitor
Project performance	0.217	0.118	0.191	-0.088	0.091	-0.005
Project outcome	0.086	0.012	0.117	-0.013	0.122	0.121
System implementation	0.142	0.186	0.269*	0.047	0.219	0.054
Benefits (client)	0.117	0.183	0.084	0.031	-0.030	-0.123
Benefits (stakeholders)	0.427**	0.283*	0.317*	0.178	0.053	0.191
Total project success	0.293*	0.259*	0.341**	0.044	0.100	0.039

Note: The statistical significance of the correlation values is ** for p>.01 and * for p>.05

Table 4. Correlation matrix

role importance is also identified (r = .269, p = .035). As table 4 confirms, no other correlations between the independent and dependent variables are significant.

We conducted additional analyses looking at specific background variables regard the sample of projects, but no other significant correlations between management roles and total project success were identified.

Discussion and Implications

While recent studies on leadership and project management have focused on characteristics and skills of successful project managers (Thite 2000), this study has taken another perspective and concentrates on different project management roles. In this research, we examine the relationship between the importance of management roles and total project success.

The strongest finding of this research was that total project success is positively related to management roles importance. First, our results support the assertion of Edum-Fotwe and McCaffer (2000) that the leader function is essential for achieving project success. The findings are consistent with the critical success factors, project mission, personnel, communication and trouble-shooting identified by Pinto and Slevin (1988b). Second, our results indicate that the resource allocator role is positively related to project success, which underline the observation found by Pinto and Slevin (1988b) in their study of critical success factors. These two management roles are both internal to the IT project for the project manager, as illustrated in figure 1. Third, the finding of this study shows that spokesman role, which focuses on client consultations and acceptance for the project in the line organization, is significant for achieving project success. None of the other presented hypotheses were supported in the research.

Supplementary results show that IT project managers emphasize the leader role as the most important management role, while the monitor role was pointed out as the least important management role. Among the five different project success criteria that are studied, project outcome is the criterion which achieved the highest fulfilment.

The project manager is often called a hybrid manager because he/she must be able to work both with an internal and external focus, and must possess several competencies. In several articles it has been argued that project managers need to look more to the users' and other stakeholders' perception of success and failure. This view is particularly emphasized by Cleland (1995) in his discussion of leadership essentials, where he underlines the liaison and monitor role. Data from this survey show that IT project managers do not agree with this change in focus, since they identify the internal roles - leader and resource allocator - as the most important. A consequence of this focus is that project success and benefit for the stakeholders is given a lower priority by project managers.

The applicability of Atkinson's (1999) measurement of project success was well supported by the results of this study. The measurement included "the iron triangle" (cost, time and quality), technical strength of the result, benefits for the client organization and the benefits for the stakeholder community. In addition to these four success criteria, we included a fifth success criterion, system implementation, which was found to be reliable. What this tells us is that IT project managers should not only pay attention to the traditional success criteria such as cost, time and quality, but also focus on system implementation and the users' acceptance.

Conclusion and Recommendations

This research provides some empirical insight into the importance of different management roles for successful information technology (IT) projects.

First, the paper has discussed six different management roles which provide insight into behavioral aspects of project managers. These six roles consist of two internal project roles (leader and resource allocator), two roles external to the client organization (spokesman and entrepreneur) and two roles external to the stakeholder environment (monitor and liaison). The survey results show that the two internal management roles, leader and resource allocator are the most important roles.

The survey results have further provided an insight into how project success is measured, with not only a focus on the project performance and technical results, but also on the system implementation and benefits for the client organization and other stakeholders. Our findings show that project outcome is the success criterion which achieved the highest fulfillment.

Among the six hypotheses presented in the paper, three were supported. First, the survey data confirmed that project success is related to the importance of the leader role. Second, we found that there is a significant correlation between project success and the resource allocator role. Third, the analysis indicates that project success is positively related to the spokesman role.

We have learned from this research that IT project managers are internally oriented. It is our recommendation based on this study that IT project managers can be more externally oriented. It is always important that the project manager is goal oriented, but he or she must not forget the client and the reason why the project was established (Pinto and Slevin 1988a). Through an external orientation the project manager can improve the use of the project outcome and contribute to value creation for the client organization. Project stakeholder management is also important to manage external disturbances and threats from actors outside the project.

Future Directions for Research

Several suggestions for future research are relevant based the on concerns of the current study. First, the theoretical framework guiding this research should be improved. Several studies have provided interesting insights into the field of project management theory in terms of leadership styles and management characteristics. This paper has taken a different perspective - management roles, and further research should be done to improve the theoretical framework, i.e. to what extend can different kinds of management competencies explain the management roles. Project success is a concept that has long been limited to criteria such as time, cost and quality. This paper has a broader definition of project success, and includes system implementation, benefits for the organization and benefits for the stakeholders. This definition of project success should be further explored in future research. Second, key constructs should be explored. More evidence should be provided for the reliability and validity of the measurements used.

Jan Terje Karlsen

Norwegian School of Management

P.O.Box 580
1302 Sandvika, Norway

jan.terje.karlsen@bi.no
Tel +47 67 55 71 94
Fax + 47 67 55 76 78

Petter Gottschalk

Norwegian School of Management

P.O.Box 580
1302 Sandvika, Norway

petter.gottschalk@bi.no
Tel +47 67 55 73 38
Fax + 47 67 55 76 78

References

Atkinson, R., 1999.
Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria, International Journal of Project Management, vol. 17, no. 6, pp. 337-342.

Baccarini, D., 1999.
The Logical Framework Method for Defining Project Success, Project Management Journal, vol. 30, no. 4, pp. 25-32.

Cleland, D. I., 1986.
Project Stakeholder Management, Project Management Journal, September 1986, pp. 36-44.

Cleland, D. I., 1995.
Leadership and the project-management body of knowledge, International Journal of Project Management, vol. 13, no. 2, pp. 83-88.

Davidson Frame, J., 1995.
Managing project in organizations, 2nd Edition, Jossey-Bass Publishers, San Francisco, 247 p.

DeLone, W. H. and McLean, E. R., 1992.
Information Systems Success: The Quest for the Dependent Variable, Information Systems Research, vol. 3, no. 1, pp. 60-95.

Delone, W. H. and McLean, E. R., 1997.
A respecification and extension of the Delone and McLean model of IS success, Information Systems Research, vol. 8, no. 3, pp. 240-253.

Edum-Fotwe, F. T. and McCaffer, R., 2000.
Developing project management competency: perspectives from the construction industry, International Journal of Project Management, vol. 18, no. 2, pp. 111-124.

Gilbert, G. P., 1983.
The project environment, Project Management Journal, vol. 1, no. 2, pp. 83-87.

Gottschalk, P., 2000.
Information Systems Leadership Roles: An Empirical Study of Information Technology Managers in Norway, Journal of Global Information Management, October-December 2000, pp. 43-52.

Gray, C.F. and Larson, E.W., 2000.
Project Management: The Managerial Process, 1st Edition, McGraw-Hill, Boston, 496 p.

Grover, V., Jeong, S. R., Kettinger, W. J. and Lee, C. C., 1993. The Chief Information Officer: A Study of Managerial Roles, Journal of Management Information Systems, vol. 10, no. 2, pp. 107-130.

Ireland, L. R., 1992.
Customer satisfaction: the project manager's role, International Journal of Project Management, vol. 10, no. 2, pp. 123-127.

Kerzner, H., 1987.
In search of excellence in project management, Journal of Systems Management, vol. 38, no. 2, pp. 30-40.

Kerzner, H., 2001.
Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 7th Edition, Wiley, New York, 1203 p.

Kreiner, K., 1995.
In search of relevance: project management in drifting environments, Scandinavian Journal of Management, vol. 11, no. 4, pp. 335-346.

Meredith, J. R. and Mantel, S. J., 2000.
Project Management: A Managerial Approach, 4th Edition, John Wiley & Sons, New York, 616 p.

Mintzberg, H., 1990.
The Manager's Job: Folklore and Fact, Harvard Business Review, vol. 68, no. 2, pp. 163-177.

Mintzberg, H., 1994.
Rounding out the manager's job, Sloan Management Review, vol. 36, no. 1, pp. 11-26.

Murch, R.,
Project Management: Best Practices for IT Professionals, 1st Edition, Prentice Hall, New York, 247 p.

Pinto, J. K., 1998.
Project Management Handbook, 1st Edition, Jossey-Bass Publishers, San Francisco, 468 p.

Pinto, J. K. and Slevin, D. P., 1988a.
Project Success: Definitions and Measurement Techniques, Project Management Journal, vol. 19, no. 1, pp. 53-58.

Pinto, J. K. and Slevin, D. P., 1988b.
Critical Success Factors across the Project Life Cycle, Project Management Journal, vol. 19, no. 3, pp. 59-66.

Rycroft, R. W. and Kash, D. E., 1999.
Managing Complex Networks - Key to 21st Century Innovation Success, Research Technology Management, May-June 1999, pp. 13-18.

Shenhar, A. J., Levy, O. and Dvir, D., 1997.
Mapping the Dimensions of Project Success, Project Management Journal, vol. 28, no. 2, pp. 5-13.

Smith, G. R., 1999.
Project Leadership: Why Project Management Alone Doesn't Work, Hosp Materiel Management Quarterly, vol. 21, no. 1, pp.88-92.

Schwalbe, K., 2002.
Information Technology Project Management, 2nd Edition, Course Technology, Australia, 561 p.

Thite, M., 2000.
Leadership styles in information technology projects, International Journal of Project Management, vol. 18, no. 4, pp. 235-241.

Thoms, P. and Pinto, J. K., 1999.
Project Leadership: A Question of Timing, Project Management Journal, vol. 30, no. 1, pp. 19-26.

Wateridge, J., 1995.
IT projects: a basis for success, International Journal of Project Management, vol. 13, no. 3, pp. 169-172.

Zimmerer, T. W. and Yasin, M. M., 1998.
A Leadership Profile of American Project Managers, Project Management Journal, vol. 29, no. 1, pp. 31-38.

Key Elements of A Successful Project Manager

Bin Jiang, University of Texas at Arlington, USA

Keywords: Project Life Cycle, Internal and Nature Cycle, Hard and Soft Skills, Project Manager's Competencies

Organizations are changing at a breakneck pace in order to satisfy their customers and stay competitive. It is in this environment that project managers must learn to thrive, delivering products and services that meet the needs of the organization and assist businesses in delivering value to their customers. It is not surprising that project management has become a profession in its own right. Project managers who can be successful in this environment are sought after. The question that everyone is asking is, "What makes a project manager successful?"

Before that question can be answered, a more important question is, "What makes a project successful?" Why some projects might not achieve their objectives within pre-set parameters, or achieve them at an unacceptable cost, is an issue constantly evaluated by professionals and academics. Some would define a successful project simply as satisfying the client's requirements within schedule and budget limitations and without burning out the project team. In the real world, implementing projects within budget and schedule performance criteria can generally be improved.

Moore and Ahmad did a useful research on the topic that the human factor impacts the success of project. They are the first ones to mention the "Mature complacent decline" (Mcd) effect during a project life cycle. Mcd is really a good start for the further research on the necessary elements of a successful project manager. This paper will introduce the Mcd model to raise the importance of human factor in a project at first, and then point out that soft skills are more efficient to deal with the Mcd effect than hard skills; at last, the author argues that to be successful, a project manager must have a big picture view beyond a special project and hard/soft skills.

Internal Life Cycle vs. Natural Life Cycle

The following provides a useful description of the development of a model with four internal cycles that may affect teams during project implementation. An understanding of the totality of constraints affecting the project process is required if future performance is to improve.

Model background

One common theme throughout most of the literature is the idea of natural cycles (Cleland and King, 1983, Morris, 1994). These are essentially defined as the time periods it takes to develop and accomplish the features of implementation--such as design, construction, commissioning and handover of a facility or plant item to an asset owner. These sequential patterns are common throughout most projects and, thus, can be considered "natural."

The effect these sequential patterns have on internal development and maturing of project teams, and how they perceive and react to the complexity and stress present in the project process, is somewhat understood. Authors have developed various aspects of the process (Adams and Barndt, 1983, Thamhain and Wilemon, 1986). These range from the behavioral implications present in the project life cycle, to the perception of obstacles affecting schedule progress, to the determinant of successful project management.

Some authors have addressed the behavioral aspects of groups/teams, concentrating on issues such as adaptive mind patterns, group pressure/anxiety and perceptions of change (Lynn, 1990). Considering those authors' assertions, a model of internal cycles similar to natural ones has been developed (Figure 1).

Models in general are considered a reliable way of explaining complex behavior, and are used by diverse disciplines to map and predict change. Models seem to be a logical way of considering developments and they also incor-

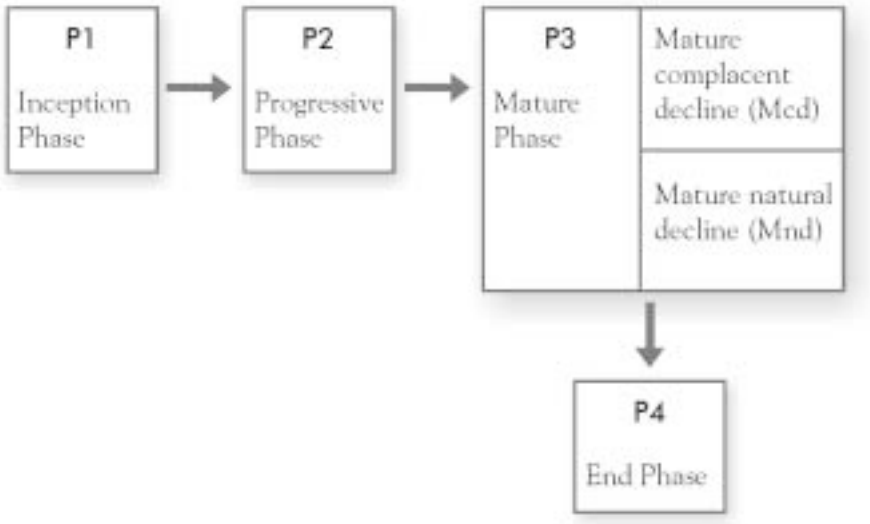


Figure 1. A model of project life cycle internal phase

porate an explanation of why, in certain circumstances, teams may fail to deliver their objectives, or deliver them at an unacceptable cost, through the action of mature complacent decline (Mcd)--a component of phase 3 of the model (Moore and Ahmad, 2000).

Phases

As the team implementing a project will be prime movers of the activity sequence through these complex natural cycles, it will be subjected to different pressures occurring during each particular phase. In responding to the requirements of natural cycles, project teams are, in fact, going through phases themselves--as a collective experience.

Thus, two types of cycles are occurring. One is a natural cycle, the other is an internal cycle affecting the project team (internal life cycle). A series of internal phases are occurring during the life of a project (Figure 1). The team moves through:

- Initial inception phase
- Progressive phase
- Mature phase
- End phase.

As internal cycles will influence progression through natural cycles, by measuring indicators of internal cycle, it should be possible to predict project success or failure. Table I summarizes this internal cycle model as related to a typical natural cycle model of the project engineering process.

Detailed analysis

All project management teams come together with a purpose in mind and a goal to achieve. Financial, human and material resources are pooled, objectives are laid down, and targets are set. This could be considered the Inception phase of the proposed internal cycle model.

As the team sets to work, progress is made in establishing the project systems. Interfaces and working methods are established, a coherent structure is laid down for the project, and patterns of control emerge. This is a very productive period and could be considered the Progressive phase.

As systems controls, interface management, functionality and authority, etc., take over, the project becomes established. When the process flows of input and output data become routine, it is the Mature phase. When projects enter the mature phase of the cycle, one of two things can happen. They can continue to mature and achieve an orderly/natural decline to the End phase "mature natural decline" (Mnd), or they can become complacent (chaotic) and enter a downward spiral. This results in unnatural decline "mature complacent decline" (Mcd), due to an early entry into the End phase.

Therefore in this model, decline can be considered in two ways:

- As the planned natural ending of a project by the erosion of task-time (Mnd).
- As unnatural decline by entering a complacency phase and eroding excessive time in relation to the tasks achieved (Mcd).

By this action, the project team induces the early arrival of the End phase, which is simply project termination by natural or complacent decline, Mnd or Mcd.

A study notes that job satisfaction "may be reduced" during the phase 3 period, due to personnel seeing themselves as resolving problems created by the errors and optimism of earlier project personnel (Adams and Barndt, 1983). The authors also noted that pressure to achieve project goals is intense in this period; conflicts were recorded to be high. This might indicate that triggering agents may be present in the process and responsible for inducing Mcd.

Internal cycle model	Natural cycle model
Inception phase	Development
Progressive phase	Design
Mature phase	Construction
End phase	Commission handover

Table 1. Comparison between two models

1. Loss of key players
2. Interface management disputes
3. Personal motivation
4. Imposed norms standards workload
5. Subcontractor performance
6. Time management

Table 2. Verified indicators for project prediction

Other researchers have reported that senior management tends to think the causes of "missed schedules and budget targets are due to inadequate project definition planning and control." (Thamhain and Wilemon, 1986). This study found that "problems with organizing the project team, weak leadership, communications, conflict, confusion and inappropriate/insufficient upper management involvement" were the real underlying issues. There are six indicators (Kinnear and Gray, 1994) that could be useful for further analysis (Table 2).

These predictor variables can be considered as evaluators of the extent that Mcd might influence the dependent variable, in particular project scenarios.

Result

This model builds on a prior evaluation of project life cycle, relative to their effect on the project team (Adams and Barndt, 1983). The phenomenon Mcd could be considered akin to failure as classified by management in a study where "missed schedules and budget targets are due to inadequate project definition, planning and control," indicating that management may not always consider that failure may have a social origin (Thamhain and Wilemon, 1986).

Variable	Hazard level
Loss of key players	Scrutinize: If three key persons are lost
Imposed norms standards workload (Unfreezing the workscope)	Scrutinize: Any (imposition, particulary over 20% of the original workscope)
Interface management disputes month	Scrutinize: If unresolved for over one
Subcontractor performance	Scrutinize: If performance drops below 15% of planned vs. actual

Table 3. Complacency appraisal data

Examine Table 3 in relation to a particular project's Mature phase and consider the predictor variables as stress focus points, which may act singularly or in combination initiating the process of Mcd (Moore and Ahmad, 2000). This indicates the potential that exists for circumstances to move into unproductive descent when lack of success is corrected for merely by ensuring cost, time, schedule, industrial relations and material resources are held constant.

Internal cycle offers a logical way of considering the life cycle of project teams. They offer a possible explanation of why some projects might vary in delivery of objectives as different aspects of the process are applicable to each phase. Maintaining the Progressive phase is advantageous. Management should work to maintain this position throughout the project's life.

Management should evaluate internal Progressive and Mature phases in relation to the actual activity schedule. They should look specifically for issues related to team decline--as opposed to schedule decline--using Table 3 as a guide.

The Key to Project Management Success

Project management is art as well as science. Understanding processes, tools, and techniques (the hard skills, the science of project management)-and knowing when and how to apply them-is only part of the answer. A greater piece of the puzzle for successful project delivery is soft skills (the art of maintaining the Progressive phase). Soft skills help to define the business value, clarify the vision, determine requirements, provide direction, build teams, resolve issues, and mitigate risk. Without the appropriate soft skills, the likelihood of project success diminishes.

Generally, we apply hard skills to project natural life cycle issues, and apply soft skills to project internal life cycle.

Hard Skills

Project managers must have the appropriate processes, tools, and techniques at their fingertips to deliver projects. A key resource to many project managers today is the Project Management Institutes Project Management Body of Knowledge (PMBOK), which provides the manager with generally accepted processes, tools, and techniques of project management. It groups the processes into nine knowledge areas, detailing what is required by the process (the inputs), what occurs during the process, and the deliverables of the process (the outputs). This document merely provides the project manager with a guide; the appropriate implementation of these processes, tools, and techniques on a given project is another challenge. Understanding the best way to do this comes with experience (Morris and Hough 1987).

It is true that the hard skills associated with these project management practices can be learned from a textbook and can be further developed through experience. But if a project manager focuses on these practices and skimps on the broader soft skills, success will be elusive. Consider the following scenarios (Claser, 1984):

- Managing scope without being able to clearly communicate its meaning can cause unclear deliverables and requirements and a dissatisfied client.
- Managing communications without the ability to develop an open and honest exchange of ideas within the project team can result in issues not being raised until they reach a critical point.
- Developing a project plan without engaging the team appropriately can lead team members to ignore the plan and create mistrust within the team.
- Making use of all these processes and procedures without displaying leadership in delivering the end product or service will result in failure.

Even with a mastery of hard skills and a keen sense of when to use them, a project will rarely be completely successful without the appropriate application of soft skills.

Soft Skills

A clear understanding of the soft skills of project management and the ability to apply these skills effectively throughout the internal life cycle of a project will enhance the success of a project exponentially. Few projects fail because the Gantt chart/PERT/CPM are wrong, the roles/responsibilities are not mapped out in a matrix, or the cost charts were off. More often they fail because of a project manager's inability to communicate effectively, work within the organization's culture, motivate the project team, manage stakeholder expectations, understand the business objectives, solve problems effectively, and make clear and knowledgeable decisions (Baker, Murphy, and D. Fisher, 1974). On the other words, the project manager can't maintain the Progressive phase of internal life cycle effectively.

The following soft skills are crucial for successful project management:

- Communication. This is, quite simply, the most important soft skill for all project managers. They

must have the ability to convey complex ideas easily, clearly articulate what must be accomplished, keep the team moving toward a common goal, foster an environment that allows team members to communicate openly and honestly, admit their own mistakes without loosing respect, negotiate, listen, facilitate the list goes on.

- Organizational Effectiveness. Project managers must understand the corporate culture, the organizational dynamics, and the individuals they are dealing with. With this understanding, they will be able to obtain resources more effectively, gain support, and build a stronger foundation for the effort.
- Leadership. Project Managers must lead. They frequently do not have direct authority, yet they do have direct responsibility. They must build authority through appropriate leadership.
- Problem Solving and Decision-Making. Resolving issues or solving problems is a large portion of what a project manager does every day. Each phase of a project has its own unique set of problems. Without strong problem-solving skills, the sheer volume of issues that are a normal part of every project will soon overwhelm the project manager.
- Team Building. Building a team in the business environment is a challenge. Co-location is not easy and rarely occurs. More frequently a project team is made up of borrowed resources from other functional areas within the organization and usually also has vendors and suppliers. Creating a team atmosphere where the team believes that "we are all in this together" is a critical component to project success.
- Flexibility and Creativity. Having a proven framework to guide a project manager is not enough. The project manager must also adapt to the needs of the project. Since every project is unique, each may require different components, templates, tools, and techniques. Using the "project manager toolbox" effectively will assist in delivering a successful project.
- Trustworthiness. The project manager must have the trust of all of the stakeholders involved in the project. Simply meeting deadlines is just one facet of this; a project manager must also be able to convey that he can be trusted day-to-day to do what is right at the right time to keep the project successful and the client satisfied.

The list above is not all-inclusive. Time management, stress management, customer relationship management, expectation management, coaching, mentoring, and sound business judgment are other soft skills that a project manager needs to be successful. The project manager's role now encompasses an enlarged set of skills that can be mastered only over time.

The following (Table 4) can show us the relationship between the hard/soft skills levels and the project manager's competencies (St Germain, 1997).

Competency	Entry Level	Mid Level	Senior Level
Leadership		Good	Mastery
Developing Staff		Good	Mastery
Motivation Skills		Good	Mastery
Fostering Creativity		Good	Mastery
Selling & Influencing		Good	Mastery
Conflict Resolution		Good	Mastery
Story Telling		Good	Mastery
Networking		Good	Mastery
Project Management Tools	Some	Excellent	Mastery
Change Management	Some	Excellent	Mastery
General Business Skills	Some	Excellent	Mastery
Negotiating	Some	Excellent	Mastery
Relationship Management	Some	Excellent	Mastery
Active Listening	Some	Excellent	Mastery
Facilitation	Some	Excellent	Mastery
Interviewing	Some	Excellent	Mastery
Presentation	Some	Excellent	Mastery
Analysis & Research	Some	Excellent	Mastery
Teamwork	Some	Excellent	Mastery
Ethics & Character	Some	Excellent	Mastery
General Business Knowledge	Some	Excellent	Mastery

Table 4. A model of project manager's competencies

Jump the Project Fence

Every project has to be caught through in an organization. Of course, a project manager operates within the context of the enterprise itself, and so a full understanding of the organization and how it works is essential. He or she must understand the "big picture" of the enterprise, the system in which daily activity takes place. In this "big picture," there are unwritten and written rules by which the organization operates, and the leadership structures/styles (St. Germain, 1997).

Written and Unwritten Rules

When undertaking a project, it is necessary to understand both the business's corporate culture (behaviour patterns and beliefs) and its organizational dynamics (an interactive system, especially one involving competing or conflicting forces). A project manager must work within these unwritten guidelines to be successful. An understanding of culture and organizational dynamics will dictate whom to work with, how to work with them, and why-not to mention more superficial but still important issues such as appropriate dress and work schedule.

It is also clear that both culture and organizational dynamics change over time. These changes come about through the restructuring, downsizing, or flattening of the organization itself or by changes in key players (the sponsor or support staff of the project), all of which could impact a project. These two portions, corporate culture and organizational dynamics, influence the business practices within the enterprise.

Understanding business practices, the written guidelines, is another key element. Each business unit within an organization may run projects differently. In some cases, business practices might be nonexistent, the participants expecting magic to deliver successful projects; in other situations, a clearly defined project management methodology might already be in place. If a project manager is not prepared to deal with this diversity and insists on sticking to a given method, no matter how strong the method is, the project could suffer. If a client, sponsor, user, or project team is expecting some information in a particular format and receives it in a different, less familiar form, confusion will likely result.

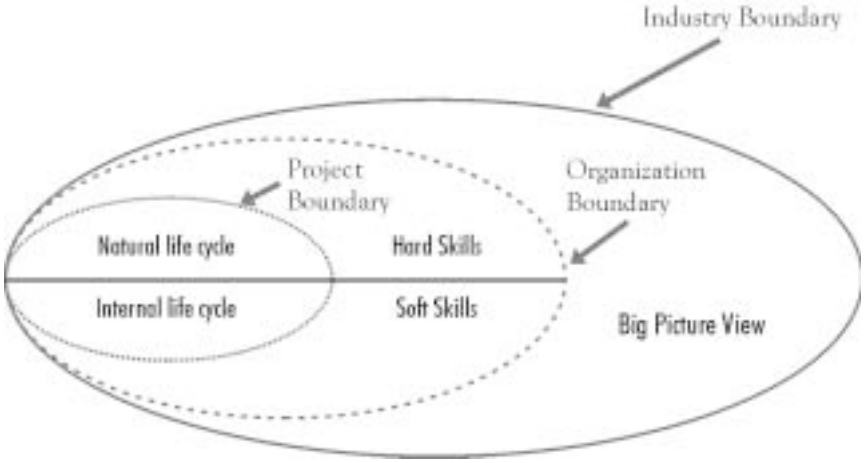


Figure 2. Jump the Project Fence

Building Relationships with Executives/Sponsors/Business Units

One would think that with the many volumes written about project management, executives, sponsors, and business units involved in a project would understand their roles and responsibilities. But instead there is often a gap between what is required from these audiences and what actually occurs. Working within the organization to educate these groups of people is a key responsibility of the project manager (Melymuka, 2000).

It is essential to guide the sponsor in building the relationships necessary for project success and to identify key individuals and groups within the organization that must be appropriately engaged. Without these relationships, a project can become mired in political bogs; it can be difficult to have changes approved and get sign-off on key phases, slowing the progress of a project to a crawl (Lauriano, 2000). On the other hand, strong relationships can help a project move forward. Building these relationships before the project gets started will ensure appropriate involvement, maintaining these relationships during the project will ensure successful implementation, and closing out the project on good terms with all involved will ensure that future efforts will have a greater likelihood of success.

Viewing projects as parts of a larger system

Dr. Deming and the total quality movement have taught us to focus on more than meeting project goals, because by focusing only on short-term, project-specific goals, we create products that are difficult to manufacture and service (St. Germain, 1997). This focus encourages us to concentrate on immediately visible deliverables, such as functions and features, rather than the broader and longer-term issues of customer acceptance and overall utility. Figure 2 provides a guideline for a project manager who is pursuing for a successful result. A successful project manager must consider the business value generated over the entire life of whatever he or she creates with projects. Simply meeting deadline or budget requirements does not define project success. Delivering business value does (Haransky,2000).

Although designing for manufacturability and serviceability is not a new concept, measuring the business value and impact of projects over their total life cycle or estimating their effect on the organization is quite difficult.

There is a second more significant reason to view projects as part of a larger system. Systems theory--or systems thinking (Senge, 1990)--looks at things as interconnected parts of a whole rather than as independent happenings. Viewing projects from this perspective provides some powerful insights.

Conclusion

Today's work environment is inherently complex, constantly changing, and focused on customer satisfaction. This environment is challenging the capabilities of project managers. Delivering business value on time, within budget, and to the customers' satisfaction is both science and art. Today's project manager must be able to apply the processes, tools, and techniques of the trade effi-

ciently and effectively throughout the natural life cycle to be successful. However, without mastering the timeless soft skills to supplement the hard skills by the internal life cycle control, few project managers will succeed. This combination of art and science, while taking into consideration the broader organizational context, will lead to successful projects.

Bin Jiang

Department of Information Systems and Management Science

College of Business Administration

Box 19437
535 Business Building
Arlington, Texas 76019, USA

E-mail: binjiang@marshall.usc.edu

References

Cleland D. I. and King W. R., 1983.
Life Cycle Management, Project Management Handbook, Van Norstrad Reinhold, New York.

Morris P.W.G., 1994.
The Management of Projects, Trowbridge, Redwood Books.

Adams J. R. and Barndt S. E., 1983.
Behavioural Implications of the Project Life Cycle. in Project Management Handbook, Cleland, D. I. and W. R. King, eds., Van Norstrad Reinhold, New York.

Thamhaim H. J. and Wilemon D. I., 1986.
Criteria for Controlling Projects According to Plan, Project Management Journal, June, XVII, Issue 2, 75-81. 1986.

Lewin K., 1997.
Frontiers in Group Dynamics, Human Relations, Vol. 1, No. 1, 05-42, 1997.

Lynn I., 1990.
Evolving Interpretations as Change Unfolds: How Managers Construe Key Organisational Events, Academy of Management Journal, Vol. 33, No. 1, 07-41, 1990.

Claser G., 1984.
"Managing Projects in the Computer Industry," IEEE Computer, October 1984.

Morris P.W.G. and Hough G. H., 1987.
The Anatomy of Major Projects, A Study of the Reality of Project Management, John Wiley & Sons, Chichester.

Baker B. N., Murphy D. C. and Fisher D., 1974.
Determinants of Project Success, N-74-30392 September, National Technical Information Service, Springfield, Virginia, 1974.

Anderson D.R., Sweeney D.S. and Willians T.A., 1993. Statistics for Business and Economics, West Publishing Co., St. Paul, Minnesota.

Senge P., 1990.
The Fifth Discipline: The Art and Practice of the Learning Organization, New York: Doubleday/Currency.

Moore T. and Ahmad M., 2000.
Can Project Success and Failure Be Predicted? Hydrocarbon Processing, 55-57, February 2000.

St. Germain R., 1997.
Humanizing Project Management: A Revolution in Progress. Information Strategy: The Executive's Journal, Spring 1997, Vol. 13 Issue 3, p30-34.

Melymuka K., 2000.
Born to Lead Projects. Computerworld, March 2000, Vol. 34 Issue 13, p62.

Lauriano D., 2000.
Take Project Management Seriously! Educause Review, May/June 2000, Vol. 35 Issue 3, p12.

Haransky S., 2000.
Designing Better Managers. Civil Engineering, April 2000, Col. 70 Issue 4, p66.

Joch A., 2001.
Project Managers' Next Step. EWeek, March 5, 2001 p51.

Stokes Jr., S., 1990.
Building Effective Project Teams. Information Systems Management, Summer 1990, Vol. 7 Issues, p38.

DeVoe D., 1999.
When All Eyes Are on You. InfoWorkd, April 1999, Vol. 21 Issue 15 p111.

On the Development of Project Management Research: Schools of Thought and Critique

Jonas Söderlund, Linköping University, Sweden

Keywords: Project, Project Organization, Project Management, Research, Temporary Organization, Categorization, Schools of Thought

From being dominated by various planning techniques with a strong operations research orientation, "project research" today shows a significant level of plurality. This paper begins with a historical overview of the development of project research to trace the intellectual roots and backgrounds of the diversity in terms of foci and assumptions underlying present project research. The observed plurality is evidenced both in the broadening scope of empirical studies and the establishment of a range of theories and perspectives. Plurality is also observed in the units of analysis that range across the levels of the individual, the group, the project and the organization.

The aim of the paper is to review the literature on project management and suggest a categorization of the schools of thought currently prevailing. The categorization centers on the research at the project-level, i.e. the type of research that is specifically concerned with the management and organization of single projects. Seven schools have been identified based on a literature search and a review of the relevant literature. The schools vary in terms of their main focus and research question, and type of theorizing. It is argued that a categorization might not only reveal possibilities for future research but also point to opportunities for cross-fertilization between the schools identified.

Introduction

Research on projects and project management has increased tremendously in recent years. New perspectives, theories and studies proliferate. New conferences are initiated, and the number of project management journals is flourishing. Several studies have also documented the increased use of projects as an organizational form in a plethora of industries (e.g. Whittington et al, 1999). Below, I center on the theoretical debate in "project research" and especially concentrate on the research on project management. For reasons of simplicity, I will label all types of research that study projects, project management, project organization, project-based firms, etc. as examples of project research. Project management research will in this article be referred to as the research that studies the management and organization of single projects.

The paper is structured in the following way. First, I will give a brief overview of the history of project management research, showing its relatively firm grounding in operations research. Second, I turn to some of the more recent developments, especially emphasizing the 1990s. Here it is argued that project management was for long dominated by research based on assumptions/ideas of operations research and research on the "critical success factors" of projects and project management. However, as I will demonstrate, considerable developments have occurred in project management research over the past decade. I then analyze the research on project management in proposing a categorization of the literature in terms of its most influential lines of thought. It will be revealed that most of the research is grounded in one or the other of the seven schools identified.

The aim with the paper is to contribute to the knowledge on project management. In order to do so, I concentrate on the literature during the last decade and point to some recent trends in the development of project management research. The paper aims at complementing the literature review by Packendorff (1995) published in the Scandinavian Journal of Management and focus on the years following his literature search. However, the paper will also point to some of the weaknesses with the Packendorff study and show

that the division of project management research into essentially two strands of research is overly simplistic and thus neglects a number of key contributions to the field of project management. As this paper will show, other important strands of research are found in areas not frequently thought of as "core" project management, for instance, marketing and decision-making.

This paper is based on a literature search of the leading academic management and organization journals. Hence, the argument is put forward that project management research has entered the "best room" of management research. I argue that, in order to further the knowledge on project management, the link to overall organizational matters need to be addressed. It is thus a positive sign that project management researchers publish in traditional journals along with typical project management journals, such as Project Management Journal and International Journal of Project Management. The present paper focuses especially on the work published in a number of high-ranked management and organization journals.

Project management research: a brief history

According to Levene (1996:4162) the development of "modern project management techniques" stemmed from advances in operations research, which led to the development of several network techniques in the 1950s. Levene argues that the common viewpoint of project management is still very much orientated towards techniques for the management of time to enable the planning and scheduling of activities. Since the 1950s and 1960s, it is possible to observe major developments in the field. Professional and academic organizations dedicated to project management have been established (e.g. International Project Management Association and Project Management Institute), professional and academic conferences have been arranged on an annual basis, and academic journals on project management have been launched (e.g. Project Management Journal, International Journal of Project Management). However, as will be shown below, there are still inconclusive debates taking place within the field.

Initially, a management and organizational concern, focusing exclusively on the implementation of a single project, project research, in general, now spans a variety of levels of analysis. Concepts such as the management of projects (Morris, 1994; Packendorff, 1993) and the management by projects (Sharad, 1986; Gareis, 1989) clearly point to the current devotion of project research to the management of project-based firms and the conscious "application" of project-based management to the management of companies (cf. Morris, 1994). In the present article, however, I will concentrate on the literature at the project-centric level, i.e. the management and the organization of single projects.

Within the literature and the research at the project-level, it is possible to identify various foci. Most literature, however, addresses the management of industrial projects (cf. Morris, 1994). These studies investigate primarily development and implementation projects in industries such as construction, automotive, power generation and transmission, aerospace, and defense. They vary in terms of their focus along the project lifecycle in directing their attention to the early phases of projects or the actual implementation of projects.

This paper argues that "traditional" project management research is classifiable either as one of "optimization," or as "critical success factor" research. The former deals primarily with the development of various "work breakdown techniques" for the division of labor and network planning for integrating the tasks (cf. Packendorff, 1995). The research on critical success is primarily focused on finding the generic factors determining project success utilizing large sample surveys. These streams of research have, according to Shenhar (1993), devoted relatively little effort to creating a contingency theory but instead focused on the general aspects of project management. However, since the early 1990s, a few important contingency studies have been reported (cf. Shenhar & Dvir, 1996). These studies build on a long tradition of contingency reasoning in organization theory and innovation research. This stream of research will be referred to as the "Contingency School."

Perhaps stimulated by the inception of the IRNOP conferences (International Research Network of Organizing by Projects) in 1994, the use of the concept of "temporary organization" has increased in project management writings (cf. Lundin, 1995). In the publication from the first IRNOP conference (cf. Lundin & Packendorff, 1994; Lundin & Midler, 1998), several authors made explicit reference to the term "temporary organization" (see e.g. Lowendahl; 1995; Lundin & Söderholm, 1995; Midler, 1995; Packendorff, 1995). As it seems, several of these studies have aimed at extending the interpretations of project management within organization theory. This type of research was not interested in planning techniques or critical success factors, but, instead, the various behavioral dimensions of projects. The line of research adopting this organization-theory inspired approach will later in the paper be referred to as the "Behavioral School."

During the late 1980s and 1990s, different applications of transaction cost economics entered into project management research (Williamson, 1975). A typical piece of work in this category is the work by Winch (see e.g. Winch, 1989; 1995) and, furthermore, the contribution by Kolltveit & Reve (1998). In analyzing projects, the authors stress the typical project as being highly uncertain, carried out on a low frequency basis, being highly unique and typically of high complexity. This line of research will be discussed in further detail in the next part of the article under the heading of the "Transaction Cost School."

Moreover, within the research on project marketing, a group of researchers commenced studying the marketing activities preceding large-scale industrial projects. The article by Cova & Holstius (1993) has probably played a key role in this development (Günter & Bonaccorsi, 1996). Whilst the researchers on project marketing are mainly inspired by industrial marketing, their focus is here considered to be of importance for project management research. For instance, they stress the importance of project management in the early stages and a "proactive approach" in the marketing of projects. This line of research will be analyzed in further detail in the next part of the paper under the heading of the "Marketing School."

As a critique against many rational decision-making and project management models, several studies of the decision processes preceding large projects (or project implementations) have been reported (e.g. Sahlin-Andersson, 1989; 1992; Hellgren &

Stjernberg, 1995). The research seems to be driven by an interest to understand the formation of large projects and the political decision-making processes typically involved in "project networks" (Hellgren & Stjernberg, 1995). The studies of decision processes will be discussed in further detail under the heading of the "Decision School" of project management research.

Categorization methodology

The present overview builds, not only on my own literature search, but also on earlier literature overviews. The major academic management journals were reviewed and taken as the basis for the present literature review. The following management journals were included in the review: Administrative Science Quarterly, Academy of Management Journal, Academy of Management Review, British Journal of Management, International Studies of Management and Organization, Journal of Management, Journal of Management Studies, Management Science, Organization, Organization Science, Organization Studies, Research Policy, Scandinavian Journal of Management, Strategic Management Journal. Besides these journals, a number of leading journals in different areas were chosen, namely R&D Management and Research Policy (for high rank and for the number of hits on projects, project management, project organization as keywords), International Business Review (for a frequently cited special issue on projects), Construction Management and Economics (for high rank and for several hits on projects, construction projects, project management, as keywords). The rankings were taken from the study by Collin et al (1996).

For the time period prior to 1993, the work by Packendorff (1993) was heavily relied upon (published in a shorter version as Packendorff, 1995). However, compared to the Packendorff study, the present study has, in terms of levels of analysis, a more narrow focus. The focus of the review and school categorization reported here is only on the project-centric level. The review has also benefited greatly from previous overviews (such as Engwall, 1995; Morris, 1994; Packendorff, 1993; Packendorff, 1995). As mentioned earlier, Packendorff (1995), in his review, concluded that the field could be divided into two separate strands, the first one adopting a rationalistic view of organization processes, characterized by treating projects as "tools," the second one analyzing projects as (temporary) "organizations."

The work by Packendorff (1995) is based on a literature search carried out almost ten years ago and is partly biased toward "organization-theory" viewpoints (see Packendorff, 1993). I would argue that in the last decade, a number of contributions have been made that are not easily subsumable under "organization theory." Furthermore, I submitted that the dichotomy of projects as "plans or organizations" is intelligible but might not reveal important differences between, for instance, various types of organization-theory inspired research.

My intention is thus to provide a categorization of the "schools of thought" (cf. Mintzberg & Lampel, 1999) that might not only function as an account of the present state of theorizing, but also open up the discourse for new developments and new combinations of existing perspectives. Some limitations are required in order to fulfill this task. First, the focus of attention is on the project (organization) level. This means that various literature focusing on other levels of analysis, such as the management of project-based firms, the management of project portfolios are not considered (e.g. DeFillippi & Arthur, 1998; Ford & Randolph, 1992; Gareis, 1989). This also means that studies on specific topics, such as multi-cultural project teams (e.g. Dadfar & Gustavsson, 1992; Hofstede, 1983), project leadership and project teams (e.g. Barker et al, 1988; Gersick, 1988; Gersick, 1989) have been considered to be beyond the scope of this article.

The focus of attention here is on studies and articles that analyze projects from a "holistic" (organizational) point of view. It should be noted that the primary sectors for analysis is R&D and construction. Specific journals on IT project management are not included in the literature search. The research literature selected here is fundamentally centering the governance, management and organizational structures and processes of individual projects. The articles covered in the first stage of the literature search (i.e. the articles covered in the literature search and in the literature review by Packendorff, 1995) were included in the present study if they met the following criteria:

1. Published in any of the selected journals,
2. focusing on governance, management and organization of (industrial) projects, and
3. in the background or conclusions sections explicitly aiming at contributing to project management research.

After the first round of literature was gathered, the categorization method used in this paper was similar to Mintzberg's (1990) categorization of strategy schools. Mintzberg (1990), for instance, states that it is important to look at the different perspectives, and schools of thought to get a picture of the entirety of a certain problem-complex. However, Mintzberg also points out, that it is impossible to cover everything in a categorization and, hence, a categorizations must focus on a limited number of categories (in his case ten schools). In Mintzberg's categorization the following criteria were used: influential sources, base discipline, current and future states, champions, intended message, realized message, vocabulary, strategy, process dimensions, change, central actors, organization, leadership, contextual dimensions and structure. For sure, this is an ambitious effort. As touched upon previously, I direct my interest to mainly influential sources, base discipline, key question, current and future status, and champions (examples of key contributors).

The schools of thought outlined in this paper show major differences in terms of the focus of the empirical studies, the methodologies used, and the key questions posed. It should be noted that several of the authors' considered here have written much more broadly and adopted a more "balanced" orientation than the classification indicates. If possible, I have also searched for each of the authors other work in order to trace other references that might be included in the present study. Of course, this might also lead to a dominance by very few researchers in each of the schools. It should, nevertheless, be noted that we do not suggest label a particular researcher as a "behavior researcher" because of the particular perspective and the focus adopted on a particular occasion. As is well known, most authors adopt unique perspectives for specific, limited purposes and circumstances (cf. Astley & Van de Ven, 1983:265).

During the course of research a specific "tracking methodology" has been adopted in order to trace the theoretical inspiration of each of the articles. This means that for a certain article, the references have been scanned in order to find the most important reference for the paper. This was made based on either the authors' clear positioning towards certain articles, or the most frequently cited references. Based on this information, the articles were ordered and abstracts were read. In the cases where the article met the requirements of the present study, the entire article was read. This process could go on for several stages. For instance, Lundin & Söderholm (1995) (published in Scandinavian Journal of Management, included in the literature search) refers to Bryman et al (1987) as a key reference, who in turn cite Goodman & Goodman (1976). Moreover, by using the Social Sciences Citation Index, we were able to search for articles that have been referred to in the studies covered in our literature search. In some cases, additional information was gathered from scholarly books in order to support the categorization made in this study. This study was, however, narrow and structured. The logic was primarily to support and improve the information of each of the categories and to use existing knowledge on project management literature as far as possible despite the limited scope of the literature search. Most of the "supporting references" are taken, or traced, from the literature search by Packendorff (1995).

Seven schools of project management research

I have divided the field of project management research into the following school categories:

- Optimization School
- Critical Success Factor School
- Contingency School
- Behavioral School
- Transaction Cost School
- Marketing School
- Decision School

In the following sections, I briefly indicate the history, the inspirations, the key questions and major contributions of each of these schools.

Optimization School

Systems analysis played a key role in the development of management practice and research from the 1950s and in several disciplines it still prevail. As several researchers have demonstrated, systems analysis also played a key role in the development of project management (Morris, 1994:73-75; Engwall, 1995:88-107). In this particular category such diverse fields as network planning research and systems analysis applications are found. The common denominator is basically that they all advocate one fairly rationalistic and analytic perspective on projects. The writers within this particular strand of research are also prescriptive and normative, rather than descriptive. According to Nathan (1991), systems analysis and network techniques are closely related. For instance, they were developed around the same time, i.e. in the 1950s and 1960s. In this sense, they borrow heavily from physiological systems and in particular the structure, relationships and behavior of the sub-systems in explaining how the objectives of the system as a whole are achieved. These sub-systems can be further broken down to work packages. According to Nathan, a great deal of the work on project management has dealt with the system-sub-system structural framework. One might argue that systems analysis helps decomposing the total systems down to manageable work packages and the network techniques facilitate efficient integration of the work packages in terms of time and cost.

The starting point for much of the research in the Optimization School is to define the objective of the project, the content and the actors to be involved in execution of the project (Cleland & King, 1968). The major concerns of the Optimization School are how to reach efficiency, low cost, and optimal solutions in delivering the specified project task. It is thus not a surprise that many of the articles in our literature search in this particular school were found in Management Science - a journal renowned for seminal contributions within the quantitative area of management and organization. Furthermore, this strand of project management research seems to argue that project management is a method or technique for solving problems. Accordingly, project management provides a set of techniques to approach the complex organizational problem of executing a project. The history of the Optimization School is to be found in the PERT (Program Evaluation Review Technique) and the CPM (Critical Path Method) (Morris, 1994) in conjunction with various scheduling techniques and breakdown structures, e.g. work breakdown, product breakdown and cost breakdown structures (see e.g. Archibald, 1977; Turner, 1999b). The logic of the approach is to look at the system, but with limited attention to environmental issues of the task. This implies an attention focus to define the objectives, the different parts and the relationships between the parts in order to design the system optimally. A key issue here has been the reliability of PERT/CPM to offer correct estimations on resource requirements and project completion time (Gutierrez & Kouvelis, 1991).

A typical assumption found in the articles is that "successful management of…projects requires a careful planning, scheduling…of activities" (Granot & Zuckerman, 1991:140). In recent years, much research into this area revolves around the limitations of PERT and CPM. However, contributions have not questioned the basic rationale behind these techniques, but instead, furthered and complemented this particular strand of research. One example here would be the work by Gutierrez & Kouvelis (1991:990) who state the fundamental problem with these methods is that they continuously underestimate the time required for completing a project. More sophisticated (planning) methods, the authors argue, are necessary for handling these problems.

The underlying logic behind much of the research into this area has a strong resemblance with practice-oriented writings on systems analysis and project management (see e.g. Burke, 1994; Lock, 1996). This is, for instance, witnessed in the advocacy of structured approaches of defining the project and breaking down the work into work packages, and estimating costs and time.

Much work in the optimization area has been criticized for a number of reasons. Lundin & Söderholm (1998:41), for instance, stress that the preoccupation with efficiency leads to an under-emphasis, or even complete disregard, of the project context. By implication, this approach excludes project aspects such as the decision-making process in the specification of the project task, the evaluation of alternative project ideas and the accomplishment of parallel activities. Subsequently, Lundin & Söderholm (1998) conclude, the understanding of projects and their management is limited to internal issues

of the project implementation phase.

Two contributions need to be noted here as they have exerted, not only historically an important influence on project management thinking, but continue to have a strong influence. First, there is the book by Cleland & King (1968) entitled "Systems analysis and project management," which has been reprinted and revised several times since its initial publication. The book is frequently cited in articles covered in our literature search (e.g. Packendorff, 1995; Lundin & Söderholm, 1995). Second, there is the book by Kerzner (1999) entitled "Project management - a systems approach to planning, scheduling and controlling" first published in the 70s (see also Kerzner, 1980; 1982; 1982b), which also is frequently cited.

In essence, optimization thinking in project management research treats projects as analyzable complex tasks that require methodical approaches and structured techniques for optimally planning and executing projects.

Critical Success Factor School

A considerable body of project management research, particularly of North American provenance, is grounded in critical success factor thinking. Publications both in the International Journal of Project Management and Project Management Journal reflect the search for "factors" of success and failure. Here, I use the term "factor" to denote the dependent variable and the term "criteria" to denote the independent variable, i.e. success is determined through different success criteria and explained by different critical success factors. In this particular school of research, much effort has also been devoted to analyses and debates on the various types of success criteria. Still, the main research focus has been on what (managerial and organizational) factors that lead to or enhance the success of projects.

Research on critical success factors is also observed in other research field, for instance in product development (e.g. Cooper, 1982; Cooper and Kleinsmidt, 1987). In a project context, this approach seeks to systematically determine "the set of generic factors" that are critical to project success (Pinto & Prescott, 1988; Pinto & Prescott, 1990:308; Wateridge, 1996). The reason for the examination of critical success factors has been justified by the empirically overwhelming fact of project failure and the belief that the identification of generic factors will greatly improve the project implementation process in practice (Pinto & Prescott, 1990).

Important contributions in this field have been made by scholars such as Baker et al (1983), Pinto (1986), Pinto & Slevin (1987), Morris (1983), Pinto & Slevin (1987), Pinto & Slevin (1988), Pinto & Mantel (1990), Pinto & Prescott (1988), Pinto & Prescott (1990).

The study by Pinto & Prescott (1990) used the following set of critical factors: clarity of goals, top management support, clear project plans, client relationship, and communication. The studies by Baker, Murphy & Fisher (1983) focused on the behavioral dimensions and organizational issues of project organization. This study employed a broader definition of project success than the typical triple constraints of cost, time and conformance to specifications. However, as has been pointed out by Turner (1999b), although much of the research into this particular area has adopted broader definitions of project success, the traditional triple constraint criteria seem to prevail.

The critical success writings have been one dominant line in project management research. Its history can be traced back to the empirical studies of project failures in which writers sought to explain the reasons for the frequent failures of projects in practice. In the 1980s, this led to several publications in, not only project management journals and books, but also in other management journals, such as the Journal of Management Studies and Journal of Management. A continuing issue for debate has been how to look upon these success factors, their generic applicability and the survey methods used (Pinto & Kharbanda, 1995). Some authors have also stressed the need for studies comparing different projects and the variation of factors across the project lifecycle (Pinto & Kharbanda, 1995).

Contingency School

Project management research has been struggling with finding a balance between developing a theory of project management, whilst, at the same time, developing theories for different types of projects and project organization (cf. Packendorff, 1995). Based on their critique of the insufficient differentiation of project type, strategic problems, and managerial concerns in existing project management research, Shenhar and associates focused their efforts on the advancement of a contingency theory of project management (e.g. Shenhar & Dvir, 1996:608; Dvir et al, 1998).

They further state that, as an organizational concept, project management is relatively new and not well understood. As a step forward, Shenhar & Dvir (1996) propose a contingency theory of project management, identifying two main dimensions of projects and a two-dimensional typology of projects and their management styles. The first dimension concerns "technological uncertainty" of the task distinguishing between low-tech, medium-tech, high-tech and super-high-tech. The second dimension concerns the "system scope" of a project. This dimension is divided into three main categories: assembly, system and array. Their findings suggest that projects have a wide range of variation. Technological uncertainty affects the number of designs, the time of commitment to a final design, the need for prototype building, the extent of testing, the intensity of communication, and the frequency and complexity of tradeoff decisions. The dimension of system scope was found to be mainly associated with the extent of administrative issues, the degree of formality of managerial processes, and the prevalence of political and societal issues. As scope increases, projects are managed with additional attention to planning, control, coordination, and politics. They further claimed that a contractor, in such situations, usually resorts to a larger number of external subcontractors, often uses additional legal advice, making the project management task generally characterized by increased bureaucracy and documentation (Shenhar & Dvir, 1996:629).

For its significance in the development of a contingency theory of projects, the work by Shenhar and associates has been discussed in greater detail. The argument underlying their contribution, although not explicitly stated, is in line with Galbraith's (1973:2) two assumptions of contingency studies, namely: (1) there is no one best way to organize, and (2) any way of organizing is not equally effective. Based on these premises, we might thus conclude that the best way of organizing depends on the nature of the "contingencies" to which the organization relates. From a classic organization theory point of view, such contingencies

would typically involve the nature of the task (Perrow, 1970; Woodward, 1965), the environment (Emery & Trist, 1965;), the technology (Thompson, 1967), and the size and age of the organization (cf. Mintzberg, 1979).

Next to the studies by Shenhar and colleagues, some other influential contributions to the Contingency School of project management need to be noted. These include the work of product development researchers, such as Clark & Fujimoto (1991) and Wheelwright & Clark (1992). The study by Clark & Fujimoto has been utilized by many project management researchers (e.g. Morris, 1994; Midler, 1995) and, especially, their "heavyweight-lightweight" distinction has attracted much attention. Similar to this kind of reasoning is the well-known differentiating between functional organization, functional-matrix organization, project-matrix organization and project organization (e.g. Gobeli & Larson, 1987; Larson & Gobeli, 1987). Many of the researchers that focus on this particular repertoire are not interested in project management per se but focus, instead, on the organization-level (see e.g. Ford & Randolph, 1992; Knight, 1976; Sayles, 1976; Sayles & Chandler, 1971). They are thus not particularly concerned with different types of projects, different ways of organizing projects, or different project management styles.

The typology suggested by Shenhar and colleagues seems to accommodate most of the attributes of a contingency theory" of projects. The term "theory" and the concept of "organizational theory of project management" are, however, narrowly defined. Although their interpretation of contingency theory might be criticized for being an overly deterministic and decontextualized one, it nevertheless provides valuable insight into the differences among project contexts. A recent example of contingency writings is also found in the article by Lindkvist et al (1998), published in Organization Studies - one of the leading journals on organization theory. The article stresses the importance for contingency thinking for developing the knowledge on project management. The dimensions put forward by the authors have some resemblance with the work by Shenhar, but seeks to build knowledge also by drawing on some classic work in organization theory. The authors, for instance, stress their "contingency dimensions" relate to important "technological aspects" of the project context (ibid: 942).

Another seminal publication is the one by Hobday (2000), published in Research Policy, who, as a representative for the field of CoPS (Complex Product Systems), has approached the field of project management in recent years. The work by Hobday is also clearly contingency oriented. For instance, the author stresses that there has not "been much discussion of the various different types of [project-based organizations]" (Hobday, 200: 872).

As it seems, many of the contingency writers have also in recent years taken into account other aspects of project organization and furthered their studies by looking at other issues. As stated above, the Dvir et al study (Dvir et al, 1998) is an example where the research has started as a contingency approach to in later stages concentrate on success factors. An integration of the contingency school and the critical success factor school is thus possible to identify here. The study by Lindkvist et al (1998) is an example of taking the contingency thinking as a starting point and moving the analysis further to integrate behavioral aspects, which will discussed in more detail in the next section on the Behavioral School.

Behavioral School

Under the category of the Behavioral School, a broad variety of organization-theory inspired research on project organization is found. The term "behavioral" should be here interpreted broadly in that it is seen to accommodate research with an explicit focus on the processes of organizing, the "behavior" of project organizations and human interactions within projects.

Lundin & Söderholm (1995) argue that projects have certain characteristics and thus a unique way of "life" or "behavior" in contrast to traditional, permanent organizations. For instance, projects are time-limited processes of organization, projects are processes of transition (or transformation), projects are realized by a team, and projects are always organized around a certain task. The suggested theory is developed around a number of what the authors term "sequencing" concepts. The notion informing the sequencing concepts is that of the well-known project life cycle (concept, development, implementation and termination). They suggest four sequencing concepts, namely action-based entrepreneuralism, fragmentation for commitment-building, planned isolation and institutionalized termination. Their basic idea is be to develop a conceptual framework for the analysis of project processes from an action point of view.

Although, Lundin & Söderholm (1995) are the only ones who explicitly relate their work to "behavioral" theory, there are several other studies that share a similar processual view of organizations (cf. Bryman et al, 1987). Projects are thus viewed not as stable, structured entities, but as emerging processes that often change direction and scope (Kreiner, 1995). For instance, Kreiner (1992) suggests that project behavior follows the idea of a "theater of passion" where emotions and depressions are important aspects. Gustafsson (1998) follows a similar line arguing that projects, as compared to "permanent" organizations, are "high motivation organizations." Furthermore, in an earlier study the "temporary system" metaphor (cf. Miles, 1964; Bennis & Slater, 1968), Bryman et al (1987) argue that projects are places of stress and high ambiguity. Managing such organizations, they explain, is largely a process of managing "anxiety." Similarly, Goodman (1981) has investigated the role-blurring problems and the problems of competence development in project organization (see also Goodman, 1967; Goodman & Goodman, 1976).

As it seems, the Behavioral School core interests lie in the processes of project execution. The concern seems strongly to revolve around the differences between permanent and temporary organizations, inspired by early authors such as Miles (1964) and Bennis & Slater (1968) (see also Keith, 1978; Palisi, 1970). This is, for instance, observed in the focus on the "time component" of such organizations, and the time effects on, and the variations across, the project lifecycle. It should be noted that a large number of the studies do not reveal their empirical studies, but discuss the behavior of project organizations from a "general" or theoretical viewpoint (e.g. Gustafsson, 1998; Kreiner, 1995; Lundin & Söderholm, 1995).

Transaction Cost School

Two early examples of transaction cost studies in project management are provided by Eccles's (1981) study of subcontractors in construction projects, and Stinchcombe's (1985) analysis of the "violation of the decoupling principle"

in the offshore industry. Two other examples are the studies by Winch (1989; 1995) and the book by Kolltveit & Reve (1998).

Eccles' (1981) study revolves around the "quasi-firm," i.e. a type of bilateral governance that emerges through continuing relationships in project-based industries. Eccles' (1981) study addresses the way sub-contractors are hired on a project-by-project basis. In his view, the market solution is always present, although contractors tend to use the same sub-contractors recurrently. He also identifies the emergence of certain types of routines, and the evolution of mutual trust that functions as an asset specificity, which impedes contractors' flexibility in switching to other sub-contractors.

Stinchcombe (1985) argues that many project management problems result from the "violation of the decoupling principle." This means that activities are "fragmented" in instances where a single authority solution is being preferred. He thus argues in favor of market-based alternatives when decoupling is viable and hierarchical solutions when it is not. In placing projects within the dynamic of firms and markets, Stinchcombe (1985) seems to advocate a transaction cost approach to project management research.

Winch (1989; 1995) sets out to develop a "transaction cost approach" to the study of construction projects. His primary interests concern the questions "why" project organizations exist and why they take the particular form they do (Winch, 1995:2). According to Winch (1995), it is the time component that furnishes project organization with its particular characteristic (1995:2). In other words, the typifying characteristic of project organization is its temporary character. Winch analyzes projects by the classic transaction cost theory concepts of uncertainty, asset specificity and transaction frequency. He concludes that in instances where "contracts are not discrete, and rely upon continuing relations between the parties during execution, then more elaborate forms of transaction governance tend to emerge." (Winch, 1995:5) The type of form that will emerge is, in turn, a function of transaction frequency and asset specificity.

A recent example of project management research that explicitly adopts the transaction cost approach is provided by Kolltveit & Reve (1998). Furthermore, the transaction cost approach is often used to examine different forms of transaction governance, such as bilateral or trilateral types of governance (e.g. Winch, 1995:10; Üsdiken, Sözen & Enbiyaoglu, 1988; Eccles, 1981b). Other articles adopt a more general approach, however, the focal point on project governance analyzed from a transaction cost perspective is still apparent (e.g. O'Brien et al, 1995; Pietroforte, 1997; Reve & Levitt, 1984).

In my interpretation, transaction cost inspired research in project contexts mainly reflects the application of the Williamson theory in particularly complex empirical settings, e.g. large-scale construction or offshore projects. The impact of transaction cost economics on the development of management theory is well documented, and hence, it is no surprise that it has been applied and extended in project settings. The Transaction Cost School aims at analyzing why projects exist and the appropriate governing mechanisms of "project transactions". In depicting project management largely as a macro-level concern, the transaction cost approach has led to the creation of forms of governance, e.g. choice of project contract and choice of bilateral or trilateral governance.

Marketing School

The literature on "project marketing" is important in this review in a number of respects. Project marketing researchers have mainly contributed to the field in explaining how companies sell and market their projects, how clients buy projects, or how the early stages of a project can be seen as management and organization of the interaction between the client and the contractor.

For instance, in Bansard et al (1993) the purpose is to investigate "strategic behaviors" of companies dealing with projects and to propose a model for supplier-based adaptation strategies in project marketing. According to the authors, the current trend in project business is towards the adoption of a much more proactive approach by contractors. So it is, for instance, often stated that these types of (occasional) transactions require lengthy investigation into client needs and negotiation of the content of a contract before a project can be implemented (Cova et al, 1994). To efficiently accomplish these lengthy processes, managers need a strategy to network and prepare for project implementation. This is, for instance, important for the formation of the supplier alliance and the buyer alliance (Holstius, 1987). Managing the early phases of projects is addressed as an organization and networking problem that requires not only an appropriate managerial strategy but also considerable time and resources (Cova et al, 1994; Cova et al, 1996). Accordingly, the management of the early stages of projects has been seen to bear crucial implications for the success of the entire project (Cova & Holstius, 1993).

The more recent literature on project marketing, partly originating from the research on systems selling (Mattsson, 1973), appears to be as much an attempt at combining knowledge from different areas as to improving our understanding of the ways in which projects are instigated and how they are structured (Cova & Hoskins, 1997). In summary, project-marketing research is largely devoted to the investigation into the management of the early phases of projects, the identification of client needs and the formation of project organizations.

Decision School

The Decision School in project management research is typified by its principal focus on the pre-project phases. Decision researchers frequently refer to Hall's (1980) famous study of planning disasters and the classic work by Sapolsky (1972) (for a review, see Morris, 1994: chapter 8). Decision researchers, in a project management context, are fundamentally concerned with two questions; why are projects instigated, and why are certain decisions made?

Sahlin-Andersson's (1989) study of the Stockholm Globe Arena is explicitly decision-oriented in seeking to expand the knowledge of the complex decision processes that characterize the formation of "large, extraordinary projects." The author criticizes several of the assumptions underlying the mainstream project management literature. Instead, she argues, pre-project phases (and also too a large extent the implementation phase) are characterized by ambiguity and uncertainty. She highlights the dangers of applying a "strategy of clarity" in situations of ambiguity and uncertainty. Instead, it is suggested, in the context of complex, extraordinary projects, a "strategy of ambiguity" is far more appropriate to create a project. Along a similar line of argument, Jacobsson (1987) introduces the notion

of "closed" and "open" decision processes. These concepts are based on his study of the decision process prior to the execution of a major power plant project. From this research he found that actors needed to be aware of the project's current, specific type of process. With their focal interest in the design phase of projects, as opposed to the implementation phase, Hellgren & Stjernberg's (1995) study employs a "project network" perspective. In order to study project processes and aspects where traditional project management techniques and routines do not apply, they select those types of projects for study that are particularly "fuzzy," and extended over long periods of time, and are hard to capture (Hellgren & Stjernberg, 1995:378).

Many of the projects under study in the Decision School are "extraordinary," (Sahlin-Andersson, 1992), "grand-scale," (Shapira & Berndt, 1997), or "major" (Hellgren & Stjernberg, 1995). As it seems, decision researchers are mostly interested either in very rare or occasional projects, which involve many different actors, several decision-making centers, or public as well as private companies (cf. Hall, 1980; Morris, 1994). One major concern seems to be to explain why projects (or individual actors) that do not follow a rational (decision-making) model, seem to work successfully, and why some projects which seem to be unwise to implement get implemented. The Decision School has documented and identified the utilization of various "strategies" during project realization (Sahlin-Andersson, 1992), the impact and effects of "escalation of commitment" (Ross & Staw, 1993; Staw & Ross, 1989), and the roles of project champions and promoters in the early stages of projects (cf. Sapolsky, 1972). Shapira & Berndt (1997), for instance, show that "project champions" believe that their chances in initiating and completing a grand-scale project are high despite "objective" evidence pointing to the contrary.

A shared characteristic of the Decision School is the studies' emphasis on the early stages of projects, the interaction among a multitude of actors, the understanding of single cases in-depth, and the political processes inherent in large societal projects involving a great number of actors (cf. Morris & Hough, 1987; Kharbanda & Stallworthy, 1983).

Summarizing the schools of project management research

Based on the review of the seven schools, it is possible to distinguish between various focuses and overall questions in which each of these schools take interest. In order to point to my interpretation of each school's view upon the "task or idea of project management", I have to the table added a brief statement of each school's interpretation of project management ("project management idea"). The table centers on each school's primary focus and key research question.

Concluding discussion

The main aim of the paper was to present the evolution of a plurality of perspectives in project management research. The historical review pointed to the broadening of scopes, levels of analysis, and perspectives that could be observed in recent years.

The article's prime focus is on the studies at the project-centric level. The article offers a categorization of the most influential schools of thought that includes not only the classic or traditional project management writings, as observed in the Optimization School and

Characteristics / Line of research	Examples of contributions	Primary focus of analysis	Key question / issue investigated	"Project management idea"
Optimization School	Cleland & King (1968), Kerzner (1995)	Planning and breakdown techniques of complex tasks.	How to manage/plan a project?	"Optimizing project implementation by planning"
Critical Success Factor School	Baker et al (1983), Pinto & Prescott (1990), Morris (1983)	Success factors and project outcomes.	What determines project success?	"Targeting project organization by factors"
Contingency School	Shenhar & Dvir (1996), Dvir et al (1998), Lindkvist et al (1998), Hobday (2000)	Project organization design.	Why do project organizations differ?	"Adapting project organization to contingencies"
Behavioral School	Lundin & Söderholm (1995), Kreiner (1995)	Project organization process(es).	How do project organizations behave?	"Shaping processes of project organization"
Transaction Cost School	Eccles (1981), Stinchcombe (1985), Winch (1995)	Governance of project organizations/transactions	How are project (transactions) organizations governed?	"Governing project organization/ transactions"
Marketing School	Bansard, Cova & Salle (1993), Cova & Holstius (1993)	Management of the formation phase of projects.	How are the early stages of projects managed?	"Forming and championing the project"
Decision School	Sahlin-Andersson (1992), Hellgren & Stjernberg (1995), Shapira & Berndt (1997)	The interplay between actors in the early stages of projects.	How do multi-organizational projects behave in the early phases?	"Politicking and positioning in the project network"

Table 1. An overview of the schools of thought of project management research

the Critical Success Factor School, but also more recent, and perhaps more challenging, lines of development. The schools of thought analyzed in this paper offer different ways of looking at the management and organization of projects. In some respects, they compete, whilst in others, they are complementary. The paper both built upon and criticized the review presented by Packendorff (1995). The Packendorff article gives a relatively delimited view on what project management research is about, whereas the presented study has aimed at broadening the scope and discussion of project management by pointing to other important literatures as well as pointing to some new contributions to the area. The paper has shown that a number of important developments have occurred in recent years. The paper has also shown that project management is currently a topic frequently discussed in scholarly journals on management and organization. As an example, several of the articles covered in this study are published in traditional management journals but the articles' contributions are explicitly positioned in the area of project management.

In terms of the critique put forward in the paper, the study of the management and the organization of projects has seen an overwhelming preponderance of optimization theorizing (see Engwall, 1995; Morris, 1994; Packendorff, 1995). Optimization thinking has made a valuable contribution in providing a structured approach to solving a priori problems of project management, for instance, with regards to the question of how to group activities, or how to structure the interdependence between different activities, and a scheduling logic for their integration. However, there are, and this has been pointed out by several researchers, serious limitations and constraints to the optimization approach.

The Critical Success Factor School, which might also be grouped under the heading "traditional schools," suffers partly from similar shortcomings. For instance, the argument that some factors are more important than others is not only difficult to verify, but also a matter of simplifying the task of project management to a level which is far from the actual challenges in managing projects in practice (Pinto & Kharbanda, 1995). As it seems, many writers on project management consider project management research very much as an area for studies related to optimization and of critical success factors. This, for sure, might hinder the further development of the academic discipline of project management. The paper has stressed the importance of also seriously looking at other contributions.

An interesting development is the contingency school of project management. It is also interesting to note that within this field of research, several articles have been published in leading management research journals. There are, however, some drawbacks related to this stream of research. The contingency theory, published in Research Policy, suggested by Shenhar & Dvir (1996) can be criticized for adopting a very narrow application of contingency theory. For instance, contingency theory is basically a search for determining and analyzing important contingencies of project organization, not necessarily a mapping of exact relationships between, for instance, the technological uncertainty and the number of prototypes in a development setting. Adopting such a contingency approach would seem to run the risk of missing the importance of theory as exploring, not only as explaining (cf. Meyer, Tsui & Hinnings, 1993). Moreover, in later studies Dvir et al (1998) partly reveal their primary interest as complementing the Critical Success Factor School. A recent example of contingency writings in project management contexts, is the article by Lindkvist et al (1998), published in Organization Studies. The article points to some key dimensions (type of error problematics and complexity) to consider when researching project management in complex development contexts.

The Behavioral School has been represented in this paper as a broad collection of many types of studies of project management and project organization inspired by organization theory, social psychology and sociology (e.g. Bryman et al, 1987; Lundin & Söderholm, 1995). The Behavioral School contributes by viewing project organization as social interaction, rather than optimization calculations, and by examining the various social processes that characterize the life of a project. An important concept in this tradition is "temporary organization." Temporary organization is, as yet, relatively unclear and there seems to be a need to specify what "temporary" means. For instance, "temporary" might be analyzed along a "participation dimension," i.e. the relationship between individuals and the firm, and between firms in an interaction process.

The Transaction Cost School is primarily an application of the writings by Williamson (1975) to the context of projects. The overall question raised here is why project transactions and project organizations exist and how they are governed. The dimensions of uncertainty, uniqueness, and frequency of purchase seem to be important in a project context. There are, however, many more questions that need to be addressed, such as the role of third parties, the consequences and problems of "opportunistic" clients, and the interaction between client and contractor during project execution.

The Marketing School has primarily focused on the phase prior to project execution. The studies typically address the issue of the interactive buying and selling processes from the contractor's perspective. An important, yet uncovered, aspect concerns the cooperation and coordination between client and contractor during project execution. A critique of this strand of research is, thus, its limited understanding of project execution as an interactive process between client and contractor, and, in some cases, also the relationship with third parties.

The Decision School has provided insights into the formation of projects of mainly public projects where the client typically is a state-owned or municipality-owned organizational unit. The studies might generally be viewed as a critique of rationalistic theories of project management that take the project as given without addressing the reasons and processes of the early project phases. The Decision School thus produces valuable knowledge about the political processes in the early stages of a project that might be inherent also in projects outside the public context. It might therefore be reasonable to extend their empirical base and to look at the early stages of projects in other settings where the possibilities for control might be different.

The schools presented in this overview are broad and fragmented to some extent. The review has identified a broad collection of research on project management which at times subscribe to different interpretations of the project concept. Furthermore, in the case of the Behavioral School where a lot of literature inspired by organization theory is grouped, a variety of perspectives and

approaches is found. Investigating the differences among behavioral research might be a task for forthcoming reviews. I stated that a school categorization might not only reveal possibilities for future research but also point to opportunities for cross-fertilization. In terms of cross-fertilization, I would argue that the combination of contingency reasoning with behavioral reasoning appears to offer a promising approach for understanding the dynamics of project organization. It is thus submitted that an understanding of the variety of project contexts and project organizations together with an analysis of their "generic" behavior might be at the core of expanding the knowledge of project organization.

In terms of the further development of project management research, the paper has drawn attention to some fundamental problems of this particular field of research as a whole. First, the interpretation of what "projects" are, is clearly an important question in order to develop the "theory of projects" in a similar fashion as the development of "theories of the firm". Moreover, the role of "project management" is also considerably different in the different theory traditions covered in the literature review. In practical terms, one views project management primarily as a job for planners and schedulers, whereas another points to it as a "shaper of behavior." Underlying the different schools of thought is also completely different views on what projects are and what project management is about. These different views, I argue, must be made more explicit in order to facilitate the furthering of the field of project management as an academic discipline.

Acknowledgement

I acknowledge the financial support from VINNOVA and HSFR. The paper has benefited from the comments of Dr Karin Breu, Dr Mats Engwall, Dr Johann Packendorff and the anonymous referees. Any omissions or errors, of course, rest with myself.

Jonas Söderlund, PhD

Assistant Professor
School of Management
Linköping University

SE 581 83 Linköping, Sweden

Tel: +46 13 28 10 00
E-mail: jonso@eki.liu.se

References

Archibald R. A., 1977/1992.
Managing high technology programs and projects, New York: Wiley & Sons.

Astley G. and Van de Ven A., 1983.
"Central problems and debates in organization theory," Administrative Science Quarterly, Vol. 28. pp. 245-273.

Baker B. N., Murphy D. D., and Fisher D., 1983 .
"Factors affecting project success," in D. Cleland, & W. King (Eds.), Project management handbook, New York: Van Nostrand.

Bansard D., Cova B., and Salle R., 1993.
"Project marketing: beyond competitive bidding strategies," International Business Review, Vol. 2, No. 2. pp. 125-141.

Barker J., Tjosvold D. and Andrews R., 1988.
"Conflict approaches to effective and ineffective project managers," Journal of Management Studies, Vol. 25, No. 2. pp. 167-178.

Bennis W. G. and Slater P. E., 1968 (Eds.)
The temporary society, New York: Harper & Row.

Bryman A., Bresnen M., Beardsworth A. D., Ford J. and Keil E. T., 1987. "The concept of the temporary system: the case of the construction project," Research in the Sociology of Organizations, Vol. 5. pp.253-283.

Christensen S. and Kreiner K., 1991.
Projektledelse i lost koblede systemer: ledelse och laering i en ufoldkommen verden, Copenhagen: Jurist- og Okonomiforbundets forlag. (in Danish, "Project management in loosely coupled systems")

Clark K. and Fujimoto T., 1991.
Product development performance: strategy, organization and management in the world auto industry, Boston: Harvard Business School.

Cleland D. I. and King W. R., 1968.
Systems analysis and project management, New York: McGraw-Hill.

Cleland D. I. and King W. R., 1983. (Eds.):
Project management handbook, New York: Van Nostrand.

Cleland D. I. and King W. R., 1988. (Eds.):
Project management handbook, New York: Van Nostrand.

Collin S-O., Johansson U., Svensson K. and Ulvenblad P-O., 1996. "Market segmentation in scientific publications: research patterns in American vs European Management Journals." British Journal of Management, Vol. 7, No. 2. pp. 41-154.

Cooper R. G., 1982.
"New product success in industrial firms," Industrial Marketing Management, Vol. 11. pp. 215-223.

Cooper R. G. and Kleinschmidt E. J., 1987.
"What makes a new product a winner: success factors at the project level," R&D Management, Vol. 17, No. 3. pp. 175-189.

Cova B. and Holstius K., 1993.
"How to create competitive advantage in project business," Journal of Marketing Management, Vol. 9, No. 2. pp. 105-121.

Cova B. and Hoskins S., 1997.
"A twin-track networking approach to project marketing," European Management Journal, Vol. 15, No. 5. pp. 546-556.

Cova B., Mazet F. and Salle R., 1994.
"From competitive tendering to strategic marketing: an inductive approach," Journal of Strategic Marketing, Vol. 2. pp. 1-19.

Cova B., Mazet F. and Salle R., 1996.
"Milieu as a pertinent unit of analysis in project marketing," International Business Review, Vol. 5, No. 6. pp. 647-664.

Dadfar H. and Gustavsson P., 1992.
"Competition by effective management of cultural diversity," International Studies of Management and Organization, Vol. 22, No. 4. pp. 81-92.

DeFillippi R. and Arthur M., 1998.
Paradox in project-based enterprise: the case of film making," California Management Review, Vol. 40, No. 1. pp. 186-191.

Dvir D., Lipovetsky S., Shenhar A. and Tishler A., 1998. "In search of project classification: a non-universal approach to project success factors," Research Policy, Vol. 27. pp. 915-935.

Eccles R., 1981.
"The quasifirm in the construction industry," Journal of Economic Behavior and Organization, Vol. 2. pp. 335-357.

Eccles R., 1981b.
"Bureaucratic versus craft administration: the relationship of market structure to the construction firm," Administrative Science Quarterly, Vol. 26. pp. 449-469.

Engwall M., 1995.
Jakten på det effektiva projektet, Stockholm: Nerenius and Santérus. (in Swedish, "In search of the effective project")

Ford R. and Randolph A., 1992.
"Cross-functional structures: a review and integration of matrix organization and project management," Journal of Management, Vol. 18, No. 2. pp. 267-294.

Gaddis P. O., 1959.
"The project manager," Harvard Business Review, May-June. pp. 89-97.

Galbraith J. R., 1973.
Designing complex organizations, Reading: Addison-Wesley.

Gareis R., 1989.
"Management by projects: the management approach for the future, International Journal of Project Management, Vol. 7, No. 4:243-252.

Gareis R. 1990 (Eds.)
Handbook of management by projects, Vienna: MANZ.

Gersick C., 1988.
"Time and transition in work teams: toward a new model of group development," Academy of Management Journal, Vol. 31, No. 1. pp. 9-41.

Gersick C., 1989.
"Marking time: predictable transitions in task groups," Academy of Management Journal, Vol. 32, No. 2. pp. 274-309.

Gobeli D. and Larson E. W., 1987.
"Relative effectiveness of different project structures," Project Management Journal, Vol. 18, No. 2:81-85.

Goodman R. A., 1967.
"Ambiguous authority definition in project management," Academy of Management Journal, Vol. 10. pp. 395-407.

Goodman R. A., 1981.
Temporary Systems: Professional Development, Manpower Utilization, Task Effectiveness, and Innovation, New York: Praeger.

Goodman, R. A. and Goodman L. P., 1976.
Some management issues in temporary systems: a study of professional development and manpower - the theater case," Administrative Science Quarterly, Vol. 21, No. 3. pp. 494-501.

Granot D. and Zuckerman D., 1991.
"Optimal sequencing and resource allocation in research and development projects," Management Science, Vol. 37, No. 2. pp. 140-156.

Günter, B. and A. Bonaccorsi (Eds.) (1996.
Special issue on project marketing and systems selling, International Business Review, Vol. 5, No. 6.

Gustafsson C. 1998.
"Det stora äventyret: om projektorganisationens ledningsmässiga poänger," in P. O Berg and Poulfelt F. (Eds.); Ledelselaeran i Norden: en tribut till professor Erik Johnsen, Dafolo Forlag. ("The great adventure: on the project organization's managerial points")

Gutierrez G. J. and Kouvelis P., 1991.
"Parkinson's law and its implications for project management," Management Science, Vol. 37, No. 8. pp. 990-1001.

Hall P., 1980.
Great planning disasters, London: Penguin Books.

Hellgren B. and Stjernberg T., 1995.
"Design and implementation in major investments: a project network approach," Scandinavian Journal of Management, Vol. 11, No. 4. pp. 377-394.

Hofstede G., 1983.
"Cultural dimensions for project management," International Journal of Project Management, Vol. 1, No. 1. pp. 41-48.

Holstius K., 1987.
Project export, Research Report No. 1, Lappeenranta University of Technology, Finland.

Jacobsson B., 1987. Krafsamlingen, Lund: Studentlitteratur. (in Swedish, "The accumulation of power")

Keith P., 1978.
"Individual and organizational correlates of a temporary system," Journal of Applied behavioral Science, Vol. 14, No. 2. pp. 195-203.

Kerzner H., 1980.
"Evaluation techniques in project management," Journal of Systems Management, February. pp. 10-19.

Kerzner H., 1982.
"Tradeoff analysis in a project environment - Part 1," Journal of Systems Management, October. pp. 6-12.

Kerzner H., 1982b.
"Tradeoff analysis in a project environment - Part 2," Journal of Systems Management, November. pp. 30-40.

Kerzner H., 1995.
Project management: a systems approach to planning, scheduling and controlling, New York: Van Nostrand. 4th edition.

Kerzner H., 1999.
Project management: a systems approach to planning, scheduling and controlling, New York: Van Nostrand. 5th edition.

Kharbanda O. and Stallworthy E., 1983.
How to learn from project disasters, London: Gower.

Knight K., 1976.
"Matrix organization: a review," Journal of Management Studies, Vol. 13, No. 2.pp. 111-130.

Kolltveit B. J., and Reve T., 1998.
Prosjekt - organisering, ledelse og gjennomforing, Oslo: Tano Aschehoug. (in Norwegian, " Projects - organizing, managing and implementing ")

Kreiner K., 1992.
"The postmodern epoch of organization theory," International Studies of Management and Organization, Vol. 22, No. 2. pp. 37-52.

Kreiner K., 1995.
"In search of relevance: project management in drifting environments," Scandinavian Journal of Management, Vol. 11, No. 4. pp. 335-346.

Larson E. and Gobeli D., 1987.
"Matrix management: contradictions and insights," California Management Review, Vol. 29, No. 4. pp. 126-138.

Levene R., 1996.
"The origins of project management," International Encyclopedia of Business and Management, Vol. 5, London: Thomson Business Press.

Lindkvist L., Söderlund J. and Tell F., 1998.
Managing Product Development Projects: On the Significance of Fountains and Deadlines. Organization Studies, Vol. 19, No. 6. pp. 931-951.

Lock D., 1996.
The essentials of project management, Aldershot: Gower.

Lowendahl B. R., 1995.
"Organizing the Lillehammer Olympic Winter Games," Scandinavian Journal of Management, Vol. 11, No. 4, pp. 347-362.

Lundin R. A., 1995.
"Editorial: Temporary organizations and project Management, Scandinavian Journal of Management, Vol. 11, No. 4. pp. 315-318.

Lundin R. A. and Midler C., 1998.
Projects as arenas for renewal and learning processes, Boston: Kluwer Academic Publishers.

Lundin R. A. and Packendorff J., 1994 (Eds.)
"Temporary organizations and project management," Proceedings of the IRNOP Conference, Umeå Business School, Umeå University.

Lundin R. A. and Söderholm A., 1995.
"A Theory of the temporary organization," Scandinavian Journal of Management, Vol. 11, No. 4. pp. 437-455.

Lundin R. A. and Söderholm A., 1998.
"Managing the black boxes of the project environment," in J. Pinto (Ed.), The handbook of project management, San Francisco: Jossey-Bass.

Mattson L-G., 1973.
Systems selling as a strategy on industrial markets, Industrial Marketing Management, Vol. 3. pp. 107-120.

Meyer A., Tsui A. and Hinnings C., 1993.
"Configurational approaches to organizational analysis," Academy of Management Journal, Vol. 38, No. 6. pp. 1175-1195.

Midler C., 1995.
"'Projectification' of the firm: the Renault case," Scandinavian Journal of Management, Vol. 11, No. 4. pp. 363-376.

Miles M. B., 1964.
"On Temporary Systems," In M. B. Miles (ed.), Innovation in Education, New York: Teachers College Press.

Mintzberg H., 1979.
Structuring organizations, New York. Prentice Hall.

Mintzberg H., 1990.
"Strategy formation: schools of thought," in J. Frederickson (Ed.), Perspectives on strategic management, Boston:Ballinger.

Mintzberg H. and Lampel J., 1999.
"Reflecting on the strategy process," Sloan Management Review, Spring. pp. 21-30.

Morris, P. W. G., 1994.
The management of projects, London: Thomas Telford.

Morris P. W. G., 1983.
"Managing project interfaces: key points for project success," in D. Cleland and W. King (Eds.) Project management handbook, New York: Van Nostrand.

Morris P. W. G. and Hough G. H., 1987.
The anatomy of major projects: a study of the reality of project management, Chichester: Wiley.

Nathan P., 1991.
Project planning and control systems: an investigation into their application and implications of usage in the UK construction industry, PhD thesis, Henley Management College, Brunel University.

O'Brien W., Fischer M. and Jucker J., 1995.
"An economic view of project coordination," Construction Management and Economics, Vol. 13. pp. 393-400.

Packendorff J., 1993.
Projektorganisation och projektorganisering, Licentiate Thesis, Handelshögskolan vid Umeå Universitet. (in Swedish, "Project organization and project organizing")

Packendorff J., 1995.
"Inquiring into the temporary organization: new directions for project management research," Scandinavian Journal of Management, Vol. 11, No. 4. pp. 319-334.

Palisi B. J., 1970.
"Some suggestions about the transitory-permanence dimension of organization," British Journal of Sociology, Vol. 21. pp. 200-206.

Perrow C., 1970
Organizational analysis: a sociological review, Belmont: Wadsworth.

Pinto J. K., 1986.
Project implementation: a determination of its critical success factors, moderators, and their relative importance across stages in the project life cycle, unpublished PhD dissertation, University of Pittsburgh, Pittsburgh.

Pinto J. 1998.
Project management handbook, San Francisco: Jossey-Bass. (joint publication with the Project Management Institute).

Pinto J. and Covin J., 1989.
"Critical factors in project implementation: a comparison of construction and R&D projects," Technovation, Vol. 9. pp. 49-62.

Pinto J. and Kharbanda O. P., 1995.
Successful project managers: leading your team to success, New York: Van Nostrand.

Pinto J. K. and Mantel S. J., 1990.
"The causes of project failure," IEEE Transactions on Engineering Management, Vol. 37. pp. 269-276.

Pinto J. K. and J. E. Prescott 1988.
"Variations in critical success over the stages of in the project life cycle," Journal of Management, Vol. 14:5-18.

Pinto J. K. and Prescott J. E., 1990.
"Planning and tactical factors in the project implementation process," Journal of Management Studies, Vol. 27, No. 3. pp. 305-327.

Pinto J. K. and Slevin D. P., 1987.
"Critical factors in successful project implementation," IEEE Transactions on Engineering Management, Vol. 34. pp. 22-27.

Pinto J. K. and Slevin D. P., 1988.
"Project success: definitions and measurement techniques," Project Management Journal, Vol. 19, No. 1. pp. 67-72.

Pinto J. K. and D. P. Slevin 1988b.
"Critical success factors across the project life cycle," Project Management Journal, Vol. 19, No. 3. pp. 67-75.

PMBoK Guide, Project Management Institute. (www.pmi.org)

Randolph W. A. and Posner B. Z., 1988.
"What every manager needs to know about project management," Sloan Management Review, Summer. pp. 65-73.

Reve T. and R. Levitt, 1984.
"Organization and governance in construction," Project Management, Vol. 2, No. 1. pp. 17-25.

Ross J. and Staw B., 1993.
"Organizational escalation and exit: lessons from the Shoreham nuclear power plant," Academy of Management Journal, Vol. 36. pp. 701-732.

Sahlin-Andersson K., 1989.
Oklarhetens strategi, Lund: Studentlitteratur. (in Swedish, "The strategy of ambiguity")

Sahlin-Andersson K., 1992.
"The social construction of projects: a case study of organizing an extraordinary building project - the Stockholm Globe Arena," Scandinavian Housing & Planning Research, Vol. 9. pp. 65-78.

Sapolsky H., 1972.
The Polaris System Development, Cambridge: Harvard University Press.

Sayles L. R., 1976.
"Matrix management: the structure with a future," Organizational Dynamics, Autumn. pp. 2-17.

Sayles L. and Chandler M. K., 1971.
Managing Large Systems, New York: Free Press.

Shapira Z. and Berndt D. J., 1997.
"Managing grand-scale construction projects: a risk-taking perspective," Research in Organizational Behavior, Vol. 19. pp. 303-360.

Sharad D., 1986.
"Management by projects: an idological breakthrough," Project Management Journal, No. 2. pp. 61-63.

Shenhar A., 1993.
"From low to high-tech project management," R&D Management, Vol. 23, No. 3. pp. 199-214.

Shenhar A. and Dvir D., 1996.
"Toward a typological theory of project management," Research Policy, Vol. 25. pp. 607-632.

Slater P., 1968.
"Some social consequences of temporary systems," in W. Bennis and P. Slater (Eds.), The temporary society, New York: Harper & Row.

Slevin D. P. and Pinto J. K., 1986.
"The project implementation profile: new tool for project managers," Project Management Journal, Vol. 17, No. 4. pp. 57-70.

Slevin D. P. and Pinto J. K., 1987.
"Balancing strategy and tactics in project implementation," Sloan Management Review, Vol. 29. pp. 33-41.

Staw B. M. and Ross J., 1989.
"Understanding behavior in escalation situations," Science, Vol. 9. pp. 39-78.

Stinchcombe A. L. 1965.
"Social structure and organizations," in J. G. March (Ed.) The Handbook of Organizations, Chicago: Rand McNally.

Stinchcombe A. L., 1959.
"Bureaucratic and craft administration of production," Administrative Science Quarterly, Vol. 4. pp. 168-187.

Stinchcombe A. 1985.
"Project administration in the North Sea," in A. Stinchcombe and C. Heimer (Eds.), Organization theory and project management, Oslo: Norwegian University Press.

Stinchcombe A. and Heimer C., 1985. (Eds.):
Organization theory and project management, Oslo: Norwegian University Press.

Thompson J. D., 1967.
Organizations in action, New York: McGraw Hill.

Turner J. R., 1999.
Handbook of project-based management, London: McGraw-Hill.

Turner J. R., 1999b.
"Editorial: Project management: a profession based on knowledge or faith," International Journal of Project Management, Vol. 17, No. 6. pp. 329-330.

Üsdiken B., Sözen Z., and Enbiyaoglu H., 1988.
"Strategies and boundaries: subcontracting in construction, Strategic Management Journal, Vol. 9.

Wateridge J. F., 1996.
Delivering successful IS/IT projects: eight key elements from success criteria to review via appropriate management, methodologies and teams, PhD thesis, Henley Management College, Brunel University.

Wheelwright S. C. and Clark K. B., 1992.
Revolutionizing product development, New York: Free Press.

Whittington R., Pettigrew A., Peck S., Fenton E. and Conyon M., 1999. "Change and complementarities in the new competitive landscape: A European panel study, 1992-1996," Organization Science; Vol. 10, No.5. pp. 583-600.

Williamson O. E., 1975.
Markets and Hierarchies, New York: Free Press.

Winch G., 1989.
"The construction firm and the construction project: a transaction cost approach," Construction Management and Economics, Vol. 7, No. 4. pp. 331-345.

Winch G., 1995.
Project management in construction: towards a transaction cost approach, Le Group Bagnolet, Working Paper, University College London.

Woodward J., 1965.
Industrial organization: theory and practice, London: Oxford University Press.

Project Networking - Managing Project Interdependencies

Terje I.Vaaland, Norwegian School of Management BI, Norway

Keywords: Projects, Networking, Relationships, Interdependencies, Oil Industry

The role of the project manager is to plan, implement and control activities and resources in order to attain project target. One implicit assumption is the independent organisations and traditional buyer and seller roles. This is about to change. New projects within i.e. the oil industry are based on tight interdependencies between partners, -which have an effect on how the project interacts with the external market. By applying a Norwegian field development project as context, these interdependencies are analysed in terms of how the activities, resources and actors are interrelated. We end up with the conclusion that the role of project management has to change. Rather than ruling suppliers and external resources project management has to become more like a playing coach within a project network.

Introduction

The focus and assumptions of project management is changing. This change involves a reorientation in how we understand the market and how we act in order to connect external resources to the project. Furthermore traditional project management is evolving from a preoccupation with project planning and control tools as the keys to success, towards management of people and their performance (Briner, Hastings and Geddes 1996). Concern about organisational politics, external environmental or marketing pressures has an increasing influence on how the project is managed.

The point of departure is traditional project management, which "..provides an organisation with powerful tools that improves its ability to plan, implement, and control its activities as well as the ways in which it utilises its people and resources" (Meredith and Mantel jr. 2000). From this perspective external resources are supplied from a market of free and independent actors. Furthermore the exchange processes between the project and suppliers are characterised as transactions of specified resources under clearly defined conditions. In this view one assumes that the project is capable of managing access to resources, of controlling activity structures and ruling the external actors.

These assumptions are about to change. A new style of project management is emerging. The external environment is no longer based upon "arm's length"-strategies, but rather an emerging consciousness of interdependencies between external actors. Some even claim it is a false picture to see a project as "the master of its own destiny, building its independent strategy and trying to get a favourable reaction from the market" (Ford and Saren 2001). Commitment, creativity and collaboration are brought together in "organisational networking" described as " the total "set of processes whereby individuals from different parts of the organisation and outside it, work in an active collaborative way to achieve a shared task or objective" (Briner et al. 1996). It is about removing boundaries and barriers creating a web of links and contacts between individuals so as to get things done. Bundling of technologies involve many companies, and the process may be more or less controlled by all the companies in a wide network ranging from component manufacturers to retailers. The question is thus no longer how to manage transactions in terms of controlling resources, but rather how to access these resources by means of carefully managed business relationships. The focus of project management is about understanding business relationships in a network of interdependent actors and improving the project's position and interactions in that network. This view coincides with the "systems approach" assuming that when we act on one part

of an organisation or system, we are certain to affect other parts (Meredith and Mantel jr. 2000). Hence the task of project management is about "managing the visible and invisible team to achieve the objectives of the stakeholders" (Briner et al. 1996).

One of the driving forces of this change is related to interdependencies between the project and surrounding environment. These interdependencies are related to three dimensions. Firstly, there is interdependence between the project and external actors, secondly between the resources controlled by the project and those controlled by others, and thirdly, there is interdependency related to the activity structures.

The following discusses these three dimensions of interdependencies based on a case study of an innovative technology project within the Norwegian oil industry, more specifically the fabrication of the production and storage vessel for the Norne oil field in the North Sea. The context is characterised by a high degree of technological complexity consisting of a large number of interdependencies fuelled by introduction of a new technological concept. Furthermore, there is managerial complexity, what with the introduction of an integrated team involving a large number of internal and external actors.

First activities, its links and activity structures will be discussed and related to the project. This is continued by a discussion of the resources, and the ties between resources and resource structures. In the third section actors, actor bonds and network of actors will be addressed. The fourth section suggests the managerial implications of the three dimensions of interdependencies. The conclusions are drawn in the final section.

The project as a set of activities, activity links, and structures

An activity is a specific task or set of tasks that are required by the project, use up resources, and take time to complete" (Meredith and Mantel jr. 2000). These activities occur when one or several actors combine, develop, exchange, or create resources by utilising other resources (Håkansson and Snehota 1989). The fabrication of the hull for the production vessel is a contextual example of project activity. Every activity is a link in a chain of activities, referred to as activity links. These links relate to technical, administrative, commercial and other activities that can be connected in different ways as a relationship develops (Håkansson and Snehota 1995). Prior to start of fabrication, the final product has to be conceptualised in terms of drawings and assembly instructions. The connection to the next (fabrication) phase is an activity link. Activity structure can be defined as aggregated activity links. The activity link binding "concept drawings" and "fabrication" together is a part of an activity structure which consists of a large number of other links leading up to the final product (i.e. the production vessel)

Two activity concepts

Richardson (1972) provides a framework consisting of two fruitful activity concepts, activity complementarity and activity similarity. Whereas the first deals with the sequential aspects of the activities, the second deals with how resources are utilised. The complementary activity represents different phases of a process of production and requires coordination (Richardson 1972). This implies that activities are related to vertical or sequential dependence. Complementary activities can be co-ordinated in three ways: By direction within the hierarchy of the firm, by co-operation between two or more independent organisations, or through market transaction. When complementary activities from several activity structures are compared, activity similarities can be detected, thus opening for economy of scale. The "conceptual/drawing"-activity in a project is complementary to the subsequent "fabrication"-activity.

Similar activities are the second activity concept, and address activities that require the same capability for undertaking (Richardson 1972). This implies that a particular resource can be so flexible that it can be applied to more than one activity, thereby possessing economy of scale-properties. From this follows that both the sequence of activities and resource utilisation, should be investigated, in order to suggest changes in the distribution of activities between the project and e.g. actors in the supplier market.

Three types of activity interdependencies

One activity is a part of interdependent activities in several chains. These sets of activities can be more or less adapted to fit into activities carried out by directly and indirectly related counterparts (Håkansson and Waluszewski 1999). Dubois (1998) suggests three types of such activity interdependencies: vertical interdependencies, technical interdependencies and horizontal interdependencies. Vertical interdependencies simply describe the connectedness to preceding activities of which the focal activity is a consequence. If this activity is not an "end station" in the chain, other activities are yet to come. Sequential aspects or time aspects may cause vertical interdependency. A project can thus be described as numerous and long vertical interdependent activity chains characterised by sequential constraints and time constraints. Horizontal interdependencies refer to activities going on in parallel to the focal one. These may have an impact on how resources are directed, distributed, and utilised. The technical interdependencies can be illustrated by technical properties in activity A having consequences for activity B. If B is located at a remote area in the activity structure, a change in activity A may cause a severe problem when the other activities following B and A merge at a later stage in the chain. A project is vulnerable to this phenomenon. This is illustrated by e.g. the production vessel. The hull was fabricated in Singapore, and the topside production unit, a complex process factory, was produced on the other side of the world. The two units were merged, revealing a variety of problems caused by technical interdependencies hard to identify further up in the activity chains. The fundament of technical interdependencies, however, started at an earlier stage, e.g. in the conceptual phase of the project. The issue of technical interdependencies is particularly critical at this stage, because technical concepts, including fabrication strategies are freezed here, hence introducing possible incompatibility in the upcoming fabrication process.

The activity dimension's impact on project management

Design and refinement of an activity structure require more than understanding of the technical sides of connected activities. Knowledge of capabilities and new opportunities for more effective activity interfaces and combinations are also important. In order to achieve this closeness with interacting parties a wider goal orientation is required. This is possible through proper understanding of the interdependencies combined with

the managerial skill of organisational networking. A skilled "networker" can access any information or specialist advise he/she may ever need in order to develop better activity interfaces across boundaries between the project and e.g. actors in the supplier market.

The project as a set of resources, resource ties, and structures

A resource is a relative concept, rather than an element in itself (Håkansson and Snehota 1995) because it is heterogeneous and interdependent with other resources it is combined with. The combinations for use are unlimited and accordingly never possible to finally specify. This can be illustrated by the resource possessed by the steering committee of governing oil field licenses. This resource is among others combined with skills in the educational business, with a new university course in "Management of oil fields" being marketed to foreign countries. Resource ties connect various resource elements (technological, material, knowledge resources and other intangibles) of two companies. These ties result from how the relationship has developed and represent in themselves a resource for the company. Resource structure can be described as a build-up of resource ties.

The project and its external capacity reservoir

The firm is dependent on resources controlled by other firms, and access to external resources through the company's position in the network (Johanson and Mattsson 1991). This access provides the project with capabilities beyond what is possible in the hierarchically integrated firm. The resources can be governed either by direction within the hierarchy of the project core team, by co-operation between the project core team and one or more independent organisations, or through market transactions. The internal resources in a project, provided by its own base organisation, are only a minor part of the total project resource constellation. In this respect the project may thus be characterised as an externally provided capacity reservoir allocated for a limited period of time.

It is not unusual for a conventional firm to experience imbalance between the resource needed to accomplish its tasks and its resource base. This imbalance is caused by years of accumulation of skills, facilities and equipment, more or less useful today. A distinction between the access to, and the control of resources is therefore fruitful. The market offers access, and the firm allows control. The immediate conclusion is that the control has substantial advantages, but is likely to be more costly than access (Loasby 1998), and finally: I can access more than we can control. For a conventional firm, pooling and redistributing these resources among different firms in its network reduce "slack". The project on the other hand has a somewhat different situation. Its provenance is grounded on applying the resources available in the network. It thus has no initial resources or "slack" in its own. Whether its base organisation has "slack" or not, is another issue. In this respect the network is not used for reducing "slack", but for providing the required resources.

The resource structure of a project

Some of the resource ties connect different internal resources, and others cross company boundaries. Connecting ties thus form a structure labelled resource constellation. The resource constellations have three consequences for the project: Firstly, the value of a given resource is dependent upon the number and strength of ties of which it is connected. Example: Capital is a crucial resource strongly connected to nearly all other resource items. Without this specific resource, very few other resources have value. Secondly, the resource can be connected to different types of resources. For example, the capability in a certain conceptual engineering discipline may impact on the requirements for heavy cranes on a construction site, with a further impact on requirements for financial resources. Thirdly, joint action across company or project boundaries plays an important role. Example: The mentioned engineering skill is particularly valuable if more than one actor is able to carry out the potential of the resource.

The connected resources can be identified in several ways and dimensions depending upon their purpose: Products, facilities, business units, and business relationships that will be addressed in the following.

Business Units: Ability to co-operate is crucial, and within this business unit human capabilities are found. These capabilities can be characterised as social units with knowledge and ability to work together with certain counterparts (Håkansson and Waluszewski 1999). The value of these resources or skills is, however, dependent upon their combination with other skills. A skilled geologist who knows where oil is located is of limited value, unless combined with the conceptual engineering skills that provide technical solutions for the oil well to be drained and processed. This interdependence is not only a static issue, it represents a dynamic force with effect on how resources can be combined in new ways. An interaction between company A with specific skills within seismic, and company B with specific skills in 4-dimensional computer graphics, may well end up with the development of a new skill, which opens for new exploration of previously abandoned oil fields. An important feature of this resource is its embeddedness in other business units, as well as in other types of resources such as facilities and products.

Products: The traditional view of economic exchange assumes that the product is taken for granted. It can, however, be argued that industrial buyers and sellers rarely regard a product as given (Håkansson and Waluszewski 1999). Product adaptations to customer requirements and joint specification development are examples of interaction leading up to new features, form and function of the resource. A project is for example dependent upon well developed computer systems. These have most certainly been developed as a result of tight interaction and strong ties between the project and supplier, and not as "faceless" product innovations solely within the boundaries of the supplier.

Facilities: Facilities include infrastructure and telecommunication lines. Empirical evidence shows that companies have recognised the possibilities of reducing costs by connecting facilities to each other, thus finding and utilising more or less well-known latent features. Offices and high speed data networks can be effectively connected for a smooth world-wide operation allowing skills in geographically remote areas to be involved in the concept development.

Business relationships: The resource labelled "business relationships" is used for networking, and is perhaps the most significant resource of all. It cannot be copied or reproduced, and its value does not diminish with use, as with other resources. Good business relation-

ships make uniqueness possible through extensive use of resources made available by other actors in the network, to which own resources can be added. In the project business relationships and networking activities can, for example materialise in joint industrial efforts to change the tax regime in order to make a marginal oil field profitable in spite of a low oil price. A further consequence of this relation can, in the next turn trigger counteracting forces, in terms of emerging relations between political parties, media and governmental bodies. Interaction through networking is thus a consequence of the resource labelled "business relationship".

The claimed interrelatedness between the four categories leads to the assumption that they are all clearly defined in relation to other resources.

Interdependencies

Resource interdependencies are relevant on three levels, (i) within the resource unit, (ii) between the resource units, and (iii) between specific resources in the focal project and other companies or projects.

(i) Interdependence within the resource unit: Within the group of business units "fabrication skills", "conceptual skills", and "managerial skills" are strongly interdependent. Without proper construction plans and management of project sequential activities, "fabrication skill" is of limited value. A weak supplier focus caused by lack of management resources may cause critical delays and poor quality in purchased materials leaving 50 skilled workers unemployed until recovery of the supply chain.

(ii) Interdependencies between the resource units: The facility used for construction of e.g. a production vessel requires certain skills to operate. The business unit called "fabrication skills" is one of these. A strike caused by a wage dispute would limit the access to the "fabrication skill" and most certainly affect the value of that facility ("site resource") for a certain period of time.

(iii) Interdependencies between resources in the focal project and other companies or projects: A shortage of certain capacities (e.g. docking) for one of the contractors may be solved by means of activating resources elsewhere with available capacity. These resources can be made available from other geographical areas, or from other parallel projects.

The main point in this discussion is that resources have to be combined with other resources in order to be valuable. This interdependence of resources includes internal resources within the context of the individual project, as well as external resources activated through other projects in the industrial network. Interdependencies are both a value and a constraint. They are constraints in the way that problems, conflict and disputes in one resource unit easily cause effect in other units, and a value in terms of mutual benefit from a wide resource reservoir.

The resource dimension's impact on project management

The management skill of organisational networking is highly relevant in relation to the resource dimension at least in two ways. Firstly, to detect new and more effective resource combinations within and between project and e.g. suppliers, and secondly to get access to the most attractive parts of the external resource reservoir. This reservoir includes elements of innovations and technological development that a supplier is willing to share with the most attractive and co-operative project "buyers".

The project as a set of actors, actor bonds, and structures

Actors control activities or resources and develop actor bonds with the persons or institutions they interact. The actor bonds influence on how the two actors perceive each other and form their identities in relation to each other. The bonds web the actors into actor structures, referred to as networks. The focal project (actor) has, for example, interaction with one specific supplier (actor) regarding development of technical solutions (bonds), thus being one of several such interactions going on (actor structures).

The project as an actor among actors

Håkansson and Johanson (1988) suggest five characteristics of the actor: Firstly, the actor performs and controls activities. Secondly, the actor develops relationships with others through exchange processes, e.g. buying from the supplier market, or applying local authorities for approval of deviations from night work regulations. Thirdly, the actor bases activities on the control of resources through ownership or through relationships. Fourthly, the actor tries to gain control of the network. This can be illustrated through competitive bidding for new oil fields where several oil companies fight for market shares, or when project core teams try to claim priority on the expense of others when a contractor is running out of critical capacity. Fifthly, the actors have different knowledge about activities, resources and other actors in the network. Assuming bounded knowledge in a complex environment, no actor can embrace all the complexities of the environment of which he is a part.

The actors can be defined on several vertical levels and identities ranging from the individual level to industry level. For example: the individual person allocated to the project, the core team of the project, the oil company or companies owning the project, the Norwegian oil industry, the international energy industry etc. The boundaries between the groups of actors and the number of actors are arbitrary, but are for the purpose of this paper divided into five groups embracing the focal project.

As illustrated in figure 1 the supplier market includes a large number of actors. Some of them are present (broad arrows) suppliers and sub-suppliers, and other actors do not currently serve the focal project. Customers include the Project Operation Team which will have the final construction unit handed over for operation after fabrication and completion, customers of oil and gas, and finally the community having stakes in the business in a variety of settings. The base organisation and governmental bodies are also groups of actors who affect on the focal project, and who at the same time are affected by the project. Other projects going on at the same time, which more or less compete for same resources, are also represented. They all are assumed to have a specific identity, motives and intentions acquired in interaction with others.

The bonds in offshore fabrication projects

Actor bonds are used to understand processes of social exchange. At the same time this give rise to commitment and trust between the parties (Håkansson and Waluszewski 1999). One can thus question the rationale behind the detailed contract. Is the role of the contract a consequence of low trust and commitment caused by weak actor bonds? And is it even possible to generate enough trust and commitment among parties connected to a temporary

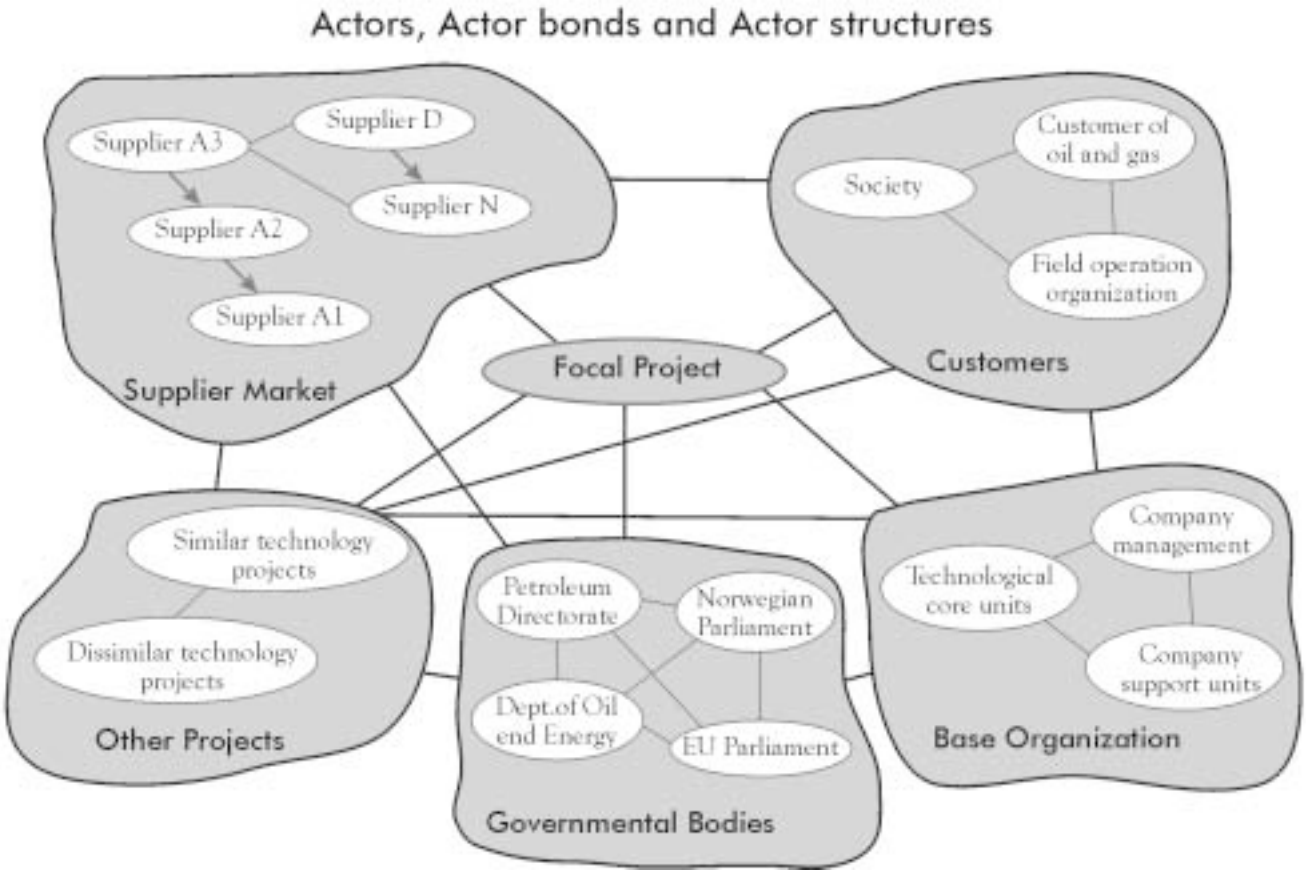


Figure 1. Actor structure, illustration

project established for a unique and complex task?

The actor bonds in a project can be described in at least two dimensions. One is the informal "soft" relational dimension including trust and expectations of a long-term business relationship. The second dimension of project actor bonds includes "hard" and authority based formal governance mechanisms with bilateral contracts acting as safety nets. It is hard to understand the actor bonds without recognising the interplay between them, as the two modes penetrate each other (Reve 1990). It can thus be argued that "hard" and authority/power based governance complements the "soft" negotiation based governance as proposed by Reve (1990). On the other hand this interplay can be contradictory in the way that the contract reduces the willingness and ability to develop trust and expectations beyond the legal documents, and supportive in the way that the formal dimension reduces risk for both buyer and seller. To get access to and exploit new activity and resource combinations thus depend on how this interplay is handled.

Strengths and other characteristics of the bonds may vary depending upon historical patterns of interaction, perceptions and previous experience. The more interaction, the stronger the bonds. Furthermore, the relations with regards to resource interdependencies and activity links add identity to the actor bonds. With respect to the largest suppliers and contractors of the focal project, these identities are partly formed by contracts, but reach far beyond the contractual level. One can suggest that social bonds developed between individuals in the focal project and the supplier are stronger than the bonds derived from the formal contracts. In this context I refer to Macaulay (1963) who argues that social relationship can be more effective than formal contracts in business relationships.

The project's identity in the network

Development goes on among the actors in the different supplier industries on which the focal project is dependent. New activity- or resource combinations can be developed in close interaction between a concurrent project and their suppliers. These suppliers, being "members" of the supplier network, will perhaps be activated later, thus allowing new solutions to be used in a new project. Technical innovations that emerge in bonds between various suppliers, industries and concurrent projects, although not directly connected to the focal project, should therefore not be neglected.

These bonds affect the behaviour and identities of the interacting parties. The position of the actor depends on which actors the focal actor has exchange relationships with (Johanson and Mattsson 1991). The position of the actor changes all the time, not only because new exchange relationships emerge and old ones change character, but also because the counterparts' position is changing. Furthermore, the positions of third parties, with whom the focal actor has no direct relationships, are also changing (Johanson and Mattsson 1991). A breakdown in bonds between a project and a supplier may easily affect "innocent" third parties more or less related to either of the two sides. The degree of influence is depen-

dent upon where they are positioned in the network in relation to the problematic relationship (Hadjikhani and Håkansson 1996).

It is necessary to acquire meanings in other actors' perceptions and behaviour to be an interesting and valuable partner. (E.g. referrals and testimonials when evaluating suppliers.) "In order to survive and develop they have to attract interest and resources and to elicit action from others. To achieve that goal they must be perceived by others as a distinct, intelligible entity; a company has to acquire the identity (the meaning) of an actor in the eyes of other" (Håkansson and Snehota 1995:138). This implies that a supplier holding an attractive resource base may easily exclude one potential customer (i.e. the project) of limited strategic interest.

The actor dimension's impact on project management

The networking project manager has at least two major challenges related to actor interdependencies and the network of which the project is embedded. Firstly he/she has to improve and strengthen the "industrial friendship" by means of actor bonds. One element in this is to fight against a condescending attitude towards the supplier market, which is not uncommon. This is necessary because the project is only one actor among several in the same network fighting for the most favourable resource and activity structures. A second challenge is to develop the project's identity in the network in order to attract the most interesting actors in the network.

Managerial implications of the interdependencies

The three dimensions of interdependencies call for managerial awareness and consciousness in several ways. Firstly, the interdependencies can cause unwanted consequences for the project illustrated by e.g. a strike among the major suppliers. Secondly the interdependencies open for a wide range of opportunities for more effective resource utilisation and activity structures if the relationships are properly managed. In the table 1 some of the managerial implications will be suggested in terms of questions:

The list of managerial questions based on the project interdependencies is endless, and should be further developed based on specific project and market characteristics. Some of the content in the business relationships between the

Dimension	Basic construct	Relevant questions for project management
Activity dimension	Activity	Activity complementarities: Who should carry out which activities; the market, the internal organisation or project/supplier in co-operation?
	Activity links	Have all vertical, horizontal and technical interdependencies been identified so as to avoid incompatible activities? What impact do interrelated activities have on resource allocation and priorities?
	Activity structure	Based on activity similarities how can economy of scale be achieved? Where are the critical paths in the activity structures? Should responsibilities in structure be redistributed between the parties?
Resource dimension	Resource	Should ownership of resources be replaced with access? Can resources be utilised more efficiently by sharing them with other actors? From where should different resources be accessed; from the market, internally or through project/supplier co-operation?
	Resource ties	Are there new innovative ways of combining resources? Are existing resources tied efficiently to other resources?
	Resource structure	Where are the crucial interdependencies and risk of misfit?Can structure be improved by altering content of resources? Should resources be managed differently in the structure? How to get access to the best capacity reservoirs in the network?
Actor dimension	Actor	Who are the crucial stakeholders? Where are the weakest links in the chain? Who has the potential for improving compliance with the time, performance and cost goals of the project?
	Actor bonds	How can informal relationships be strengthened? Is it possible to fortify the base for trust and mutual goals with crucial actors? Are we "killing" informal relationships with formalities?
	Industrial network	How attractive is the project perceived in the industrial network? How can we get better "industrial friends"? Are there any strategic enemies embedded in the network?

Table 1. Managerial implications of interdependencies

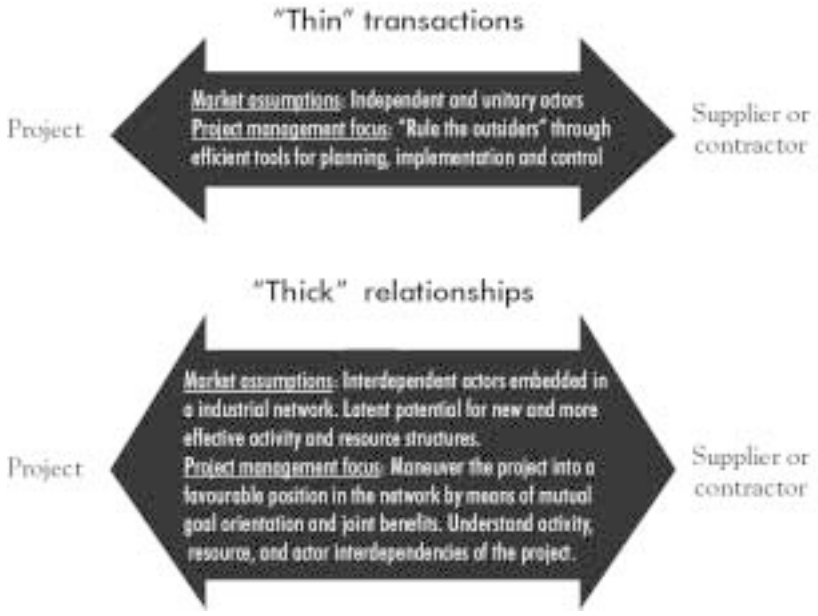


Figure 2. From "thin" transactions to "thick" relationships.

project and surrounding market environment is found in the answers to these questions, and will be further described in the following.

Concluding remarks

One metaphor used to describe the connections between the project and external actors is electrical wiring (Briner et al. 1996). It is the project manager's responsibilities to secure these by means of tools for planning, implementing, and control (Meredith and Mantel jr. 2000). These "wires" illustrate transactions consisting of a flow of resources and money, and are based on what can be characterised as ruling. By focusing on the magnitude and importance of interdependencies these "thin wires" are reinforced and widened to become "tunnels". In these tunnels, or business relationships, we find expectations, trust, social interaction and other elements in addition to the elements found in a "thin" transaction. One way of describing the content is through the three dimensions of interdependencies discussed in this paper. The interplay of the three dimensions is a driving force in the development of business relationships and it is within these relations that the main determinants of the project's performance are found. Accordingly the role of project management is to further develop and support the business relationships connecting the project with its interdependent actors.

The project manager has to move from ruling the outsiders to managing project networks. This implies a revision of market assumptions as well as a shift in project management's focus from replacing "thin" transactions to "thick" relationships.

Terje I.Vaaland
Norwegian School of Management BI,
P.O.Box 550 Sentrum,
N-4003 Stavanger,
Norway
Tel +47 51 84 67 30
+47 90 98 12 56
Fax +47 51 84 67 10
E-mail: terje.valand@bi.no

References

Briner, Wendy, Colin Hastings and Michael Geddes 1996. Project Leadership. Aldershot, Gower Publishing Ltd.

Ford, David and Michael Saren 2001. Managing & Marketing Technology. London, Thomson Learning.

Hadjikhani, Amjad and Håkan Håkansson 1996. "Political actions in business networks a Swedish case." International Journal of Research in Marketing 13. pp. 431-447.

Håkansson, Håkan and Jan Johanson 1988. A model of industrial networks. Industrial Networks. The New Reality. B. Axelsson and Easton. G. London, Routhledge.

Håkansson, Håkan and Ivan Snehota 1989. "No Business is an Island. The Network Consept of Business Strategy." Scandinavian Journal of Management 5(3).

Håkansson, Håkan and Ivan Snehota 1995. Developing Relationships in Business Networks. London, Routledge.

Håkansson, Håkan and Alexandra Waluszewski 1999. The Greening of White Paper Taking Advantage of Friction in Business Networks. 15th Annual IMP Conference, Dublin, Uppsala University.

Johanson, Jan and Lars-Gunnar Mattsson 1991. Network Positions and Strategic Action - An analytical Framework. Industrial Networks - A New View of Reality. Bjørn Axelsson and Geoff Easton. London, Routledge.

Loasby, Brian J. 1998. "The organization of capabilities." Journal of Economic Behavior & Organization 35. pp. 139-160.

Meredith, Jack R. and Samuel J. Mantel jr. 2000. Project Management, A Managerial Approach. New York, John Wiley & Sons.

Reve, Torger 1990. The Firm as a Nexus of Internal and External Contracts. The Firm as a Nexus of Treaties. M. et al Aoki. London, Sage Publications. pp. 133-161.

Richardson, G.B 1972. "The Organization of Industry." The Economic Journal Sept.. pp. 883-896.

Call for Papers
by April 30, 2003

PROJECT MANAGEMENT

A world-wide distributed journal linking industry and the academic world

Volume 9, 2003

ISSN 1455-4186

Editor-in-Chief:
Professor Karlos A.Artto
Helsinki University of Technology
Department of Industrial Management
P.O.Box 9500, FIN-02015 HUT
Telephone: +358 9 451 4751
Fascimile: +358 9 451 3665
E-mail: Karlos.Artto@hut.fi

Paper submissions are welcome. Papers are submitted in electronic format to the Editor-in-Chief. For more information about the journal and the journal policy, visit our www-pages at the Project Management Association Finland web-site,
URL: **http://www.pry.fi**

What Is an Effective Project Organisation?

Bjørn Johs. Kolltveit, Norwegian School of Management BI, Norway
Kjell Grønhaug, Norwegian School of Economics and Business Administration, Norway

Keywords: Project, Organisational Performance, Effectiveness

Use of project organisations has become increasingly more common. The execution of many projects - particularly those involving a high degree of uncertainty and complexity - has shown, however, that this form of organisation is not without its problems. In this paper we examine why this is so. We also elaborate a theory-based definition of organisational performance, which may help to guide the development of an effective project organisation.

Introduction

Since World War II we have witnessed increasing use of project organisations. This trend is not without problems, however. Over the years we have experienced serious problems in the execution of many major and complex projects. These problems have been related to quality, delivery time, and project costs, which in turn have led to cost overruns in relations to budgets and target. The perceived cost overrun problems have been the basis for many discussion and speculations. The media have focused on the problems, and asked questions concerning project organisational performance, and whether the projects are under control or not. In Norway, these discussions and processes have led to two comprehensive evaluations ordered and funded by the Government. The first report was published in 1980, "Kostnadsanalysen" (Moe et al 1980). The second report was published in 1999, "Analyse av investeringsutviklingen i utbyggingsprosjekter på kontinentalsokkelen" (Kaasen et al 1999).

The development of project cost relative to budgeted cost can be conceived to be a good indicator of goal achievement and project organisational performance. Based on data from the first evaluation report, we get the following picture of the cost overrun problems (Moe et al 1980: 360).

Table 1 shows an average cost overrun for the completed projects of 178 %. The average cost overrun for the projects under construction was 29% per July 1979. The projects Murchison, Valhall A, Statfjord B, and Frigg III were not completed by July 79, and we cannot compare the final cost of completed projects with the cost of projects under construction, but the figures are still interesting. Table 1 is not without ambiguities, however. The projects were so called gravity base structures (GBS) in the North Sea. Gravity base structure are steel or concrete structures resting

Project	Start estimate (M$)	Cost per July -79 (M$)	Overrun (%)
Ekofisk II	129.6	385.9	198
Ekofisk III	405.0	794.2	96
Pipelines	638.2	1142.9	79
Frigg I and II	352.4	1994.4	466
Statfjord A	405.7	1304.5	222
Ekofisk IV	683.1	1639.3	140
Murchison	651.7	684.8	5
Valhall A	528.5	660.0	20
Statfjord B	1280.0	1790.0	40
Frigg III	166.0	240.0	45

Table 1: Cost overruns for early offshore development projects in the North Sea

Project	Start estimate (MNOK)	Cost per -98 (MNOK)	Overrun (%)
Balder	5004	8085	62
Jotun	6199	7204	16
Njord	6310	7760	23
Norne	8621	9274	8
Oseberg South	8046	8749	9
Oseberg East	3488	4298	23
Varg	2935	3636	24
Visund	7850	11370	45
Åsgard	28524	36967	30

Table 2: Cost overruns for recent offshore development projects

on the sea bottom. These structures carry the production platforms. The start estimate for Statfjord B was increased by $ 874.3 mill., or 215.5%, relative to the estimate for Statfjord A. The two projects were slightly different in concept. This is one of the main reasons for the differences in start estimate. Another is the higher safety margin in the estimate for Statfjord B. In addition, when comparing the cost for the completed project with the start estimate, a strict task perspective is applied. Whether the higher costs represent investments for future value creation or life cycle profit (LCP) is not taken into account.

Data from the last evaluation report gives another picture of the cost overrun problems associated with more recent offshore development projects (Kaasen et al 1999: 54 - 90).

In table 2, the left-hand column gives the names of the project studied. The second column shows the start estimate of each one. The third column gives the cost status per 1998, and the final column on the far right shows the cost overruns in % of the start estimate. We have some comments on the table. Firstly, in the case of most of these projects, the construction continued after 1998, and so did the cost overruns. This means that we cannot compare costs or cost overruns for these projects with those described in table 1. Secondly, per 1998 the average cost overrun for the projects in table 2 is 26.5 %, with a total cost overrun for these projects of NOK 20.366 mill, which is still a large sum of money. Thirdly, the table 2 projects are not gravity base structures, but floating production facilities including sub-sea installations for oil and gas production. Thus, they are conceptually different from the projects in table 1. This was the situation for example, for the Åsgard project. The final cost for that project exceeded NOK 50.000 million. Fourthly, table 2 does not take into account whether the cost overruns included investments to increase LCP. This was again the case for the Åsgard project. A significant part of the cost overrun for that project was related to investments in new production technology to improve the project life cycle profit (LCP).

The cost overruns shown tables 1 and 2 related to serious and complex problems. Examples are a large number of changes per drawing, delayed drawings, logistic problems, delays in fabrication and construction (Kolltveit 1988). It is logical that questions were raised concerning project organisational performance.

So far we have highlighted problems related to offshore development projects. But serious problems have been experienced with other types of projects as well. A major study comprising 30000 information system (IS) projects, concludes that only 25 % of such projects are successful. major problems are experienced in 52 % of them, and 23 % are a total fiasco projects (Case 2000). Several types of problems were identified, but here too cost overruns was one of them. A smaller study on IS projects undertaken by NTNU confirmed these conclusions (Petersen et al 1998). These findings strengthen our conclusion that problems related to project goal achievement and project organisational performance are experienced for most projects.

In addition to the cost overruns, some of the above mentioned problems have also had significant organisational implications. For example as a consequence of the cost overrun and late delivery of Åsgaard, the CEO and the Board members of Statoil had to resign. Another example is that, after having completed the Visund project, the Umoe Group had financial problems and was sold to ABB.

Three project characteristics

To improve our understanding of why there are deviations in goal achievements for projects, we shall highlight three characteristics of projects. These are the project complexity, project uncertainty and the project time frame. These three factors are discussed below.

Complexity is related to the number of parties and disciplines involved in a project. A variety of applied technological disciplines give a complex. In addition, a large numbers of stakeholders increase project complexity. Stakeholders are defined as individuals or organisations with direct influence on the project, or directly affected by the project (PMI 1996). The stakeholders have different interests, expectations and goals for the projects (ibid). They fight for their interests and goals, and in many cases the project organisations are political systems (Pfeffer and Salancik 1980, Eisenhardt and Zabaracki 1992). An earlier study confirms that complex projects normally have many goals. Two major ongoing projects, here called projects A and B have 16 and 27 overall goals respectively. To these must be added more detailed and operational goals for the various units of the project organisations. Thus, the number of goals for these two projects is relatively large, which contributes to a high degree of project complexity. The result may often be multiple and contradictory goals. We know from the literature that contradictory goals create problems for goal achievement. In such cases changes will occur. It is impossible to have fixed goals without including adequate safety margins in the goals (Goodman and Pennings 1977). In addition, multiple goals make the organisational goal orientation a problem. Lack of goal orientation is assumed to have a negative effect on organisational performance.

Another important aspect of large-scale projects is uncertainty. Here, uncertainty is understood as the differ-

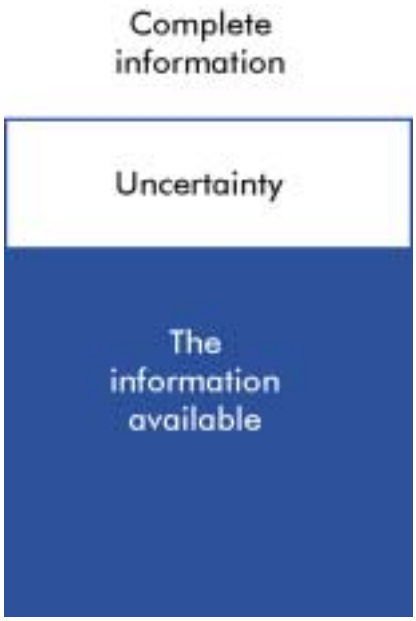


Figure 1. Project uncertainty

ence between complete information and the available information. This is shown in figure 1.

Figure 1 illustrates that project uncertainty is related to lack of information (Galbraith 1973:5). The sources of project uncertainty are many, e.g. different discipline technologies, conceptual solutions, capacity and competence of the contractors, the project logistics, performance of the project organisation and so on. This means that most major and complex projects, where the lack of information is substantial involve a high degree of uncertainty. An interesting example is the Åsgard project. At the time the project started there was much uncertainty as to production technology. The project management knew that no relevant production technology was available to solve the specific problems at the Åsgard field. Special technology had to be developed. The required technology was more expensive than anticipated and the consequences were cost overruns and deviation from the budgeted cost. However, new technology improved the project life cycle profit (LCP), and was a very profitable investment from this point of view. Even so, the goals were not met and some of the stakeholders and the media considered the project organisational performance to be negative. Perhaps the Åsgard project management could have invested less money than they did in the new production technology, but they could not avoid a change in the project goal for cost.

The project time frame requires the project scope to be completed within the agreed delivery date. In many cases the delivery date is an ultimate goal or constraint (Goodman and Pennings et al 1977). An example is the project to prepare for the Olympic Games. The games have to start on an agreed date, and the preparations have to be completed by that date. If the preparations are behind schedule, and it is highly probable that they will not be ready on time, more resources than planned will be used to ensure timely delivery. This increased use of resources will lead to increased cost, or cost overrun. Other examples are the early offshore development projects shown in table 1. These projects were gravity base structures (GBS). Because of the high probability of bad weather conditions in the North Sea in winter, the platforms had to be towed out within the so-called weather window, i.e. between May and September (Kolltveit 1988). For some platforms, the scope of work was not completed by the end of the planned weather window. In these cases the platforms had to be towed out uncompleted. The remaining scope of work had to be completed offshore in the North Sea. Offshore work is very much more expensive than work at shore. The consequence was cost overrun. The problems related to the time factor are illustrated in the Figure 2.

Figure 2 should be read as follows: Curve 1 illustrates the planned resource consumption at project start. Curve 2 illustrates the actual resource consumption. The point in time t1 is the project start. The planned termination time is called t2, and the actual termination time t3. The figure shows that the project was unable to follow the resource consumption as planned at the project start, and in order to try catch up and prevent further delay, more resources than planned were required towards the end of the project. Even so, the project delivery was delayed from t2 ton t3. The increased resource consumption during the later part of the project execution leads to that the area under curve 2 is larger than the area under curve1. This implies a resource and cost overrun relative to the start estimate. This demonstrates that the factor time frame can cause cost overrun. In our view, however, the real reasons why so many projects experience problems related to the time frame and delivery date have their roots in uncertainty and complexity. Thus, we conclude is that these two factors are the main reasons for project changes and cost overruns.

Evaluation of organisational performance

The above discussion indicates that organisational project performance is closely related to goal achievement (Campbell 1977:19-23, Scott 1977:64 Kolltveit 1988). The reason is that goals provide criteria for evaluating how well the organisation is functioning (Scott 1977:66). This is not without problems, however. As emphasised above, the goals are often many and varied. All the goals are seldom equally important, however. Usually, some goals are considered more important than others. We therefore argue that

The organisational performance of project organisations is closely related to the ability of the organisation to achieve high priority goals.

The term high priority goals implies that a project has many goals, but all are not equally important (Campbell

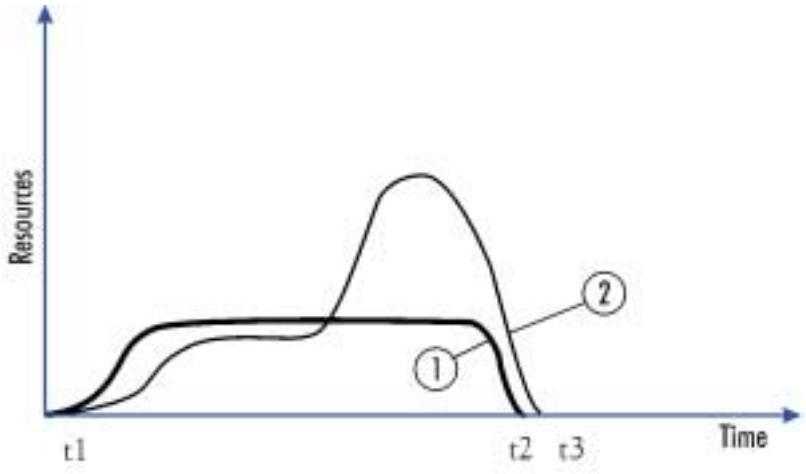


Figure 2. The project time frame

1977:48), and some goals should have higher priority than others.

Project organisational performance can be evaluated in several ways and the conclusions may vary accordingly. Here we shall focus on three time perspectives that can have a marked impact such evaluations: the task perspective, the lifecycle perspective, and the historic perspective. From a task perspective, the stakeholders evaluate the organisational performance on the basis of whether the project organisation has managed to complete the project object within the agreed budget, with a quality as specified, and within the agreed delivery time. From a lifecycle perspective the stakeholders evaluate the project organisational performance from a different angle. From this perspective the primary goals are such things as minimum lifecycle cost (LCC) or maximum lifecycle profit (LCP) (Hetland 1995). Lifecycle goals may also be related to factors like environmental impacts etc. The evaluation of organisational performance is related to the degree to which the project organisation has managed to minimise LCC, long term environmental impacts, and maximised LCP. In a historic perspective the evaluation is completely different. The cost or profit involved are of no interest, the focus is on quality alone.

To illustrate the impact of the various perspectives underlying evaluations, let us look at some examples. One is the Åsgard project, where there was a significant overrun with respect to cost and delivery time. From a task perspective, the evaluation of the project organisational performance was negative. From a lifecycle perspective, however, the evaluation was different. Therefore, the new CEO of Statoil could inform the media in April 2000 that the Åsgard project was a success because it was the most profitable project in the North Sea (Aftenposten 2000). This means the project maximises LCP, and from a lifecycle perspective the performance of the project organisation was positive. Another example is the Central Bank of Norway new head quarters. This project had major overruns in respect of cost and delivery time. From a task perspective, the project organisational performance was negative, and the media focused strongly on the problems. The lifecycle perspective is irrelevant in such a case, because the historic perspective is more interesting. From this perspective quality is the only relevant dimension. Today people regard the new headquarters as a nice building, and only few focus anymore on the cost overruns. There is reason to believe that, from a historic perspective, this project will be considered to have a positive contribution to Oslo. Another project is the cathedral in Trondheim, Nidarosdomen. That project lasted several hundred years from start to completion. Nothing is known about the costs involved, but Norwegians are very pleased with the cathedral. From a historic perspective this project has made a very positive contribution to Trondheim, but it is impossible to evaluate organisational performance. One of the projects most famous for extreme cost and time overruns is the Opera House in Sydney. At the time it was built, the project organisational performance was heavily criticised. Today, people are proud of the building and nobody mentions the cost overruns. From a historical perspective this project is a success.

Changes and goals

Above we emphasised that organisational performance is closely related to the organisation´s ability to achieve high priority goals. One major problem is the impact of project changes on the project goals and the ability to achieve them. In this section we shall discuss the relation between changes and project goals. Key questions in this connection are why cannot project goals be fixed, and why do we get changes? The above discussion shows that the answer is closely related to project uncertainty and complexity. For projects with a low degree of uncertainty and complexity, the goals can be fixed. We know that, for large projects, the degrees of uncertainty and complexity are high, and we have concluded that uncertainty and complexity often lead to variations, including changes in goals. For such projects it is almost impossible to define fixed goals without including adequate safety margins (Goodman and Pennings 1977).

Let us now consider what is meant by adequate safety margins. Most projects have a cost budget based on x % subjective probability for goal achievement. Subjective probability means that the probability is not a result of exact calculations only, it also includes subjective evaluations. Having said this, however, it represents the best data available. When a decision is made on the level of subjective probability for goal achievement for a project an appropriate sum is added to the estimate. This sum is intended to compensate for the uncertainty involved, and is called a safety margin. If the subjective probability (x) is low, the safety margin is also low. If the subjective probability is increased, the safety margin must be higher. In many cases the project cost budget is based on 50% subjective probability. This means the project has the same probability of cost overrun as cost under-run. If the project management increase the subjective probability of avoiding cost overrun, e.g. to 85%, the cost budget will increase. The main reason for the increased budget or goal is a higher safety margin. This margin is necessary to reduce subjective probability of cost overrun. A budget based on 85 % subject probability has only 15% probability of cost overrun. Such a goal is, however, less ambitious and demanding than a budget based on 50% subjective probability. If the project management want 100% subjective probability of avoiding cost overrun, the safety margin and goal will increase relatively more. The relations between subjective probability and safety margin are illustrated in figure 3.

Figure 3 is to be interpreted as follows. It shows that the cost c2, based on 85% subjective probability, is relatively much higher than c1, which is based on 50% subjective probability, and that c3 is more than double c1. This because relatively higher safety margins have to be added as the subjective probability of achieving the goal increases. This gives the S-curve, i.e. the accumulated normal distribution curve. If we want to ensure fixed goals, these have to be based on 100 % subjective probability of achievement This means that we already know at the start of the project that the goals will be achieved. This necessitates a very high safety margins. Another aspect is that there are no ambitions with such goals, there is nothing to fight for. Budgets and goals affect the people involved (Argyris 1952). Accepted, ambitious goals stimulate people to higher performance. Goals without ambitions will lead to lower organisational performance. Therefore all project organisations establish ambitious goals, e.g. with 50 % or 85 % subjective probability. The consequence is a probability of deviations from the goals. Thus, goals with any level of ambitions can-

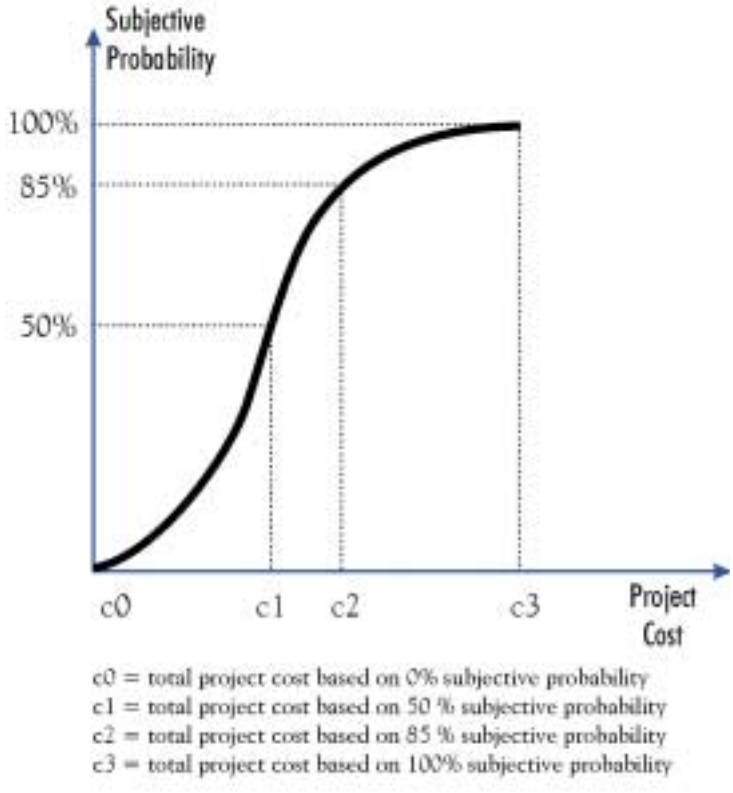


Figure 3. Subjective probability and safety margins

not be fixed.

Decision processes and changes in goals

It follows from the above discussion that decisions influence the organisational ability to achieve goals. We shall now illustrate the relations between the decision-making process and changes in goals. Assume that a local government has made the decision (d1) to build a hospital of a certain size in terms of in m^2 floor area (s1), with a specific quality (q1), a specific functionality (fu1), a defined capacity (ca1), to be ready for operation at a specific date (t1), and to be built within a certain frame of costs (c1). Let us consider s1, q1, ca1, c1, fu1 and t1 as project goals. The start decision d1 is illustrated in table 3.

Table 3 is to be read as follows. The left-hand column shows critical factors. In the centre column we have listed the goals s1, c1, ca1, fu1, q1 and t1. Decision d1 is taken at a very early phase of the project development. There is still a high degree of uncertainty related to the project. One major source of uncertainty is the project strategy chosen for application of hospital technology. There are two strategically extreme choices as regards technology. One is to make maximum use of the "proven" technology available when the decision d1 is taken. If this strategy is chosen, the internal uncertainty related to technology is reduced to a minimum. The other side of the coin, however, is that by the time the new hospital is ready for operation, the installed technology may be old and outdated. The other extreme strategic alternative is a make maximum use of new technology developed as the hospital project progresses. This strategy allows the hospital the most up-to-date technology, but introduces a high degree of internal uncertainty and downside risk for overrun on project costs and delivery time relative to the goals. Obviously there are many strategic alternatives related to application of technology between these two extremes.

Decision d1		
Factor	Goal	Comment
Size	s1	
Cost	c1	
Capacity	ca1	
Functionality	fu1	
Quality	q1	
Delivery time	t1	

Table 3. The initial decision

Assume the project has chosen strategies with a high degree of internal uncertainty. As the project develops, discussions may arise related to requests for increased size, higher quality, better functionality etc. There are several reasons for such discussions: Firstly, because the chosen strategy implies a high degree of uncertainty, changes may be needed. Secondly, since the project passes through several phases, new actors or stakeholders become involved during the transition from phase to phase (Kolltveit 1988). The new stakeholders may disagree with the chosen concept and project targets. Thirdly, the uncertainty may be related to what has been termed "forming, storming and norming" (Handy 1978). This can be explained as follows. Storming has its roots in the new organisational members needs for clarification of own position and power. The discussions may focus on adjustment of the project size, quality, capacity, functionality, delivery date and project costs, but the real reason could be that the new members are fighting for power and position. Fourthly, new information and technology may make it relevant to discuss adjustment of project goals. This is illustrated below. Assume a request is made for more advanced technology. The argument launched is that "more advanced technology is available on the market, and this technology could be beneficial to the new hospital". Such technology will, however raise the project cost.

Assume that the project management decides to use the new technology. This decision is called d2, and it can cause the following changes.

Table 4 is to be read as follows:

the new technology has an affect on functionality, quality and project costs. Therefore, the functionality is changed from fu1 to fu2, the quality from q1 to q2, and the project costs from c1 to c2. The new technology is more expensive, and therefore c2>c1. In addition, the decision d2 could increase project uncertainty if the new technology replaces the proven technology.

As the project progresses, other discussions arise that challenge other targets. One of them may be a request for larger size, for example in order to improve functionality and/or increase the capacity. The proposed changes will raise the project cost. If the project management agrees to the proposal we get a new decision (d3). Decision, d3, may cause the variations illustrated in Table 5.

This table shows that the size is increased from s1 to s2. The impact of this change is that the capacity is changed from ca1 to ca2, functionality from fu2 to fu3, and project cost from c2 to c3. Since it cost money to increase size, we can conclude that c3>c2.

Despite the fact that the project management considers discussions related to changes seriously, also the implications of these changes, the consequences of such processes are that all the project goals can be changed as the project proceeds. In addition, most of these changes affect project costs. This creates a situation where it looks as if the goals are floating. Such change processes may be understandable to internal stakeholders, but almost impossible to grasp by external stakeholders. In spite of the fact that the changes are carefully considered and each of them improves the project, the change processes may "create" a strange picture for the external stakeholders. Even though the project could be well under control, the change processes may give the impression of that the project is in a difficult situation, and out of control.

Weighted goals, and constraints

Organisational goals represent agreed desired ends. Pennings and Goodman (1977:160) argue that organisations are effective if organisational results approximate or exceed a set of referents for multiple goals. Some of the project goals are of crucial importance and have to be achieved by the project organisation.. These goals can be conceived as constraints. Referents are the standards

Decision d2		
Start Goal	Change	New Goal
s1	0	s1
c1	Δc1	c2
ca1	0	ca1
fu1	Δfu1	fu2
q1	Δq1	q2
t1	0	t1

Table 4. Impact of the second decision

Decision d3		
Goal	Change	New Goal
s1	Δs1	s2
c2	Δc2	c3
ca1	Δca1	ca2
fu2	Δfu2	fu3
q2	0	q2
t1	0	t1

Table 5. Further decisional impact

against which constraints and goals can be evaluated. We have mentioned, for example that the delivery time has to be achieved in the case of preparation projects for the Olympic Games, and of GBS projects in the North Sea because of the weather window. In these examples the delivery dates are project constraints. What the project constraints are, and how the project goals should be weighted will be results of discussions and processes between the stakeholders involved in the specific project. We underline the importance of these decision making processes, and argue that when goals are properly discussed and the stakeholders have come to a decision on constraints and the weighting of goals, there is a good basis for evaluating project organisational performance. Therefore, we conclude that a concept for evaluating organisational performance based on weighted goals and project constraints provides the project management with strong guidelines for focusing on the right things.

It follow from the above conclusion that, in our effort to develop a definition of project organisational performance, we shall focus on the organisational ability to satisfy constraints and achieve weighted goals. It also follows that the project constraints should be met. The consequence is that, if the project has to make adjustments, the constraints should remain the same, but other goals may have be adjusted. This may lead to new decision-making processes, as illustrated below:

Assume that the principal stakeholder has concluded that the cost (c1) and functionality (fu1) are constraints. His reason is that the stakeholder has no more money to invest in the hospital and functionality is the essential success factor for any project.

If we apply our new concept, what will happen if an increased size is requested? According to the new concept for evaluating organisational performance, the only situation where the project management can accept an increase in size is if the cost involved does not exceed c1 or can be compensated by a reduction of cost elements related to other factors, and the functionality is not reduced below fu1. This situation is met in decision (d2), which is illustrated in Table 6.

Table 6 is to be read as follows: First we assume a2 > a1, and ca2 < ca1.

Another decision d2			
Goal	Constraints	Change	New Goals
s1		s1	s2
c1	c1	0	c1
ca1		-Δca	ca2
fu1	fu1	0	fu1
q1		0	g1
t1		0	t1

Table 6. Changed impacts from decision

The table shows that the cost implication of the larger size Da1 is compensated by a reduction in the capacity of the hospital. This is necessary in order to satisfy the cost constraints. If a reduction in capacity is not possible, a reduction must be made in some other factors. If not, the project management cannot accept an increased size.

Such decision-making processes based on using the concept of constraints are easier to communicate to external stakeholders than are the traditional processes, where all the goals may vary. In addition, by focusing strongly on how to meet the constraints, the project organisation is forced to focus on the right things, and not only on how to do things right. Weighted goals will strengthen these effects.

Discussion

Based on the above discussion we shall now sum up what we mean by organisational performance. We argue that organisational performance is synonymous with organisational effectiveness (Wild 1977). Therefore, we use the term organisational effectiveness in our definition of organisational performance for project organisations dealing with high uncertainty and complex projects.

The definition of organisational effectiveness in respect of project organisations must meet three requirements. First, it is impossible to define organisational effectiveness by using one factor only. Therefore, the definition has to be a multivariate construct. Second, it should be possible to evaluate the organisational performance based on inter-subjective measures (Nachmia and Nachmias 1981). The term inter-subjectivity reflects that analysts following the same rules should arrive at the same conclusions. Third, the definition should have a high degree of generality (Holsti 1969). Generality reflects that the definition should have some theoretical relevance. This is very important.

Argyris (1964) defines organisational effectiveness as follows: "The criteria of total organisational effectiveness is an integration of the three effectiveness scores, namely the degree of energy needed to carry out the three core activities (achieving objectives, maintaining the internal system and adapting to the external environment) in relation to output". We consider this definition as highly relevant in our effort to define project organisational performance.

The transaction cost theory is another important theoretical concept. In this concept the project is regarded as a transaction, and the project cost is split into transaction cost and production cost (Williamson 1985). Combining Argyris´s definition and the transaction cost concept we argue that transaction cost-related activities cover what Argyris defines as maintaining the internal system and adapting to the external environment. In addition, the production cost related activities cover what Argyris calls achieving the objectives. This means we can replace the three core activities with the sum of transaction and production cost. Argyris maintains that the degree of energy needed to carry out the three core activities should be seen in relation to output. We argue that goals are inter-subjective standards that reflect project output. Therefore, we can replace output with weighted goals and constraints, which meets the need to deal with the term high priority goals in our basic assumption. Based on this dis-

cussion, a definition of organisational effectiveness for project organisations reads as follows:

> ***An effective project organisation satisfies the agreed constraints, and minimises the sum of the transaction and production costs, in its effort to achieve weighted goals or referents for weighted multiple goals.***

The formulation "minimises the sum of the transaction and production costs in its effort to achieve weighted goals or referents for weighted goals", places the focus on organisational processes, and on doing things right.

The very last part of our definition "or referents for weighted multiple goals" is included because a goal is achieved at a specific milestone (Andersen et al 1995). Only at this milestone can we conclude whether the goal has been achieved or not. Before the specific milestone is reached it is often impossible to make a conclusion on goal achievement. In such situations, the referents for the goals may be more relevant for monitoring project progress and performance. Balanced Scorecard provides excellent methods for developing, implementing and monitoring relevant referents of multiple goals (Kaplan and Norton 1996).

We have stated three requirements concerning our concept: It should be a multivariate construct, it should be possible to measure organisational performance based on inter-subjective standards, and finally the definition should have a high degree of generality. Our argument is that our definition meets all three requirements.

Bjørn Johs. Kolltveit

Norwegian School of Management

P.O.Box 580
1302 Sandvika, Norway

Bjorn.Kolltveit@BI.no
Tel +4767557000
+4767557755

Kjell Grønhaug

Norwegian School of Economics and Business Administration

Breiviken 40,
5035 Bergen, Norway

Tel+4755959000

References

Aftenposten 2000.
Statoil - sjefen forsvarer Åsgard, Oslo: Aftenposten April 14th 2000

Argyris C., 1952.
The impact of Budgets on people, Cornell University, The school of Business and Public Administration

Argyris C., 1964.
Integrating the Individual and the Organizations, New York: Wiley.

Campbell J.P., 1977.
"On the nature of Organisational Effectiveness", in New Perspectives on Organizational Effectiveness, Paul S.Goodman and Johannes Pennings, eds. San Francisco: Jossey - Bass publishers.

Case R., 2000.
Prosjektene tar over industrien, Computerworld 15.11.

Eisenhardt K.M. and Zabaracki, M.J., 1992.
Strategic decision making, Strategic Management Journal, Vol 13,17-37 (1002)

Goodman P.S and Pennings J.M., 1977.
New Perspectives on Organizational Effectiveness, San Francisco; Jossey - Bass Publishers

Handy C.B., 1978.
Understanding Organisations, Great Britain; Penguin.

Hetland P.W., 1995.
Målsøkende Strategier og Kontraktsformer for gjennomføring av komplekse utbyggingsprosjekter I og II, PhD avhandling; Ålborg Universitet.

Holsti O.R.,1969.
Content Analysis, The Handbook of Social Psychology, London: Addison-Wesley publishing Company.

Kaplan R.S. and Norton, D. P., 1996.
Balanced Scorecard, USA;Harvard Business School.

Kolltveit B.J., 1988.
The Technical Concept and Organizational Effectiveness of Offshore Projects, PhD Dissertation, London; Brunel University

Kaasen K., Aslaksen I., Hervik A., Bergseth S.,Moe B., Grønner E., Tranøy A., 1999.
Analyse av investeringsutviklingen i utbyggingsprosjekter på kontinentalsokkelen, Oslo; Olje og Energidepartementet.

Moe J., Haga I., Knutsen K.B., Rolstadås A., 1980; Kostnadsanalysen, Norsk Kontinentalsokkel, Olso; Sintef

Nachmias C. and Nachmias D., 1981.
Research Methods in the Social Sciences, New York; St Martin´s Press.

Pennings J.M. and Goodman P.S., 1977.
Toward a Workable Framework, in New Perspectives on Organizational Effectiveness, Goodman and Pennings eds., San Francisco; Jossey-Bass Publishers

Petersen J., Mjåset S., Bekkeheien P., Molid S., Kilde H. 1998. Kontrakt som styringsverktøy for IT-prosjekter, Trondheim; PS 2000

Pfeffer J. and Salancik R.S., 1978.
The external control of organizations, A Resource Dependent Perspective, New York; Harper & Row Publishers.

PMI 1996.
Project Management Body of Knowledge, USA; Project Management Institute

Scott R.W., 1981.
Organizations: Rational, Natural and Open System, New Jersey; Prentice-Hall, Inc.

Wild R., 1979.
Production and Operations Management, London; Reinhart and Winston.

Competence Requirements in Managing Project Business

Harri Haapasalo, Department of Industrial Engineering University of Oulu, Finland
Vesa Pikka, Department of Industrial Engineering University of Oulu, Finland
Pekka Kess, Department of Industrial Engineering University of Oulu, Finland

Keywords: Project Management, Competence, Knowledge Area, Success Factor, Education

The purpose of this paper is to study firstly success factors and secondly development needs in practical project business from the excellent project management point of view. It first addresses some approaches like project phases, knowledge areas, problems in project management and key features of project success from a literature review. Then it presents practical success factors and development/learning challenges in the Oulu region. Finally it raises discussion about the structure of Project Management Excellence.

Introduction

The business environment has gone through quite radical changes in recent decades and these changes have become even faster recently. The reasons for the strong competition arise mostly from globalisation and technological development and their consequences. During the last decades this has modified paradigms in business and also in manufacturing, which of course has influenced the products to be manufactured. Scale, cost, quality and time in a row are the paradigms where business is managed. (Kolarik 1999, Pine 1993, Suri 1998, Womack and Jones 1996). According to Harrington (2000) the 21st century is bringing rapid innovation, driven by the continuing high-tech boom and expanding global markets from the last decade of the 20th century. The accelerating rate of change will continue to be driven principally by the exponential growth and global availability of information, technologies and technology-based infrastructure. This sets new requirements for product or process development and managing knowledge in these contexts. These requirements can be presented as in table 1.

The development presented above has changed the way to manage business and intensified a multi-project business environment covering all activities in organisation. Therefore a project-oriented approach has become

	Before the 1980's	In the 1980's	In the 1990's	Today/Tomorrow
To be winner at the market	Product Quality	Customer Satisfaction	Time to Market	Balance Expectations for All Interest Groups, Continuous Improvement in Internal Efficiency
To stay in the market	Costs	Product Quality	Customer Satisfaction	Time to Market (ability to create added value for
Precondition for entering the market	Right Product	Costs, Right Product	Product Quality, Costs, Right Product	Customer Satisfaction, Product Quality, Costs, Right Product

Table 1. Paradigms for success (European Quality).

reality in several companies and in some organisations activities are based only on projects. Therefore it is reasonable to study the competences needed for multi-project planning and management. This kind of phenomenon is even emphasised in product development environment, because product development is done with projects.

The purpose of this paper is to study firstly success factors and secondly development needs in practical project business for Project Management Excellence (PME). PME refers to the ultimate research effort in the background, more than a new label itself. In addition the purpose is to find out, what kind of competences should people in the project business have and what are the key issues to educate the project staff. Practical project management has been chosen as an approach, because we have to first know what happens in practice and then look at it from the pedagogics point of view. The presented PME outline is a preliminary approach in effective management of projects. This paper does not seek final answers or present a final framework, but rather aims to raise discussions on the concept and contents of PME.

Managing Projects

The idea of a project is conceptually mixed on many occasions with process, because the relation is sometimes vacillating. However, there is a clear difference, because projects are unique at least in some sense and process activities are more permanent (Artto et al. 1998, Pelin 1996, Stenlund 1986). The difference is greater when discussing how to manage projects or processes.

Project management is a universal concept containing controlling and managing the project oriented activities. It has evolved in order to plan, coordinate, and control the complex and diverse activities of modern industrial and commercial projects. (Artto et al. 1998, Lock 2000) The purpose of project management is to foresee or predict dangers and problems as far as possible to plan, organise and control activities so that the project can be completed as successfully as possible in spite of the risks. It starts before any resources are committed, and must continue until all work is finished. (Lock 2000) Project business or project-oriented business refers to a company, or rather a project company, where activities generally are aimed to deliver and implement projects for its customers. (Artto et al. 1998)

Change is the only consistent feature of the modern business. It arises mainly from the structural and operational development of the business environment. This connected to table 1 creates the basis for the project business. Project management or business is not, as such, a new invention, because there has been and will be different kind of projects like construction of the Egyptian pyramids, the Apollo space shuttle program and development of the 3rd generation base stations. American forces manage their missile launch like a project, the duration of that kind of project is about 10 minutes from start to the target.

Organisations are required to change what they do and how they do it. According to Maylor (1999) world-class performance is seen to be possible through the development of excellent management, one significant part of which is the management of projects (figure 1).

According to Maylor (1999) the complexity of projects is dependent on the next three features: the organisational complexity (the number of people, departments, organisations and nations involved), the resource complexity or scale (the volume of resources involved, time, capital, processes) and technical complexity (the level of innovation involved in the product or the project process). In the globalized high-tech industry projects are often very complex, because in the same project there can be very high technological risk and organisational risk or complexity. Also project implementation can be done in a multisite environment.

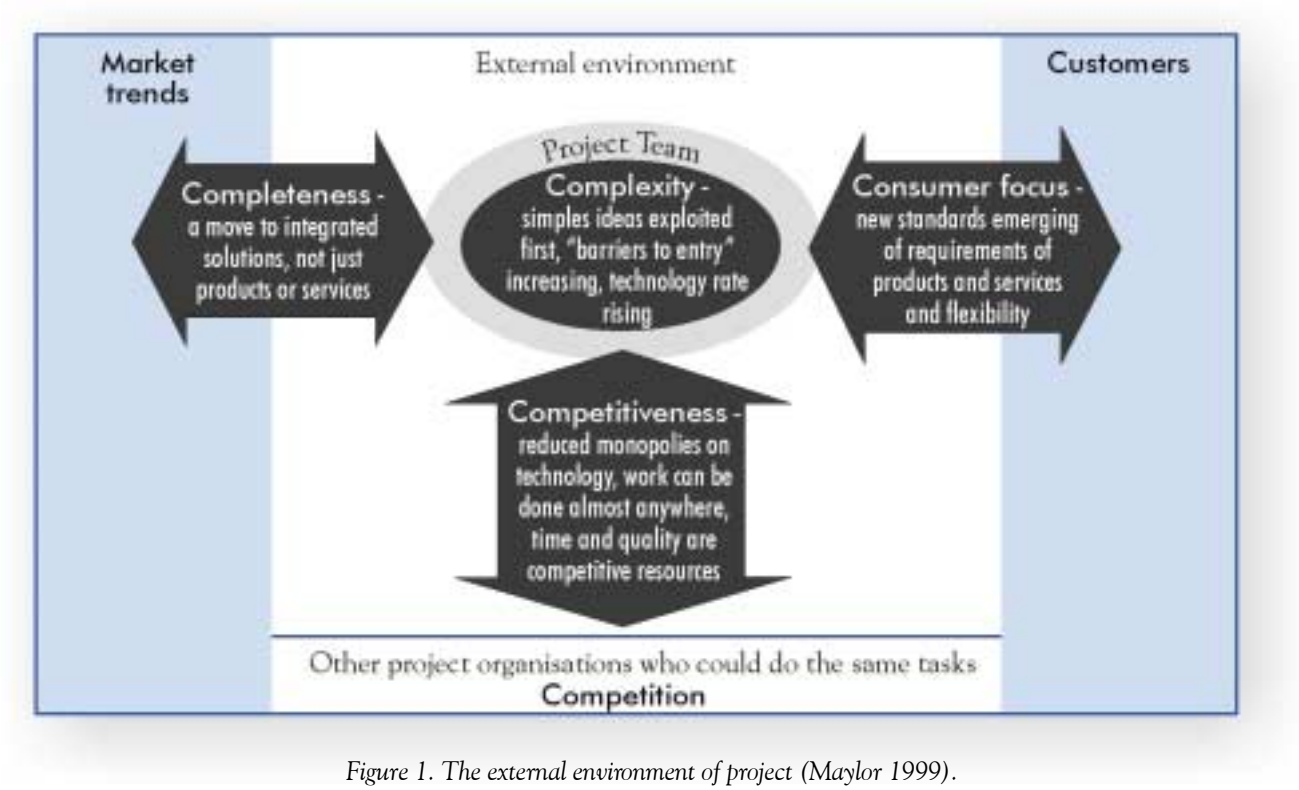


Figure 1. The external environment of project (Maylor 1999).

Project Management

Project management has been like a matter of course so far, and there have always been projects and of course there always will. However, management practices are becoming more important, not only because the projects are becoming more general, but because most of those fail somehow. Standishgroup (1995) has made a survey among 8380 IT application development projects from 365 company and got stunning results. Only 16,2% of projects are on-time and on-budget. Research shows a staggering 31,1% of projects will be cancelled before they ever get completed.

Projects are composed of processes, which are performed by people and generally fall into two major categories: project management processes or product-oriented processes. Project management processes are concerned with describing and organizing the work. Product-oriented processes are concerned with specifying and creating the project product. Project management processes and product-oriented processes overlap and interact throughout the project. For example the scope of the project cannot be defined without understanding how to create the product. The Project Management Institute (PMI) (Duncan 1996) has organized project management processes into five groups (see figure 2) of one or more processes each: initiating processes (recognizing that a project or phase should begin and committing to do so), planning processes (devising and maintaining a workable scheme to accomplish the business need that the project was undertaken to address), executing processes (coordinating people and other resources to carry out the plan), controlling processes (ensuring that project objectives are met by monitoring and measuring progress and taking corrective action when necessary) and closing processes (formalizing acceptance of the project or phase and bringing it to an orderly end).

Project management process groups are not discrete, one-time events; they are overlapping activities, which occur at varying levels of intensity throughout each phase of the project (see figure 2). (Duncan 1996) And it seems that one way or the other all phases are important or critical. E.g. skipping the first phases is a driver for failure (Lienz and Rea 1999).

The process group interactions also cross phases such that closing one phase provides an input for initiating the next. For example, closing a design phase requires customer acceptance of the design document. Simultaneously, the design document defines the product description for the following implementation phase. Repeating the initiation process at the start of each phase helps to keep the project focused on the business need it was undertaken to address. It should also help to ensure that the project is halted if the business need no longer exists or if the project is unlikely to satisfy that need. There are also many overlaps between phases. The planning process, for example, must not only provide details of the work to be done to bring the current phase of the project to a successful completion, but must also provide some preliminary description of work to be done in later phases. This progressive detailing of the project plan is often called rolling wave planning. (Duncan 1996, Meredith and Mantel 1995)

Knowledge Areas inside the Project Management

Project management can be divided into specific functions, knowledge areas. Those structure all basic knowledge of the project management area. There exist many kind of definitions for those areas and usually there is overlapping between areas. If we start from general management scope, it has traditionally been divided into five functions: planning, organizing, staffing, controlling and directing. Although these management functions have been generally applied to cover all traditional management structures, they have recently been applied to the project management area, too. Their fundamental meanings remain the same, but the applications to project management are different. (Robbins and Coulter 1996, Kerzner 1995) PMI has structured project management knowledge into nine more detailed different categories (table 2). Other models have divided management more or less clearly into some other categories. There is no consensus within the project management profession about the 'right' knowledge areas. The next matrix provides a rough overview of how different models have divided management into different knowledge areas.

In the following different knowledge areas are briefly analyzed. PMI's nine separate knowledge areas have been used as a baseline. However these knowledge areas interact strongly with each other. Each process inside a certain knowledge area may involve effort from one or more individuals or groups of individuals based on the needs of the project. Each process generally occurs at least once in every project phase. Each knowledge area is also required in the

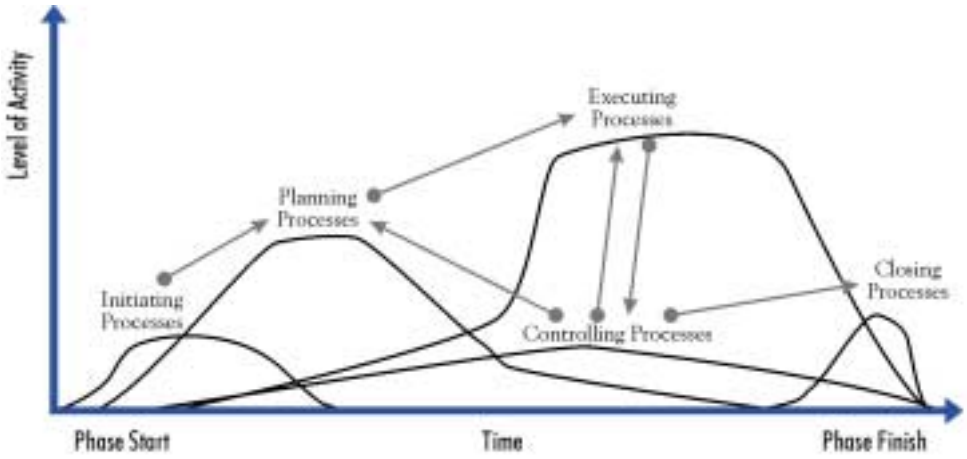


Figure 2. Project management processes. Arrows represent flow of documents and documentable items and overlap of process groups in a phase (adapted from Duncan 1996).

	PMI Duncan 1996	SEI Paulk et al. 1993	Shtub et al. 1994	Buttrick 1997	Kerzner 1995
Project Integration Management					
Project Planning					
Configuration management					
Organizing					
Project Scope Management					
Requirements management					
Strategic alignment					
Project Time Management					
Project Tracking & oversight					
Controlling					
Project Cost Management					
Fund Management					
Project Quality Management					
Project Human Resource Mgmt					
Directing					
Motivating					
Leading					
Staffing					
Resource Management					
Project Communications Mgmt					
Project Risk Management					
Project Procurement Mgmt					
Decision Making					
Business planning					
Release Management					

Table 2. Overview of different definitions of knowledge areas. Areas have been roughly structured according PMI's Knowledge areas (in bold) (Hannula 2001).

planning process. (Duncan 1996).

Project integration management includes the processes required to ensure that the various elements of the project are properly coordinated. It involves making tradeoffs among competing objectives and alternatives in order to meet or exceed stakeholder needs and expectations. Project scope management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. It is primarily concerned with defining and controlling what is or is not included in the project. Project time management includes the processes required to ensure timely completion of the project. On some projects, especially smaller ones, activity sequencing, duration estimating and schedule development are so tightly linked that they are viewed as a single process. (Duncan 1996). There is no consensus within the project management profession about the relationship between activities and tasks. In many application areas, activities are seen as being composed of tasks. This is the most common usage and also the preferred usage. In some cases, tasks are seen as being composed of activities.

Project cost management is required to ensure that the project is completed within the budget. Project cost management is primarily concerned with the cost of the resources needed to complete project activities. However, project cost management should also consider the effect of project decisions on the cost of using the project product. For example, limiting the number of design reviews may reduce the cost of the project at the expense of an increase in the customer's operating costs. This broader view of project cost management is often called life-cycle costing. Project quality management includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It includes all activities of the overall management function that determine the quality policy, objectives and responsibilities and implements them by means such as quality planning, quality control, quality assurance and quality improvement, within the quality system. Project quality management must address both the management of the project and the product of the project. Project human resource management includes the processes required to make the most effective use of the people involved with the project. It includes all the project stakeholders - e.g. sponsors, customers, individual contributors. (Duncan 1996) Shtub et al. (1994) emphasizes the importance of motivating and leading. Motivating is a principal function of lower management to instill in the workforce a commitment and enthusiasm for pursuing the goals and objectives of the various tasks that may be assigned to them. Leading involves setting examples for others, establishing a sense of group pride and spirit and instilling allegiance.

Project communications management is required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate dispo-

sition of project information. It provides the critical links among people, ideas and information that are necessary for success. Everyone involved in the project must be prepared to send and receive communications in the project 'language'. Everyone must also understand how the communication they are involved in as individuals affect the project as a whole. Project risk management includes the processes concerned with identifying, analyzing and responding to project risk. It includes maximizing the results of positive events and minimizing the consequence of adverse events. Project procurement management includes the processes required to acquire goods and services from outside the performing organization. (Duncan 1996)

Problems in Project Management and Key Features of Project Success

Nikander and Eloranta (2001) have made a study of early warnings of possible problems in industrial construction projects. They identify project problems in order to find out what kind of possible signals these problems assign to project managers. This is of course important in eliminating becoming problems even before emerging. According to Nikander and Eloranta (2001) four of the most significant project problems were; schedule related problems, delivery problems, total management problems and problems related to technical design. The dominant causes of problems were e.g.; management methods, differences in project culture, personnel skills and talent, lack of resources and organizational reasons. These are identifications of one sector, but we can utilize these identified problems in developing competences for project managers.

Incentives for managers to control and guide projects are criteria for judging project success. White and Fortune (2002) have studied several industry sectors and found ranked criteria as follows; meets client's requirements, completed on schedule, completed in budget, meets organizational objectives, yields business and other benefits, causes minimal business disruption, meet quality/safety standards and multiple criteria. It is interesting to see that other factors than on time, on budget and on specification are also preferred. White and Fortune (2002) also studied critical factors affecting to the projects' outcome, which reveals the factors to which competence development has to be assigned. The five most important in ranked order were; clear goals/objectives, support from senior management, adequate funds/resources, realistic schedule and end user commitment. These factors have to be kept in mind when planning the contents of education programs.

There have been several studies of skills needed in management in general level. One of the most often presented is planning, organizing, leading and controlling (e.g. Robbins and Coulter 1996). The importance of these activities varies depending of the level of management. Meredith and Mantel (1995) have categorized the skills needed in project management into six skill areas: communication, organization, team building, leadership, coping and technological skills. Already at the beginning of seventies Katz (1991) suggested that effective administration rests on three basic skills; human skill, conceptual skill and technical skill. The importance varies also depending on the management level. El-Sabaa (2001) agreed with this classification in a study of project management in different industries. The relative importance was summarized 85% in human skills, 80% in conceptual skills and 51% in technical skills. However, a project manager should have extensive cross-functional experience. (El-Sabaa 2001) Therefore also Lampel (2001A) emphasizes the shift towards a holistic approach to strategic project management. Gray (2001) expresses an even wider perspective; management attention would be more productively focused on creating the kind of organizational environment that has been shown to be conducive to successful project outcomes. Silén (1998) has also found that important on the general level. In project business, however, the process is different and organization competences are required to be more dynamic. It is difficult to build an organization prepared for everything. Therefore Lampel (2001B) suggest that the organization identifies and concentrates on certain core competences.

Survey in Project Business in Oulu Region

A survey of the success factors of project management was carried out at the end of the year 2000. The inquiry was addressed mainly to high tech industry in Oulu region. A total of about 350 inquiries were sent of which 105 in total were retuned when the answer rate was 30%. The questionnaire used was very simple, just containing two open ended questions (see table 3 and table 4), in addition to the general information, which was confidential. In the first main question companies were asked to name the most important success factors in project business in general (table 3). To analyse the answers five main factors were classified and sub-factors were placed under the main factors. The order of factors or sub-factors does not have any significance.

The second question was to find out what are the three main development/learning challenges in project business (table 4). The main factors were found to be similar to the success factor, but the sub-factors were a bit different.

Project Management Excellence - How to Achieve?

Project Management Excellence means efficient planning and implementation of projects. "Efficient" is usually evaluated in the name of time, cost and quality of the project, but some have criticised the triangle as being too simple and other criteria should be considered too (e.g. Gray 2001, White and Fortune 2002). However the final successfulness of the project in a business sense can be measured from the revenue in the long run. In order be successful in the long run an organisation must have a good foundation. Our perspective in this study is to find the competences needed in successful project business. Competence means those abilities that a member in an organisation i.e. project manager should have in order to achieve better performance as a whole. The knowledge area can be seen as a reflection of the competences needed i.e. what areas have to be tackled in excellent project management. Competence is usually a requirement for the success factor in the long run. Success factors are factors for an organisation with which it pursues and maintains existence, development and future. In the beginning of organisations, development success factors can be goals or linked to learning challenges, but in the long run at least critical success factors and learning challenges should be converted into core competences.

In Table 5 there is the basis for a Project Management Excellence - PME - competence development outline. It is only a rough framework, but it brings out the main idea of features in regional

Factor	Sub factors
Planning	Holistic planning, Timing, Cost estimating Goal setting, Resource planning
Customers and co-operators	Co-operation with customers, Understanding customer needs, Dealing with co-operators, Networking, Trust/openness
Management	Capable project managing, Project control, Wholeness control, Risk management, Cost efficiency
Skills	Labour skills, Total quality, Experience, Team working, Working facilities
Information	Information flows

Table 3. The success factors and those sub factors of project business.

Factor	Sub factors
Planning	Timing, Workload estimating Holistic planning Pricing, Project defining
Customers and co-operators	Defining customer needs, Partners commitment, Managing cultural differences, Understanding customer's business, Globalisation
Management	Project management, Assessment of project progress, Know-how of managing tools, Change management, Familiarisation of new employees
Skills	Utilisation of experience, Professional skills of workers, Human relations and team working skills, Education management, Utilisation and dissemination of learning
Information	Information flows

Table 4. The development/learning challenges and sub-challenges in project business.

or company-specific PME. It is roughly converted from the phases of project and project management and also from knowledge areas connected to practical and regional needs for competences. Project phases and knowledge areas create internal approach from project point of view. Those have to be managed somehow in any case in every project. Practical and regional needs are more like indirect consequences of the nature of the project. Examining the table can be done by rows, columns or cell by cell. E.g. in the planning phase we can process all knowledge areas presented and evaluate the sub-factors for planning presented in table 3 and 4. Even when there is overlapping in competences, the example points out the great number of competences needed in planning projects. This represents well the comparison between phases, knowledge areas and practical needs. It points out that it is not necessarily reasonable to make a certain model, because the universal model will be on such a general level or it will become so large in detail that it is not actually a model anymore. Rather than create a specific universal model we should keep it simple as in table 5 and always connect regional or company specific needs to it. In our PME, phases and knowledge areas were found to be quite similar, but e.g. the communication and connection to the customer were clearly more emphasized than in earlier studies. This may result from the need to integrate customers into R & D and delivery projects.

There are several different classifications depending on what kind of tasks or purposes they are. They start from short continuing education courses to a Master's degree at the university level or even a Doctorate (Turner and Huemann 2000). In many countries national project management associations have their certifications that are tailored to suit their national needs and requirements (Artto 2000). To support the universality of the project management model some organisations (IPMA 2001, PMI 2001, PMA Finland 2001) have created competence requirements for the people needed in project business. These so-called certificates for project business competences contain quite similar issues, but also these frameworks seem to be on a quite general level, too.

Project Phases / Project Knowledge Areas	Initiating process	Planning process	Executing process	Controlling process	Closing process
Project Integration Management	PRACTICAL AND REGIONAL NEEDS FOR COMPETENCES - success factors in project business - development/learning challenges in project business → COMPETENCE DEVELOPMENT FOR PROJECT MANAGEMENT EXCELLENCE - PME				
Project Scope Management					
Project Time Management					
Project Cost Management					
Project Quality Management					
Project Human Resource Mgmt					
Project Communications Mgmt					
Project Risk Management					

Table 5. Contents of the PME framework.

Discussion

From the project progress point of view different knowledge and capabilities are needed in different phases, which of course emphasizes the need for versatile know-how. The problem usually is that, what exactly is this versatile know-how? You can of course present a list like figure 2, tables 2, 3 and 4 as content, but that might be difficult to fulfil at least for one person.

So, different personnel have different capabilities. Therefore the planning phase has great significance at least in two ways. First, when planning a project you have to recognise the competence inside your organisation in order to get the right people in the right position or task. Secondly, when planning e.g. human resource management different capabilities and skills needed have to be considered carefully, because as mentioned it is very difficult to get a person with versatile know-how or it is at least expensive to do that. Planning has also an additional internal importance for the organisation in doing project business. As an example of the competences needed, project planning requires extensive know-how from the area of the project and those who implement the project need more profound than extensive know-how in the sense of technology.

The development of individual competence in project management needs a certain amount of experience. Turner and Huemann (2000) present a classification where a project team member can acquire their competence through formal education, but managers on every level should have also experience in developing their competence. Sherrard et al. (2000) points out the manager's ability to think as a most essential skill or ability, but this competence is very difficult to educate. Turner and Huemann (2000) also emphasise that knowledge management is one of the most important approach in developing competence. Nonaka and Takeuchi (1995) present a general distinction of knowledge (tacit -explicit). From project personnel point of view this means utilizing all possible capabilities or one could say that it is creative management. A comparison can be found from Indiana Jones: "Don't worry, I'll think of something!". But there are not enough Indiana Jones' for every organisation. So the question is how we educate a project manager to be like Indiana Jones? We need to have a formal structure and formal needs in education. Usually the information flow in education means that all information obtained in formal education doesn't convert directly to knowledge, but during the practical work later on it can convert as a competence.

Turner and Huemann (2000) agree with the regional needs for the contents of a programme, but in global organisations or, more accurately, in global projects different cultures and values have to be considered. According to Turner and Huemann (2000) the structure of the education process has to be considered - education is life-long learning. In the theory of organisational learning Argyris and Schön (1978) state that learning from experience is essential for individual and organisational effectiveness. Kolb (1984) defines learning, in the theory of experiential learning, as the process whereby knowledge is created by the transformation of experience.

Change is maybe the only constant variable project business. It is not an internal factor inside PME, but it is more like an external fact that has to be considered. Then the competences also have to evolve. Versatility and flexibility are significant variables in the PME equation and they are needed both in planning and in managing projects. One possibility to get these and also other important capabilities needed is experience. But, there are no short cuts in obtaining experience, and using experience as the education philosophy is too time-consuming and expensive.

The framework presented is based on the phases of a project and knowledge areas needed in successful project implementation compared to practical needs. The preliminary framework is actually a platform for further and more specific development of a certain PME and generally development of project management education. Turner and Huemann (2000) emphasise that the practical relevance of the education and training process sets up some very important confrontations concerning the contents; conceptual vs practical, academic vs business, long-term vs short-term, normative vs creative and specialist vs generalist. We can conclude that comparing success factors and challenges with project management literature there is nothing totally new! Most of them exist in different literature, but the challenge is now how to really make things better and improve the overall performance of the projects inside an organisation. The practical problem lies in coordination of education activities. Who is taking care that all these separate activities are taken into consideration in projects or support functions?

Part of those above-mentioned challenges are included in project management knowledge areas, part of them are leadership issues and therefore part of a project manager's responsibilities. In a project's reality there is still a need for a systematic approach to how all these things can be managed. On the managerial level all knowledge cannot be pumped into students, they have to learn themselves. On the other hand, students sometimes learn in a programme more than the syllabus presents or cannot learn all that is included in the education.

Harri Haapasalo

Department of Industrial Engineering University of Oulu, Oulu, Finland

P.O. Box 4610
FIN-90014 University of Oulu
FINLAND

Tel: +358 8 5532931
Fax:+358 8 5532904
E-mail: harri.haapasalo@oulu.fi

Vesa Pikka

Department of Industrial Engineering University of Oulu, Oulu, Finland

P.O. Box 4610
FIN-90014 University of Oulu
FINLAND

Tel: +358 8 5532940
Fax:+358 8 5532904
E-mail: vesa.pikka@oulu.fi

Pekka Kess

Department of Industrial Engineering University of Oulu, Oulu, Finland

P.O. Box 4610
FIN-90014 University of Oulu
FINLAND

Tel: +358 8 5532932
Fax:+358 8 5532904
E-mail: pekka.kess@oulu.fi

References

Argyris, C. and Schön, D.A. 1978 Organizational Learning: A Theory of Action Perspective. Addison-Wesley. Reading, Massachusetts.

Artto, K. A. 2000. What Do You Manage - Process or Personnel's Competencies for Managing the Procsses? Project Management. Vol. 6, No. 1. pp 4 - 8.

Artto, K., Heinonen, R., Arenius, M., Kovanen, V. and Nyberg, T. 1998. Projektiliiketoiminta yrityksen menestystekijäksi. TEKES, Helsinki. 142 p.

Buttrick, R. 1997. The Project Workout. London. Financial Times Management. 407 p.

Duncan, W. R. 1996. A Guide to the Project Management Body of Knowledge, Maryland USA, Project Management Institute, 176 p.

El-Sabaa, S. 2001. The skills and career path of an effective project manager. International Journal of Project Management. Vol. 19, pp 1-7.

Gray, J. R. 2001. Organizational climate and project success. International Journal of Project Management. Vol. 19, pp 103-109.

Hannula, J. 2001. Program planning. Master's Thesis. University of Oulu. Oulu. 86 p.

Harrington, H. J. 2000. Project Change Management. McGraw-Hill. 332 p.

IPMA. 2001. IPMA Validated Four-Level Certification Programme Goals, Objectives, Requirements, Concept. Retrieved 1.5.2001. URL: http://www.ipma.ch/certification.html

Katz, R. I. 1991. Skills of an effective administer. Harvard business review. Business classics. Fifteen key concepts of business classics.

Kerzner, H. 1995. Project Management - A systems approach to planning, scheduling and controlling, 5th edition, New York, Van Nostrand Reinhold, 1145 p.

Kolarik, W. J. 1999. Creating Quality: Process Design For Results. McGraw-Hill. 641 p.

Kolb, D. A. 1984 Experimential Learning: Experience as the Source of Learning and Development. Prentice-Hall: New Jersey. 256 p.

Lampel, J. 2001A. Towards a holistic approach to strategic project management. International Journal of Project Management. Vol. 19, pp 433-435.

Lampel, J. 2001B. The core competencies of effective project execution: the challenge of diversity. International Journal of Project Management. Vol. 19, pp 471-483.

Lienz, B. P. and Rea, K. P. 1999. Breakthrough Technology Project Management, San Diego, Academic Press. 289 p.

Lock, D. 2000. Project Management. 7th edition. Gowr Publishing Ltd. Vrmont USA. 613 p.

Maylor, H. 1999. Project Management. Harlow. Prentice Hall. 291 p.

Meredith, J. and Mantel, S. J. 1995. Project Management - A managerial approach, 3rd edition, Crawfordsville, John Wiley and Sons. 766 p.

Nikander, I. O. and Eloranta, E. 2001. Project management by early warnings. International Journal of Project Management. Vol. 19, pp 385-399.

Nonaka, I. and Takeuchi, H. 1995. The Knowledge-Creating Company. Oxford University Press. 284 p.

Paulk, M. C.,Webr, C. W. and Garcia, S. M. 1993. Key Practices of the Capability Maturity Model 1.1. Pennsylvania, USA. Software Engineering Institute. 479 p.

Pelin, R. 1996. Projektihallinnan käsikirja. Projektijohtaminen Oy. Risto Pelin.

Pine III, J. B. 1993. Mass Customization: the new frontier in business competition. Harvard Business School Press. 333 p.

PMA Finland, Projektiyhdistys. 2001. SERTIFIOINTI - (International Project Management Association) IPMA Certificates. Retrieved 1.5.2001 URL: http://www.pry.fi/pry_sertifiointi.htm

PMI. 2001. Overview of Project Management Institute Certification. Retrieved 1.5.2001. URL: http://www.pmi.org/certification/certprog/CertOverview.htm

Robbins, S. and Coulter, M. 1996. Management (5th Edition). Prentice HALL Inc. 770 p.

Sherrard, W. R., Hampton, D. R., Curry, R. and Brck, L. W. 2000. Testing Knowledge Competency - Does PMI Certification Examination Measure Up? Project Management. Vol. 6, No. 1. pp 16 - 19.

Shtub A., Bard J. and Globerson S. 1994. Project Management - Engineering, Technology and Implementation. Englewood Cliffs. Prentice-Hall. 634 p.

Silén, T. 1998. Laatujohtaminen - menetelmä kilpailukyvyn vahvistamiseksi.145 p.

Standishgroup. 1995. Sample Research Paper. Homepage of Standishgroup. Retrieved 8.5.2001. URL: http://standishgroup.com/visitor/chaos.htm

Stenlund, H. 1986. Projektin ohjaus. Helsinki. Valtion painatuskeskus, 181 p.

Suri, R. 1998. Quick Response Manufacturing: Companywide Approach to Reducing Leadtimes. Productivity Press Inc. 633 p.

Turner, J. R. and Huemann, M. 2000. Current and Future Trends in the education in Project Managers. Project Management. Vol. 6, No. 1. pp 20 - 26.

White, D. and Fortune, J. 2002. Current practice in project management - an empirical study. International Journal of Project Management. Vol. 20, pp 1-11.

Womack, J. and Jones, D. 1996. Lean Thinking. Simon & Schuster. 350 p.

Construction Contracts: A Framework of Mistrust

Ramy Zaghloul, University of Calgary, Canada
Francis Hartman, University of Calgary, Canada

Keywords: Construction Contracts, Risk Allocation, Trust Relationships, Disclaimer Clauses, Trust Based Contracts

In an owner–contractor relationship, current contracting practice encourages the contractor to be creative in how to write a good claim and collect more money as a reaction to the contract that has been written by the owner. Current risk allocation practice through disclaimer clauses are mainly based on confrontational situations that reflect the level of trust (or the level of mistrust) in the contract documents. This can be the driver to increase the total cost of a specific project and above all affect the overall relationship between the contracting parties.

This has been tested in the construction industry in Canada, and appears to be generalizable across North America. Based on two independent surveys of Owners, Consultants and Contractors across Canada, the assessed premium associated with the five most commonly used exculpatory clauses in construction is between 8% and 20% in a seller's market.

This paper presents the Colours of Trust Model (Blue trust—competence, Yellow trust—integrity, and Red trust—intuitive) and some results regarding its applications and its relationship to cost reduction in construction contracts. These results are based on a research study that includes a survey conducted across the Canadian construction industry including owners, contractors, consultants, and contract specialists. The results identify opportunities for significant cost reduction in the annual North American bill for construction of about trillion dollars.

Introduction

The construction industry in both Canada and the United States is the single largest non-governmental employer. In 1997, the industry was estimated in Canada to have a value of about $90 billion, representing 15% of the gross domestic product [Statistics Canada, 2001]. However, within the last twenty years considerable cost wastage has been identified by the Construction Industry Institute [CII, 1986]. A significant portion of this cost wastage may be attributed to inappropriate risk allocation in contracts, as cited in various examples analysing risk allocation in the construction industry and the underlying causes of disputes conducted in Canada and the US [American Consulting Engineers Council (ACE) and Associated General Contractors of America (AGC), 1991; Enger, 1997; CII, 1988]. Erikson and O'Conner (1978) suggested that risk associated with the construction industry could be categorized as either contractual or construction. Contractual risks emanate from contracts, and risk is increased with decreased contract clarity as well as imperfect communication and untimely contract administration. Construction risk, which is inherent in the process, arises from such diverse issues as unforeseen conditions, weather, business climate, and resource availability.

Meanwhile, construction risks are a major element that can significantly affects the final cost of any project. Specifically, how these risks are allocated has a direct bearing on the final total cost. The cost of these risks is carried by the owner, contractor, or both, as determined by the type of the construction contract [Hartman, 2000]. Risk allocation always occurs in any situation where more than one party (owner, contractor, consultant, etc.) is responsible for the execution of a project. Making sure that every risk is recognised and managed is good practice in any project. This activity is an important step in that this allocation can significantly influence the behaviour of the project participants and hence impact both project performance and final cost.

Construction Contracts and Risk Allocation

Construction contracts are the written agreements signed by the contracting parties (mainly an owner and a contractor), which bind them, defining relationships and obligations [O'Reilly, 1996]. In any certain project, the owner's goal can best be achieved by selecting the contract type that will most effectively motivate the contractor to the desired end. This step is also dependent on completeness of information for the bidder(s) at tender time and the extent that the owner wishes to take specific risk. In this context, contract risk can be divided into performance risks and cost risks [Hartman, 2000]. Regarding risk allocation, the concept of "limitation of liability" dates back more than three hundred years, when the British Parliament declared, as part of Maritime

Law, that a ship's owner should not bear greater liability than the value of the ship's hull [Zoino, 1989]. In this context, every contract allocates risk. Not all contracts allocate risk equitably or such that the power and authority to manage the risk is allocated along with the risk itself. Given the opportunity, an owner should favour efficient allocation of risk between parties to a project that simultaneously reduces risk and improves project performance. However, in an owner–contractor relationship at least, a common aim of owners appears to be to avoid risk as far as possible by allocating as many risks as it can to the contractor [Gransberg et al, 1997].

Risk Allocation Through Disclaimer Clauses

The decisions regarding risk sharing or risk shifting are made within the context of an owner's contracting policy [Kozek et al, 1998]. One way in which the contracting parties attempt to address the right and responsibilities for risk is through dealing directly with the issue of legal liability by including provisions that exclude liability arising from certain causes. Such clauses attempt to transfer one party's risk (which may be a legal liability) to another by contractual terms. As such, a disclaimer clause would release one of the contract parties from liability.

Disclaimer clauses frequently found in construction contracts deal with issues such as uncertainty of work conditions, delaying events, indemnification, liquidated damages, and sufficiency of contract documents. Using these clauses to allocate risk has been identified by recent studies and industry practice as a main reason to increase the overall cost of a project [Khan, 1998; Hartman, 1998; Jergeas et al, 1996; Zack, 1996; Erikson et al, 1978; CII, 1988; 1986]. When a risk is shifted to the contractor and the contractor has no means by which to control the occurrence or outcome of the risk, the contractor must either insure against it or add a contingency to the bid price [Jergeas et al, 1994]. Two recent studies (including the one presented in this paper) indicate that using disclaimer clauses in Canadian contracts (which can be generalizable to the US construction industry) carries a premium of between 8% and 20%, depending on whether business conditions were favourable—low need for work, low technical complexity, fair contract administration, negotiated and suitable contract type, and complete design work-or adverse—high need for work, high technical complexity, unfair contract administration, un negotiated and un suitable contract type, and un complete design work-[Khan, 1998; Hartman, 1998; Zaghloul 2001]. On multimillion-dollar projects, such an increase obviously can be significant. Additionally, but not so visibly, transferring risk to the contractor through disclaimer clauses in the contract presents a number of hidden costs including restricted bid competition, increased potential for claims and disputes, and a more adversial owner–contractor relationships.

Why Trust

Trust is at the heart of how people should do and think about risks. Meanwhile, these risks vary as the form of a relationship between the contracting parties varies. Risks that the trusting contracting parties assume and the mechanisms for mitigating those risks emerge as a function of the form of the relationship between those parties. Moreover, trust influences almost every aspect of the project management process, which affect the execution, and the cost of any specific project. However, the concept of trust is very complex and multidimensional and there has been much debate within academic circles regarding a common definition or model [Hosmer, 1995; Mayer et al, 1995; Hartman 1999]. In an attempt to advance the conceptual understanding of the topic of trust, Hartman (2000; 1999) developed a model of trust (the Colour of Trust Model) that enables a more simplified understanding of the concept. This model has been adapted for the purpose of this research.

The Colour of Trust Model

The Colour of Trust Model specifies three colours (or types) of trust: Blue, Yellow, and Red trust. These types are identified as follows:

- Blue (or competence) trust is all about ability and competence, which is based on the perception of the other's capacity to perform what is required. It is simply the answer for the question "*Can you do the job?*".
- Yellow (or Integrity) trust is based on integrity, which is founded upon the perception of the other's attitude to act ethically, to adhere to values that we hold important, and to be motivated to not take advantage of the other party. It is simply answer the question "*Will you consistently take care of my interests?*".
- Red (or intuitive) trust is based on intuition, which is the result of a combination of emotional response and rapid processing of information and may be described as the instincts or "gut feelings" that one person has about the other, a situation, or an artefact. It simply answers the question "*Does this relationship feel right?*"

In this paper, the authors present some of the findings of a study conducted across the Canadian construction industry including owners, contractors, and consultants and appear to be generalizable to the United States construction industry. These findings identify the relationship between trust and risk allocation practices in construction contracts and how can a strong trust relationship affects the final cost of any specific project by improving the risk allocation method between the contracting parties.

The Industry Survey

The study is based on a mailed self-administered questionnaire to collect the data required. The survey solicited qualitative and quantitative information on individuals' perception of the most common disclaimer clauses in the Canadian contracts identified in recent research and studies. These clauses include:

- Uncertainty of work conditions
- Delaying events
- Indemnification
- Liquidated damages
- Sufficiency of contract documents

The question types used were multiple-choice questions to identify respondent's agreement and/or practice regarding these clauses, and open-ended questions to identify respondent's professional judgement on barriers for better risk allocation practice in the industry.

The results of the study were based on more than 300 respondents to the survey. The study sample includes owners, contractors, and consultants from both private and public industry sectors, working in different types of projects; civil, industrial, commercial, residential, and others such as pipelines.

Results and Discussion

The study suggests that contracts pre-

pared and drafted by the owner are mainly used in owner-contractor agreements. Results show that these contracts, whether negotiated or prepared, typically include one or more of the five most common disclaimer clauses previously mentioned. In other words, these clauses exist in more than 75% of the survey respondents' contracts, which means that using disclaimer clauses to allocate risk in construction contracts is still a general industry or corporate practice. Table 1. illustrates the frequency of disclaimer clauses usage in construction contracts.

Another major finding from the results was that risk premiums associated with the five most common exculpatory clauses were validated with an average of 8% to 20% based on ideal or adverse market conditions in the construction industry. The study reports that under all circumstances, with the existence of disclaimer clauses, contractors attached risk premiums to the total cost of a project in order to protect themselves against these clauses. What interesting is that these clauses continue to be used in some of the newer contractual agreements between owners and contractors such as partnering/alliances.

Trust and Risk Allocation

Generally, the amount of the risk premium is based on the contractor's perception of the disclaimer clause risk. This means that if the contractor's perception of the disclaimer clause risk is high, the premium will be large. One of the most important finding of the study is that a significant relationship exists between the amount of the premiums associated with the disclaimer clauses and the level of trust between the contracting parties. The perception of disclaimer clauses' risk under low trust relationships is very high (average of 4.4 out of 5 points scale). The perception of disclaimer clauses' risk under high trust relationships is very low (average of 2.3 out of 5 points scale). As the results report, owners and contractors risk allocation contracting practice is mainly a function of their trust (or mistrust) relationship between each other. If the owner-contractor contract is based on a strong trust relationship, the amount of the premiums associated with disclaimer clauses is very low, or even better; the disclaimer clauses would not exist on the contract from the outset. Table 2 illustrates the average for the perception of disclaimer clauses risks under low and high trust relationships.

Disclaimer Clause Types	Percentage
Uncertainty of work conditions	92.0%
Delaying events	72.0%
Indemnification	77.0%
Liquidated damages	61.0%
Sufficiency of contract documents	67.0%

Table 1. Frequency of disclaimer clauses usage in construction contracts

Disclaimer Clause	Low Trust Relationship	Low Trust Relationship
Uncertainty of work conditions	4.5	2.4
Delaying events	4.5	2.4
Indemnification	4.4	2.2
Liquidated damages	4.3	2.1
Sufficiency of contract documents	4.5	2.1

Table 2. Perception of disclaimer clauses risks under low and high trust relationships (averages out of 5 points scale)

Trust, Risk Behaviour, and Cost Reduction

Based on the survey results, parties with a history of past successful working relationships (which can be related to competence and integrity trust) are less likely to be affected by the adverse impact of disclaimer clauses. It is the authors' belief that the reason behind this is as they are much more likely to share information that will help to reduce these types of risks. They may place greater reliance on other parties not to act opportunistically when given access to proprietary information in the project. Additionally, these parties are likely to view the information they received from each other as more reliable. The authors believe that trust and successful past working experience will increase the likelihood that contracting parties will be able to exercise greater autonomy without fearing a loss of control in any step of a project lifecycle.

One of the interesting finding of the study was that the trust level that generally exists in the construction industry contracts between contracting parties is low (average 2.3 out of 5 points scale), which reflects the level of mistrust in the industry contracting practice. The level of trust exists between the contracting parties is one of the most significant factors that affect the total cost of any specific construction project, and above all it affects the overall relationship between them. The study shows that there is a need for each type of trust (competence, Integrity, and Intuitive) that should exist to eliminate the use of disclaimer clauses in construction contracts or at least to create a better risk allocation mechanism between the contracting parties. Table 3 shows the averages for the levels of each type of trust required to eliminate disclaimer clauses form construction contracts. These averages are based on a 5 point scale.

The results also showed that owners and contractors are willing to change their risk allocation practice regarding these clauses when contracting parties have previous working experience with each other, which can be related to the three types of trust mentioned before in the Colour of Trust Model. In other words:

- A contracting party has evidence that other party will protect his interests;
- A contracting party has an industry or practical evidence that other party is knowledgeable enough to manage the risk; and
- The other contracting party has a good industry reputation.

It is the authors' belief that most of these criteria can be met through a trust-based relationship between the contracting parties. Such a relationship can be built at the front-end of a project and can be a significant contributor to cost reduction.

The participants reported that an owner-contractor trust-based relationship enables them to command structure and authority systems, incentive systems, administrated pricing systems, good communication, and team working environment in order to reduce the total cost of a project. In other words, owners and contractors under a trust-based relationship are likely try to man-

Trust Type	Level
Blue (competence) trust	4.3
Yellow (integrity) trust	4.3
Red (intuitive) trust	3.3

Table 3. Averages for the level of each type of trust required to eliminate disclaimer clauses from construction contracts (out of 5 points scale)

age and mitigate risk primarily for their own benefit and not to the disadvantage of the other party.

Other Barriers for Better Risk Allocation Process

In 90 percent of the survey responses, disclaimer clauses were used due to the request of the other contracting party. The results reported that some of the most significant barriers to better risk allocation processes are:

- The absence of education regarding the negative impacts associated with the usage of these clauses;
- Legal departments and their resistance to change;
- The bidding process and the lower bid is usually the winning one;
- Low trust relationship that exists in the construction industry; and
- The perception that using these clauses is an industry practice that no need to change it and/or cannot be changed.

It is the authors' belief that addressing these issues in the construction industry will likely cause a significant saving in the final cost for any given project. Initiating a good owner-contractor relationship with a win-win spirit will be to the advantage of all contracting parties in the construction process.

Conclusion and Recommendations

Recent research and industry experts have indicated that inappropriate risk allocation through disclaimer clauses in contracts is a significant reason for increasing the total cost of a project. Any improvement in the process would result in significant savings for the construction industry. This paper examined the affects of the Colour of Trust Model on risk allocation process through disclaimer clauses. The most important findings of this study identify that the existence of a trust relationship is significantly important for better risk allocation processes and methods. The study also indicates that there is a certain level of each type of trust (competence, integrity, and intuitive) is required to reduce the amount of risk premiums associated with disclaimer clauses or even better; to eliminate the disclaimer clauses from the outset. The survey respondents report that to reach a better risk allocation process, a trust relationship between the contracting parties should exist first. This can be done through certain stages as follow:

- A clear specification of the required activities and associated risks;
- A clear understanding of the risks being born by each party and who owns or can manage the risk;
- More time and effort in the front-end of a project and sufficient experience to manage or mitigate the risks;
- Adequate risk-sharing or risk-reward system to manage the risk; and
- A trust-based relationship between contracting parties to build a win-win spirit.

The rationale for allocating risk between owners and contractors ought to be based on meeting these conditions as far as possible. Missing one of these criteria is very likely to trigger inappropriate risk allocation process for any given project and hence bring additional cost for the contracting parties.

Mr. Ramy Zaghloul

PhD Candidate
Project Management Specialization
Civil Engineering Department
University of Calgary

2500 University Dr. NW. Calgary, Alberta, Canada, T2N 1N4

Email: rszmoham@ucalgary.ca

Dr. Francis Hartman, P.Eng, PMP

Director and Chair
Project Management Specialization
Civil Engineering Department
University of Calgary

2500 University Dr. NW.
Calgary, Alberta, Canada, T2N 1N4

Email: fhartman@ucalgary.ca

References

ACE & AGC, 1991. "Owner's Guide to Saving Money by Risk Allocation", American Consulting Engineers Council and Associated General Contractors of America, Washington, pp. 6 – 12.

Construction Industry Institute (CII), 1986. "Impact of Various Construction Contract Types and Clauses on Project Performance", Publication # 5-1, pp. 1 – 14.

Construction Industry Institute (CII), 1988. "Impact of Risk Allocation and Equity in Construction Contracts", Publication SD – 44, pp. 1 – 7.

Cooper D. and Emory, 1995. "Business Research Methods", fifth edition, Irwin.

Erikson C., O'Connor M. and Boyer L., 1978. "Construction Process Risk Allocation", Transaction of the American Association of Cost Engineers, July 9-12.

Gransberg D and Ellicot M, 1997. "Best-Value Contracting Criteria", Cost Engineering, Morgantown, Jun., Vol. 39, Issue 6, pp. 31 – 34.

Hartman F., 2000. "Don't Park Your Brain Outside – A Practical Guide to Improving Shareholder Value With SMART Management", PMI Publications, N. C.

Hartman F., 1999. "The Role of Trust in Project Management", Proceeding of the PMI research Conference.

Hartman F., 1998. "The Real Cost of Weasel Clauses in Your Contracts", Proceeding of the 29th Annual Project Management Institute Seminars and Symposium, October 9 to 15.

Hosmer L. T., 1995. "Trust: The Connecting Link Between Organizational Theory and Philosophical Ethics." Academy of Management Review, Vol. 20, Issue 2, pp. 1. – 25.

Jergeas G. and Hartman F., 1994. "Contractors' Protection Against Construction Claims", American Association of Cost Engineers, AACE Transactions

Jergeas G. and Hartman F., 1996. "A Contract Clause for Allocating Risk", Transaction of the American Association of Cost Engineers

Khan Z., 1998. "Risk Premiums Associated With Exculpatory Clauses", Masters Thesis, University of Calgary, Calgary, Alberta, Canada.

Kozek J. and Hebberd C., 1998. "Contracts: Share the Risk", Journal of Construction Engineering and Management, Vol. 111, No. 2, September, pp. 356-361.

Mayer R.; Davis C., and Schoorman F., 1995. "An Integrative Model of Organizational Trust", Academy of Management Review, Vol. 20, pp. 709 – 734.

O'Reilly M., 1996. "Civil engineering construction contracts", Thomas Telford Publication Inc., London, England.

Statistic Canada 2001. "Construction in Canada", Cat. No. 64 – 201, 1997.

Zack J., 1996. "Risk Sharing – Good Concept, Bad Name", Cost Engineering, Transaction of the American Association of Cost Engineers, July, Vol. 38, No. 7, pp. 26 – 31.

Zaghloul R., 2001. Contracts' Hidden Costs: A Trust/Risk Allocation Approach, Unpublished PhD Dissertation, Project Management Specialization, University of Calgary, Canada.

Zoino W., 1989. "Cautious Risk Taking", Civil Engineering, Vol. 59, issue 10, October, pp.65– 68.

Why Does Partner Conflict in Projects Occur?

Terje I.Vaaland, Norwegian School of Management BI, Norway

Keywords: Conflict, Partner Relationships, Development Projects, Oil Industry

The causes of conflict between project owner and contractor are related to formal and informal governance mechanisms. Formal governance mechanism conflicts are explained in terms of lack of predetermined prescriptions for behaviour, caused by inadequacies of planning. As to informal governance mechanisms the causes of conflict are expressed through lack of informal judgement and improvisation, which is caused by low trust and low commitment in a situation where rules and contract do not exist. In this study I extracted 266 conflict events from 5 dyads. The events (including 738 observations) were then assessed by the buyer and seller side, in order to place the events in the right category of causes. I found that informal relational mechanisms are significantly more important as causes of conflict than formal plans and contractual specifications. So why not shift the focus to the "softer" aspects of project management?

Introduction

The aim of this article is to explore the determinants of conflict between the project and its partners. One way of finding these determinants is to ask the following question: When events of conflict occur in business relationships, to what extent are they associated with deficits in formal planning compared with our ability to handle the unforeseen? In the first category of determinants we find unclear contracts, ambiguous specifications, weak routines, procedures and other kinds of activities or tools for predetermining the behaviour of the parties. This will be referred to as "formal governance mechanisms" in the following. The second category of determinants comprises our lack of ability to improvise, and finding creative solutions to new challenges in a complex project. Important ingredients here are mutual trust and the ability to understand the complex set of interdependencies which link the parties together. This category is labelled "informal governance mechanisms".

The study on which this article is based follows three different research streams, all embracing empirical or conceptual studies of conflict. One research stream deals with conflict within business-to-business marketing (e.g. Brown and Frazier 1978, Eliashberg and Michie 1984, and Hibbard, Kumar and Stern 2001). This study differs from the majority of marketing studies in terms of contextual complexity. This complexity is apparent both in terms of organisational form (i.e. a project is a more complex organisational form than a traditional company) and "output" complexity (e.g. fabricating an oil production vessel is more complex than distributing cars). Time constraints and a high technological level are new elements. A second research stream includes a set of classical conceptual studies of the antecedents of conflict and management of conflict (e.g. Pondy 1967, Deutsch 1973, and Thomas 1992b). In relation to this stream, my categorisation of conflict determinants into formal and informal governance mechanisms is a possible new contribution.

The third stream of research within conflict is found in project management studies. The study of Thamhain and Wilemon (1975a) addresses the nature of conflict in projects including determinants, types and intensity of conflict in the various phases of a project. Three fundamental different categories of project conflict are suggested; differences in goals and expectations; uncertainty about authority; and interpersonal conflict between people who are parties-at-interest in the project (Thamhain and Wilemon 1975b). This study addresses the importance of interpersonal aspects. This stream also draws upon the study of Pelled and Adler (1994) which addresses conflict between discipline-orientation and problem-orientation in projects. A final example is the study by Loosemore (1999) which adresses conflict between large and minor contractors in construction projects. Compared to this research stream my contribution is probably on a contextual level (e.g. oil industry development projects) and the methodology in terms of applying an event based study of conflict.

The following describes the empirical context, followed by a conceptualisation of the phenomenon

of conflict, and a brief outline of research design and validation. Then the findings are discussed, followed by implications and limitations. The final sections include further research and conclusions.

Empirical context

Three cases are applied in this study. Two are complex projects limited to the fabrication phase of a new type of production vessel and a more traditional oil rig. The third is not a project, but the base operations in an oil company, which were established to supply goods and services to offshore installations. In the following these will be described.

Case: Norne fabrication project

The Norne field was discovered by Statoil and confirmed in December 1991 as the biggest oil find to be made in a number of years. Conceptual engineering started late 1993, with the completed vessel being finished and in full production at the Norne field in late 1997. The field was developed by means of a production and storage ship tied to subsea templates. The installation consists of a hull similar to an ordinary ship and a process unit placed on the deck of the vessel. This functions as an alternative to traditional oil rigs. Investments were reduced by roughly 30 per cent compared to comparable projects, because Statoil, its license partners and suppliers adopted innovative field development concepts.

Case: Siri fabrication project

The Siri field is a marginal field that required short project planning and fabrication time, with small follow-up costs, in order to be profitable. The installation is a jack-up platform connected onto a seabed storage tank, pipelines and a loading buoy. The platform was based on contemporary design solutions. The short time frame in project execution plan represented considerable challenges in terms of technical solutions, materials, availability of equipment, productivity and financial control.

Case: Non-project /base operations

The seller is one of the subsidiaries of the Aker-group. The buyer is Statoil Field Support division, which has the responsibility for supplying all company operated offshore installations in the Norwegian sector of the North Sea. The service includes loading/unloading of supply vessels and internal transportation. The tasks are characterised as high frequent, relatively simple and easy to plan.

The context represents at least two major challenges for the study. First, the context is characterised by a high degree of technological complexity consisting of a large number of interdependencies. This implies that conflict occurring in i.e. activity structures cannot easily be isolated for analysis without losing crucial parts of the picture. Second, there is considerable managerial complexity, with a large number of actors, including active third parties. This implies that conflict easily will be interpreted in terms of an open system with more or less visible interfaces between the actors. Taken together this impacts on the parties' perception of conflict and the way conflict events are approached.

The two complex projects can serve as suitable representatives for current projects in the North Sea oil industry. At the same time they reflect different technological and managerial challenges. Finally, the non-project in terms of a base operation case serves as a fruitful contrast to the projects. Perhaps the difference between a complex project and a traditional continuous organisation is smaller than anticipated.

Conceptualization

Among the variety of definitions of conflict offered, two definitions are found particularly fruitful when addressing conflict between the projects and its partners. One is applied by Thamhain and Wilemon (1975a:891) where conflict is defined as "the process which begins when one party perceives that the other has frustrated, or is about to frustrate, some concern of his". A second definition is suggested by Deutsch (1973); "a conflict exists whenever incompatible activities occur". Together these definitions address both the behavioural or attitudinal side and the incompatibility of activities per se. These initial statements about conflict constitute an adequate starting point.

In this study the concept of conflict is operationalized and narrowed down to micro processes in terms of events embracing ingredients with a potential for growing into more comprehensive and manifest conflict situations. This is in accordance with Pondy (1967) who claims that each conflict relationship is made up of a sequence of interlocking conflict episodes. We thus end up with the term "conflict event" comprising all types of events indicating disagreement between the parties. The procedures followed in identifying and analysing these events will be explained in the research design section.

Antecedents of governance mechanisms

The governance mechanism construct is applied to several purposes within interorganizational phenomena. One area of application is concerned with the way business relationships are managed. The importance and combinations of incentives, authority and trust as governance mechanisms are the most relevant governance mechanisms (i.e. Williamson 1985, Haugland 1996) in this context.

According to (Williamson 1995:11) "governance is an exercise in assessing the efficacy of alternative modes (means) of organisation. The object is to effect good order through the mechanisms of governance". One can ask whether "good order" is a main goal for business relationships. "Good order" can reduce disturbance and improve efficiency, but on the other hand it can prevent the functional side of conflict and reduce innovation. Hence I argue that the purpose of a governance mechanism should be extended to include "value creation", to grasp the crucial importance of functional disturbance. Based on this assumption I suggest the following definition of governance mechanisms: "Governance mechanisms are institutional tools, values and ideals applied to effect good order and value creation in a business relationship".

Events of conflict in a project-partner relationship can be related to the classical three forms of governance mechanisms: incentives, authority and trust. For the further study I embrace both authority and incentive mechanisms into a construct labelled "formal governance mechanisms". The trust based mechanism I label "informal governance mechanisms". If conflict in a specific dyad is primarily associated with one of the two governance mechanisms, one can assume that the antecedents of conflict are related to weaknesses in this type of governance mechanism. In order to reduce the frequency and/or intensity of conflict the mechanisms should be strengthened. The two governance mechanisms will be further described in the following:

The governance mechanisms discussed in the conceptual model and

above can further be characterised with respect to the types of attributes shown in Table 1.

Table 1 reveals major differences in the assumed point of origin of the conflict, the status, possible effect, and resolution of conflict. Related attributes such as control mechanisms, managerial ideals and the issue of communication further sharpen the dividing line between the two paradigms.

Formal Mechanisms	Type of Attribute	Informal Mechanisms
Sanction driven, power related, use of authority	*Control mechanisms*	Co-operative, trust based
Compliance, awareness, comprehensive planning, structural	*Managerial ideal*	Trust, flexibility, lack of planning, processual
High	*Contract status*	Low
Structural	*Conflict resolution*	Political and processual
Unnecessary. Avoidance is the important issue	*Conflict status*	Normal. Its resolution-process is the important issue
Reduction of transaction efficiency	*Effect of conflict*	Enhanced effectiveness through new resource- and activity combinations
Lack of formal precision	*Conflict point of origin*	Lack of informal interaction and flexibility
Functional, prescriptive and formal following predefined procedures. Normative	*Communication*	Informal, cross-functional, open, complex, social

Table 1. Governance mechanisms and attributes

Strong formal governance Highest GOV-value (5)	Strong informal governance Lowest GOV-value (1)
The event is primarily associated with: - Lack of precision or understanding of contract or specification/ standards - Better monitoring and control would prevent the event from emerging - Procedures and routines are important, but not sufficient to prevent emergence of events - Events should be reduced to a minimum in order to keep high project efficiency and effectiveness	The event is primarily associated with: - Lack of informal communication across boundaries - Lack of ability to see new possibilities in improving project activities. - Lack of willingness to take risk together with opposite party - Lack of mutual trust - No predefined rule or routine could prevent the event from emerging - Events are valuable sources of project improvements

Table 2. Measurements of the governance issue in relation to each conflict event

Conflict and formal governance mechanisms

An event of conflict associated with strong formal mechanisms can stem from lack of contractual details, unclear formal procedures or unawareness of predefined patterns of behaviour. The complexity in the atmosphere and environment is i.e. not fully reflected in the formal arrangements made prior to project start-up. Conflict events that are primarily associated with formal mechanisms are likely to be perceived as problems that should be avoided. They reflect a deficiency of planning, which in the next turn is aggravated through even more detailed routines and contracts, or perhaps the number of lawyers involved. All these problems can be seen as examples of a structural misfit and the conflict is a result of this misfit. This structural misfit coincides with scholars (e.g. Meredith and Mantel 2000) who claim that "generally, relations between the organisations carrying out a project and a subcontractor working on a project are best characterised as adversarial. Indeed, it is almost axiomatic that the two parties will have significantly different ideas about the exact nature of the deliverable itself" (Meredith and Mantel 2000:231). The formal mechanisms thus reflect a traditional view, where prescriptive and predefined patterns of behaviour are assumed to reduce conflict. In other words conflict is a problem which should be avoided through formal arrangements.

Conflict and informal governance mechanisms

Informal mechanisms are related to the social dimension. It can indicate a lack of social and cultural awareness caused by for example a lack of prior experience and trust, but it can also indicate that new opportunities for combining resources and/or activities have been found. Conflict events associated with informal mechanisms are likely to be solved by improving social interaction and the parties' mutual understanding of each other. This further opens for more flexibility and exploration of new opportunities. Through the informal mechanisms we recognise conflict as a much more functional phenomenon (e.g. playing a creative role in the planning process). Furthermore conflict is "…an inherent characteristic of projects, and the project manager is constantly beset by conflict" (Meredith and Mantel jr. 2000:241). Conflict is thus assumed to be a natural part of a relationship and intertwined with how people solve problems through relating in an informal way.

Operationalization

The governance mechanism construct is based on a formative operationaliza-

tion, which is appropriate when the construct is viewed as an explanatory combination of its indicators (Heide 1987). The facets of the formal and informal governance constructs are so numerous that we run the risk of losing crucial contents by splitting up the construct. Therefore formative scale is selected instead of reflective measurements, thus reducing the possibility of testing construct validity quantitatively. Based on a formative operationalization the two constructs are elaborated into the set of elements described in Table 2.

Accordingly the conflict events were placed on a scale from 1-5, with 1 indicating a strong informal governance (hence a weak formal governance), and 5 indicating a strong formal governance (hence a weak informal governance). The GOV variable is labelled SGOV for the seller's perception of the governance issue, and BGOV for the buyer's perception of the same.

There is a possibility that some of the events associated with for example weaknesses in one mechanism cannot be improved, and that improvement of the "opposite" mechanism therefore is the only solution. In the practical sense, however, an event given 5 on the scale is assumed to indicate both (1) defectiveness of the formal governance mechanism, (2) that the formal mechanism is important, and (3) that the formal mechanisms should be improved in order to improve the interaction. In order to reduce this risk of misunderstanding informants were explained about this assumption prior to start-up of assessment.

Conceptual model

Conflict events identified in the relationships between the project (buyer's side) and the partners (the seller's side) are allocated to the two sets of governance mechanisms based on perceptual judgement made by their informants. The mode of governance connected to the conflict events is the basis of the dependent variables of the study.

The conceptual model is based on one important assumption related to the two main constructs, the conflict event and the governance mechanisms. These are perceptional in the sense that the buyer and seller sides have different considerations of the conflict events and the governance mechanisms. Differences in past experience and history thus have an effect on how these events are perceived. Hence the two constructs are not considered as neutral constructs as claimed by the pure positivist, but rather as social constructs as claimed by the realist school of thought. This implies that whereas i.e. the selling party may perceive one event as a minor isolated incident far away from a conflict, the buyer side may consider the "same" event as a highly inflamed conflict issue, simply because their past experiences are different.

Research design and validation

My study follows a two-step approach. First, conflict events were identified through an examination of written experience reports, and key informant interviews. This examination was based on a combination of archival research and survey methodology. In the second stage, informant groups from the project and partner-sides assessed the events. Data were coded for statistical treatment by means of t-tests and ANOVA after a series of tests to ensure compliance with statistical assumptions.

The analysis was based on 200 conflict events gathered from two projects, and 66 from a non-project context, i.e. a total of 266 events. These observations add up to a total of 413 buyer-observations and 325 seller observations, overall 738 observations. The

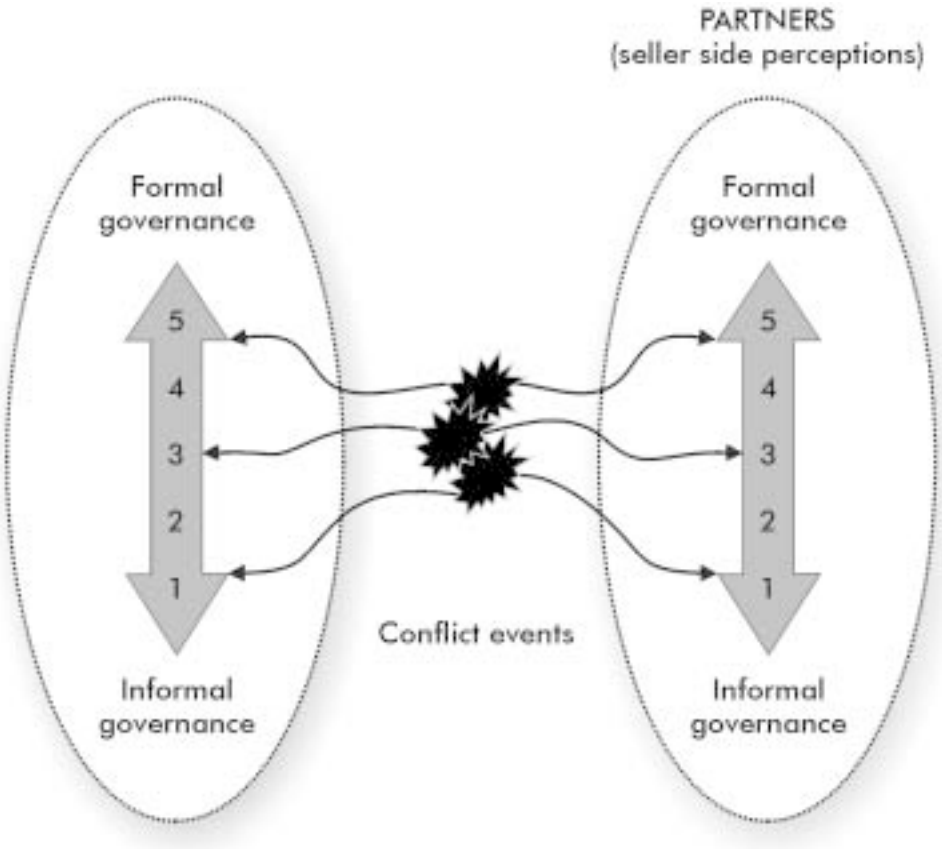


Figure 1. Conceptual model

Number of:	Norne-project				Siri project	Sum project	Base ops case	Sum
	Dyad 2	Dyad 3	Dyad 1	Sum				
Events	27	61	59	147	53	200	66	266
Buyer observations	54	122	118	294	53	347	66	413
Seller observations	27	61	118	206	53	259	66	325
Sum observations	81	183	236	500	106	606	132	738
Buyer informants				6	3	9	3	12
Seller informants	4	4	5	13	2	15	4	19
Sum informants				19	5	24	7	31

Table 3. Breakdown of empirical base.

database should be sufficient for several types of variable analysis. A detailed breakdown of the empirical figures is illustrated in Table 3.

Both parties understood and accepted all events. In order to enhance representativeness of the oil industrial network in which the cases are embedded, the informants were recruited from Japan, South Korea, Singapore and Norway. A simple t-test was applied to find the mean values of the buyer and seller perceptions. A test to ensure compliance with statistical assumptions was carried out and found acceptable.

In order to test the practical understanding, a two-step test was carried out in connection with the data collection process. The first step was made by using key informants from the buyer side to test their understanding of the constructs set forth in the conceptual model in relation to practical management. No major adjustments were found necessary. The second step was made the same day as the assessments. The informant group was presented with 10 random events and asked how it interpreted and understood the following constructs: Conflict event and informal vs. formal governance mechanisms. The constructs were further clarified and finally found acceptable by the informant group.

In addition to the face validity test above, a quantitative validity test was added. One of the dyads in Norne contained two sets of buyer perceptions and two sets of seller perceptions. The two buyer sets were compared with respect to the BGOV variable (Buyer's perception of the governance issue). The same was done for the seller perceptions. A bi-variate correlation analysis was carried out based on exactly the same conflict events. The purpose was to test the construct validity of perceptual variables. The buyer perceptions are highly correlated and within 0,01 probability level. The perceptions of SGOV (Seller's perception of the governance issue) are close to the 0.05 significance level (p=0,056). Within the seller group there may be different perceptions for the same events. This is not due to an error element in the construct, but is a result of a true component. The quantitative test of construct validity was found acceptable for the BGOV and SGOV variables.

Assumptions are met with regard to independence of observations. Tests for normality and for the assumption of equal variance for all treatment groups indicated statistic and graphic deviation. The robustness of tools, and sample and cell sizes are strong enough to conclude that no violations of assumptions have any significant effect on the study.

The lack of multiple measures strictly limit the value of the test of validity commonly applied in a variable analysis. The weakest point is related to our use of formative compounded measures for the governance mechanism construct, because this prevents us from using multi-trait test of convergent validity. A test of convergent validity, applying the same method and events, but different sets of informants, supported construct validity.

Findings and discussion

The partner's (seller-side) perceptions of conflict

The seller-side perceives the events (n=259) as being more related to informal governance mechanisms than formal, as the mean XS=2,59 is below the midpoint of 3 on the scale. There is however close to an even mix of the two mechanisms. When comparing the results we clearly see that the Norne partners have a significantly higher formal tendency than the Siri and Baseops cases. Whereas Norne has XS=2,69 and is thus close to the indifferent point between formal/informal mechanisms, Siri and Baseops are considerably lower (XS= 2,17 and XS= 2,15), see Table 4.

These differences can be found in the characteristics of the cases. Three aspects seem particularly relevant: degree of cultural homogeneity in relation to the project (buyer side), technological complexity and managerial complexity.

In the Norne-case there is a pronounced cultural heterogeneity, both between the several interdependent

Seller perceptions of governance mechan.	N	Mean (XS)	t-value	p-value (2-tailed)	Standard Deviation
Projects (Norne+Siri)	259	2,59	29,302	0,000*	1,42
Norne	206	2,69	26,283	0,000*	1,47
Siri	53	2,17	14,078	0,000*	1,12
Baseops	66	2,15	13,407	0,000*	1,30

*significant at 0,01 level

Table 4. Degree of formal- versus informal governance mechanisms perceived by seller side.

partners and between the project and its partners. This is apparent in two areas. The first is related to differences in Norwegian and Asian business cultures. The second is related to the differences existing between two industrial cultures. Whereas the Asian yard was based on a shipbuilding culture, the project (buyer side) was embedded in an oil industry environment with quite different quality standards. In the Siri and Baseops-cases the cultural aspects are different from Norne, because these projects are anchored in a homogeneous Scandinavian oil industry culture. One can assume that a partner facing cultural differences of this type will possibly be more reluctant to develop the same amount of trust necessary for an informal relationship. Hence the conflict events will have a higher association with formal governance mechanisms than in cases with a homogeneous culture.

The technological complexity is also different in Norne compared with the other two cases. The Norne project introduced new technology and design. Production vessels were not new per se, but both the size of the vessel and the topside unit entailed a large number of technical- and conceptual challenges not experienced in previous projects. Siri and Baseops did not have these challenges. Siri was based on a conventional design with no technological complexity. Both Siri and Baseops had a focus on efficiency and productivity within known resource and activity structures. From this one can argue that a partner facing high technological complexity would be aware of the technological risk and would interpret conflict more towards formal protection than when facing a conventional technology.

The third dimension is managerial complexity. Norne introduced a new managerial concept with integrated core teams, which blurred the roles of buyer and seller. In the two other cases, the roles between project and the major partner were conventional, with a clear division of roles and responsibilities. Siri focussed strongly focus on simplicity of project management, and Baseops strove to meet partner expectations for a long-lasting and predictable future relationship. Both were quite different from Norne with regards to managerial complexity and thus importance of the two governance mechanisms when facing events of conflict. One can therefore argue that ambiguous roles lead to the seller seeking formal protection.

Summing up, the degree of cultural heterogeneity, technological and managerial complexity leads to differences in importance of the informal governance mechanisms when explaining events of conflict. The selling partner seems to be more dependent on formal protection (i.e. formal governance mechanisms) when risk exposure is higher than when risk is lower.

The project's (buyer-side) perceptions of conflict

Turning to the buyer perceptions we see a strong informal association with a low mean value (XB=1,80) for the two projects. When comparing the different empirical contexts, the results indicate a significantly higher informal tendency for Norne than Siri and Baseops. Whereas Norne has XB=1,71, Siri and Baseops are considerably higher (XB= 2,11 and XB= 2,44), see Table 5.

Similar to the seller perspective discussed above the degree of cultural homogeneity in relation to the opposite party, technological complexity and managerial complexity are relevant.

The cultural heterogeneity discussed above also applies to the project (buyer side), but might have different consequences. In Norne one argument supports a high informal association. The buyer side tried to change the Asian yard's quality standards, which was based on a shipbuilding culture, to offshore standards. Such a shift presupposes a cultural change. However, cultural changes are not achieved through changing routines and contracts, but rather through a "soft" and informal approach. One can possibly add that since the buyer side has the money, the conceptual ownership, as well as being the originator of future projects, he exercises considerable power compared to the selling partner. The risk of acting in an informal manner is therefore more limited. The other two cases are culturally homogeneous, and with more past experience, which may lead to a higher focus on efficiency secured by e.g. formal procedures.

In Norne functional specifications were introduced in a new and technologically complex concept. This implies that the buyer side needs flexibility on the seller side when fabricating a prototype vessel. By means of a relational and trust based attitude, flexibility can be strengthened in order to exploit new solutions impacting on the life cycle cost of the project. This may possibly lead to a stronger informal orientation compared to Siri and Baseops, where the technological complexity is low and the benefit from being informal is limited.

The managerial complexity of the "integrated team" and blurred buyer/seller roles in Norne possibly lead to a strong informal interpretation of conflict events. It was project management who initiated such an organisation of the project. It is not surprising that in Norne the buyer side strongly emphasised the informal way of handling managerial challenges. The other two cases were more conventional with less managerial challenges, and there was probably a stronger focus on routines and procedures as tools for achieving managerial efficiency.

Summing up, the degree of cultural heterogeneity, technological and managerial complexity lead to differences in importance of the informal governance mechanisms when explaining events of conflict from a buyer's perspective. The project (i.e. the buyer side) seems to be more oriented towards informal governance mechanisms when functional and financial uncertainty is higher, than when this uncertainty is lower.

Buyer perceptions of governance mechan.	N	Mean (XB)	t-value	p-value (2-tailed)	Standard Deviation
Projects (Norne + Siri)	259	1,80	28,730	0,000*	1,01
Norne	206	1,71	28,288	0,000*	0,87
Siri	53	2,11	11,132	0,000*	1,38
Baseops	66	2,44	13,999	0,000*	1,42

*significant at 0,01 level

Table 5. Formal vs informal governance mechanisms perceived by buyer

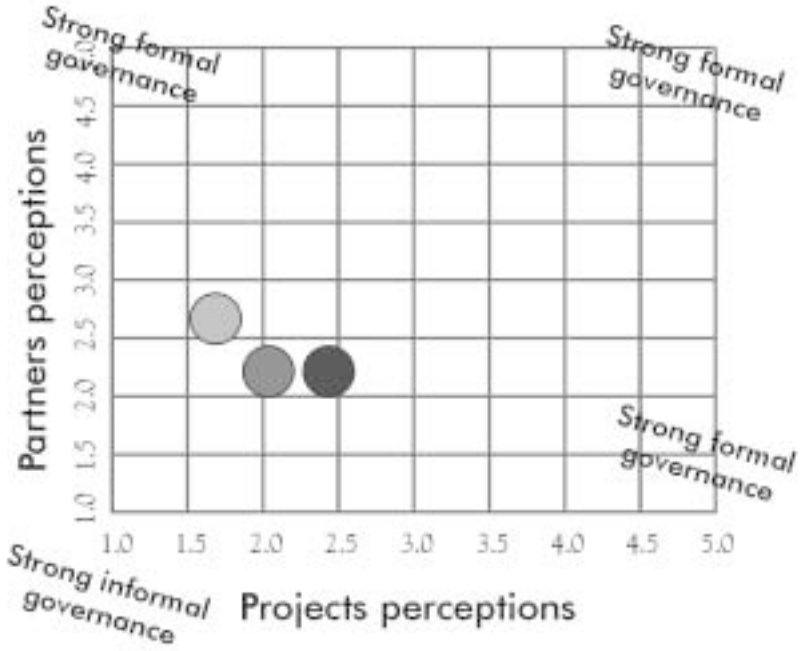


Figure 2. Governance grid. Value 1,0 on the scales indicates a very strong association with informal governance mechanisms and no association with formal governance mechanisms. Value 5,0 indicates the opposite extreme. Value 3,0 indicates equal association with the two mechanisms.

Mutual acceptance of the "human factor"

From the discussion above both parties in the three cases recognise the strong conflict event association with informal governance mechanisms. This is illustrated in what I have labelled the governance grid (Figure 2).

Why do the parties perceive conflict between them as a matter of informal judgement rather as a matter of contracts, specifications, routines, and procedures? Taking into account the large resources that base organisations spend on developing managerial, technological and conceptual details prior to start-up of a project, one would imagine that conflict events would be associated with this reality. The findings, however, give us an indication of the opposite in terms of freedom of choice and sound judgement. This coincides with parts of project management literature (e.g. Meredith and Mantel jr. 2000) which stress the importance of a high level of political sensitivity because e.g. a "technical problem" such as meeting schedule and cost goals, always has a human dimension. Thamhain and Wilemon (1975b) go even further by claiming that conflict in complex projects is primarily perceived as a phenomenon with a strong "human" factor. The increasing importance of the "people factor" when explaining disasters in engineering and construction projects is also addressed by recent project literature (e.g. Briner, Hastings and Geddes 1996).

We have four significant findings. First, conflict events are significantly more associated with informal governance mechanisms than formal. In general both the seller and the buyer sides share this perception, and the parties thus enter the mutual informal zone in the governance grid. Second, the buyer/seller perceptions separate more in the Norne-project compared with Siri. This can be explained by differences in the distribution of risk between the parties. Third, the seller side seems to go formal when the degree of innovation and functional risk is high. From the buyer's perspective it is the opposite. Fourth, in the non-project case the seller side seems to assess conflict more as an informal problem than the buyer side.

Implications and limitations

In order to improve the informal governance mechanisms, thus reducing the level of conflict, the following managerial implications are suggested. First, knowledge of how individuals act in the buyer/seller interaction is valuable information, which should be available for enhancing existing and new business relations. Systems for handling and retrieving relational information should be developed. Second, the relational importance has implications for the recruitment of project staff; too large discrepancies in personality and individual characteristics between buyer and seller should be avoided. Flexibility should be supported by a pluralistic recruitment policy to projects, and project staff should preferably have a multicultural background. Third, contracts, standard operating procedures are important in order to secure legal protection and efficiency, but should be supplemented with systems to keep track of relational investments made by both parties. This is particularly interesting in the prequalification and tendering processes where "objective" criteria are stressed on the expense of prior relational investments made by both parties.

There are four limitations that are particularly relevant for this study. First, validation measures for construct validity are weak and limited to a qualitative assessment due to lack of multiple indicators. The second pertains to the issue of generality. With only two projects (supplied with one non-project as contrast) embracing five dyads, the findings have limited generality beyond the cases in a statistical sense. The fourth limitation is related to the definition and assessment of conflict events. Exploring conflict based on isolated events without relating these to a broader context implies a risk of suppressing the synergy effects in combining different events. A combination of two conflict events may i.e. outbalance the other, whereas two

other events of low importance may by coincidence explode into a large conflict when they occur at a specific time and place.

Further Research

The empirical material is based on one Norwegian buyer organisation and several international seller representatives. An idea for a follow-up study could be to follow this methodology and conceptual framework, but to extend the empirical base, allowing a stronger focus on cultural differences. Yards from Japan, South Korea, Singapore, Norway and USA would be particularly interesting on the seller side. On the buyer side European, Asian and American oil companies would serve as an ideal reference for cultural diversity. The study could be organised as a comparative study involving research institutions from several nations.

Conclusion

Based on the study of conflict events in the Norne and Siri projects and the Baseops non-project, two findings are apparent. Firstly, the buying and selling parties have similar perceptions of the importance of "the human factor" when dealing with conflict. The assessments of the conflict events gave a strong and significant association to informal governance mechanisms. This implies that weaknesses in mutual trust, informal interaction and consciousness around interdependencies with the counterparts are important determinants of conflict. Secondly, the Norne project had a higher tendency toward formal governance on the seller side, and lower on the buyer side than in the other two cases. From this I suggest that a project characterised by high technological and managerial complexity and cultural divergence from the counterpart motivates the seller to seek formal protection to secure stability. One the other hand, the buyer side seeks informal interaction in order to secure flexibility and opportunities.

The conclusion from these findings is that the strategy for reducing level of dysfunctional conflict is not to increase the number of lawyers. Nor is the sharpening of specifications, or improvement of contractual exhibits, routines and procedures the way to go. The proper way is to strengthen the power of informal interaction with the basis in managerial focus on the "human factor".

Terje I.Vaaland

Norwegian School of Management BI,

P.O.Box 550 Sentrum, N-4003
Stavanger, Norway

Tel +47 51 84 67 30
+47 90 98 12 56
Fax +47 51 84 67 10
E-mail: terje.valand@bi.no

References

Borys, Bryan and David B. Jemison 1989. "Hybrid Arrangements as Strategic Alliances: Theoretical Issues in Organizational Combinations." *Academy of Management Review 14(2). pp. 234-249.*

Brown, James R. and Gary L. Frazier 1978. The Application of Channel Power: Its Effects and Connotations. Research Frontiers in Marketing: Dialogues and Directions. Subhash C. Jain. Chicago, American Marketing. pp. 266-270.

Deutsch, Morton 1973. The Resolution of Conflict. New Haven, Yale University Press.

Eliashberg, Jehoshua and Donald A. Michie 1984. "Multiple Business Goals Sets as Determinants of Marketing Channel Conflict: An Empirical Study." Journal of Marketing Research XXI. February 1984. pp. 75-88.

Hair, Joseph F., Jr., Rolph E. Anderson, Ronald L. Tatham and William C. Black 1998. Multivariate Data Analysis. New Jersey, Prentice-Hall International Inc.

Haugland, Sven A. 1996. Samarbeid, Allianser og Nettverk. Oslo, Tano Aschehoug.

Heide, Jan B. 1987. Explaining "closeness" in industrial purchasing relationships: The effects of dependence symmetry on inter-organizational coordination patterns. Ann Arbor, University of Wisconsin-Madison.

Hibbard, Jonathan D., Nirmalya Kumar and Louis W. Stern 2001. "Examining the Impact of Destructive Acts in Marketing Channel Relationships." Journal of Marketing Research XXXVIII. February 2001. pp. 45-61.

Loosemore, Martin 1999. "Responsibility, power and construction conflict." Construction Management and Economics 17(6). pp. 699-709.

Meredith, Jack R. and Samuel J. Mantel jr. 2000. Project Management, A Managerial Approach. New York, John Wiley & Sons.

Pelled, L.H. and P.S. Adler 1994. "Antecedents of Intergroup Conflict in Multifunctional Product Development Teams: A Conceptual model." IEEE Transactions on Engineering Management. February 1994.

Pondy , Louis R. 1967. "Organizational Conflict: Concepts and Models." Administrative Science Quarterly 12. pp. 296-320.

Thamhain, H.J. and D.L. Wilemon 1975a. "Conflict Management in Project Life Cycles." Sloan Management Review Summer.

Thamhain, H.J. and D.L. Wilemon 1975b. "Diagnosing Conflict Determinants in Project Management." IEEE Transactions on Engineering Management. February 1975.

Thomas, Kenneth W. 1992. "Conflict and Conflict Management: Reflections and Update." Journal of Organizational Behavior 13. pp. 265-74.

Williamson, Oliver E. 1985. The Economic Institutions of Capitalism. Firms, Markets, Relational Contracting. New York, The Free Press.

Williamson, Oliver E. 1995. The Mechanisms of Governance. New York, Oxford University Press.

Current Practices and Future Insights of Holistic Risk Management in Delivery Projects

Jussi Vähäkylä, EC Project Solutions Ltd, Finland
Olli Kuismanen, EC Project Solutions Ltd, Finland
Tuomo Saari, EC Project Solutions Ltd, Finland

Keywords: Project Risk Management, Holistic Risk Management, Delivery Project

Risk management is one of the central areas in the management of projects. Recent research has turned the focus of risk management from single project hazard prevention to a more extensive approach of general management. This article discusses the authors' understanding of a broader or holistic approach to risk management. The authors have been investigating the holistic approach to risk management in a research and development that aims at building software for risk management purposes. The program has so far had a strong emphasis on risk management in delivery projects. Thus delivery projects are under specific inspection in this article.

Introduction

Project risk management has been recently researched extensively in order to understand the nature of risk in the project-oriented business. As a result of the intensive research and development, risk management has evolved from nearly nothing to one of most well-researched and documented areas of project management. (Turner 1999) Lately the emphasis of project risk management has turned from yesterday's focus on single projects and hazard prevention to broader issues of general management.

One of most rapidly developing areas of risk management is different computer-based methods and tools. Nowadays a great number of computer programs for project risk management are available on the market. The existing software applications are somewhat reflections of the current understanding of project risk management theory. However the software packages provide a rather limited contribution to the wide and continuously developing spectrum of needs in project risk management. It seems that an effective and extensive software tool is still missing. (Vähäkylä 2002)

A research and development project was established in 2001 jointly with several companies and the Finnish National Technology Agency. The project was included into a technology program called Global Project Business. During the research and development project the authors have among other things investigated current risk management practices and the use of software applications in project risk management. The main goal of the project is to build a novel software product for holistic risk management purposes.

The purpose of this article is to present some of the publishable findings of the research and development project. One of the goals of the project was to investigate the current risk management practices used in different industry branches. Besides a thorough literature study the authors interviewed large project-oriented companies operating on international basis. Three of the interviewed companies implemented delivery projects and this article has an emphasis on the management of risks in the delivery project environment. Risk management in delivery projects is discussed in this article both theoretically and with the help of examples from the interviewed companies.

The article will first go through the motivation behind project risk management. The second chapter presents our insights of holistic project risk management. Third the article discusses the specific nature of delivery projects and current practices in the interviewed companies. Fourth the article discusses the role of software in holistic project risk management.

Why should risks be managed?

General project management functions like scope, time and cost estimations require us to make predictions of the future, but as we all know it is impossible to predict the future. (Turner 1999) The uncertainty of future events encourages practicing risk management, because if each tomorrow would be exactly like today there would be no need for risk management. (McNamee 1999)

But what are the actual benefits that can be gained from practicing risk management? There are many reasons why risk management is beneficial, but the main reason is that it can provide financial benefits far in excess of the cost performing it. (Norris et al 2000) In the following we will present some examples of the advantages that can be gained from risk management according to our research.

Practicing systematic risk management increases the understanding of the uncertainties related to project operations. Improving the understanding of risks related to project operations enables to capture the big picture by recognizing the relations between risks and separating severest risk from other risks. Capturing the big picture helps the organization to assign responsibilities to parties that are capable of handling the risks. The better understanding helps also in compiling more suitable contracts. If the risks are understood comprehensively many of the probable problems can be mitigated or even eliminated with contractual arrangements.

Risk management leads also to the formulation of more realistic project plans, both in terms of cost estimates and schedules. While systematic project risk management facilitates the creation on realistic plans at the same time it increases the probability of meeting the defined project goals.

Risk management is also an important tool for the top management. The support of risk information in decision-making is essential when allocating scarce resources between projects and considering the approval of capital expenditure.

Additionally a risk-aware attitude prepares the project organization for probable problems. While problems are proactively anticipated, they will not be disrupting when occurring.

Finally systematic risk management increases the organization's ability to take risk. Through more rational and controlled risk taking the organization can augment the benefits that can be gained from risk taking.

As presented above the benefits of project risk management are numerous, but who gains the actual benefits of practicing it? There are at least three parties who directly benefit from the results of project risk management: project managers, top management and customers. (Norris et al 2000)

Project managers can improve the quality of their work by implementing their projects to cost, on time and to the required performance. On the other hand top management can use risk information when making decisions about the resources used in the projects. Moreover clients, both internal and external, are more likely to get what they want, when they want and for a cost they can afford if systematic risk management is practiced.

Holistic project risk management

Traditionally project risk management has had an emphasis on single projects and hedging against unfavorable events or impacts. Recently the focus on risk management has though turned to a wider approach of general management. (Royer 2000, Artto 2001) According to the authors the novel approach can be referred as holistic risk management if risk management covers both the life cycle of the project and the whole project organization. Thus the risk management should be present in all project phases and the whole organization should actively be involved in risk management. Figure 1 attempts to illustrate the relationship of these two dimensions.

Why should the approach to risk management be changed from single project focus to extensive practices of the whole organization? For this question there is no direct answer, but several writings suggest a broader approach. (e.g. Royer 2000, Artto 2001, Ward 1999) Managing all risks related to project operations with common practices is though considered as the most important advantage of holistic risk management.

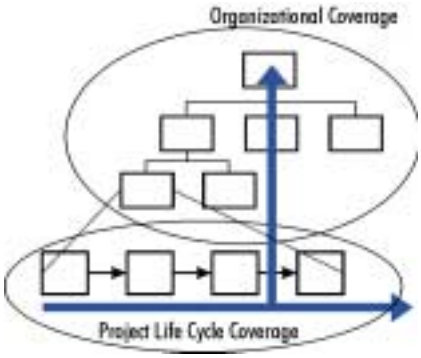


Figure 1. Dimensions of holistic risk management approach

If risk management is carried out with same procedures and common tools in all projects and throughout the organization, the comparison of project information becomes easier and top management gains valuable information about the risk exposure of projects and the whole organization. The improved commensurability of risk information facilitates top management's decision-making.

Furthermore a holistic approach to risk management enables the organization to affect the risks at an appropriate level. Sometimes it is more beneficial to take risk mitigation or elimination actions at a higher than project level. E.g. personnel shortage can be identified as a risk for project operations. At the project level the mitigation actions could be schedule change or change in project scope, whereas at a higher portfolio level the actions to mitigate this risk could include recruiting more people or reallocating the existing employees. In many cases the latter actions lead to better results than actions conducted at the project level.

Delivery projects and holistic risk management

If a project is delivered to an external customer from the project supplier's viewpoint the project is a delivery project. The life cycle of a delivery project typically consists of three different phases: sales, execution and after-sales. (Artto 1998) Characteristic for a delivery project is that the contracts strongly steer the actions of different project parties. If the project parties gain consensus of the delivery stipulations, then at the end of the sales phase the project parties usually sign a contract. The contract includes the definition and price of the project deliverables and after signing the contract it is difficult or even impossible for the project parties to terminate the project or change its central deliverables.

In a delivery project environment it is important in the holistic risk management perspective that risk management process begins in the early sales phases and continues throughout out the project life cycle. By starting risk management early enough it can be ensured that the risks threatening the project are identified as early as possible and they can be affected already before signing the delivery contract.

Besides the life cycle coverage in holistic risk management it is important that the whole organization participates in risk management. According to the results of our research the sales manager is typically responsible for risk management in the sales phase. The sales manager can use the help of experts in the technology related to the project when identifying and analyzing the risks. Additionally the prospective project manager can participate risk management in the sales phase. Based on the performed analysis the viability of the project implementation should be evaluated before proceeding to the final bid. Therefore it is essential to involve the top management in risk management already in the sales phase in order to provide them with sufficient risk information for bid positioning, to support the decision on how to bid for the project and in some cases

whether to bid at all.

In the execution phase the risk management of delivery project should concentrate on monitoring and controlling the risks identified in the sales phase. Response actions should also be taken if necessary. Furthermore new risks should be actively identified. The project manager is usually responsible for risk management during the execution. In a delivery project environment the role of the top management in the execution phase is to observe the project execution. If the risks of the project under execution become unreasonable, terminating the project might become an option. However this decision is very rare and requires thorough analysis of the current situation and possible risks. Therefore the decision is always a result of serious top management consideration.

Risk management should not be forgotten after the execution phase of the project. Lessons can be learned from the occurred risks, taken response actions and their effects. The gained experience can be used in risk management of future project operations. Thus utilizing past experiences is one of the main themes in holistic risk management.

Empirical findings of risk management in delivery projects (Vähäkylä 2002)

The following chapters will present the current project risk management practices in three companies that participated the first phase of the research and development program. The risk management practices of the case companies were investigated by interviewing five to seven project management professionals in each organization. As mentioned earlier all of the participated companies implemented delivery projects thus they deliver fully or partly tailored products to their customers in a project-oriented manner. The companies are referred to as Saturn, Jupiter and Neptune. In the following the risk management in each phase of the project life cycle is discussed individually.

Sales phase

Saturn was the only organization among the case companies that aims at systematically identify, assess and mitigate risks already in the sales phase. Jupiter and Neptune suffered from inadequate risk management in the sales phase; some of the projects were brought into execution without analyzing the risks at all in the sales phase. Furthermore the communication between sales and execution was also poor at Jupiter and Neptune. Even when in some cases risks were analyzed in the sales phase they were not transferred smoothly to the execution.

Saturn had rejected projects based on the risk analyses accomplished in the sales phase. The projects were considered too risky in relation to the possible benefits and therefore never implemented. This had happened even though the sales people might have received personal commissions from the closed deals, which can be regarded as remarkable.

Execution phase

Saturn had a great emphasis on risk management in the sales phase. Furthermore it had clearly the most mature risk management practices among the case companies in the execution phase. Saturn actively monitored and controlled the risks identified in the sales phase. Saturn also aimed at identifying new risks during the execution. At Jupiter and Neptune the risk management process seemed to wither away towards the end of the project. Risk management issues were not brought to the agenda of project meetings in these two companies, whereas at Saturn project managers always included risks and their analysis as a part of the project meeting.

At Neptune and Jupiter the extent of risk management in the execution phase depended strongly on the project manager's attitude. Some of the project managers had a very positive attitude towards risk management while others considered it a waste of time.

After-sales

As mentioned previously the risk management of the after-sales phase should concentrate on learning from the experiences gained in the project. From the investigated companies none systematically gathered and utilized the past experiences. Risk information was generally stored in MS Word documents, a documentation format that does not support flexible and rapid use of the past experiences when the risks of future projects are being identified and analyzed.

Saturn was once again one step ahead of the two other companies. It used a checklist that based on past experiences to support the identification risks. However, keeping the list up-to-date required though a lot of work and it was not seen as the optimal solution to distribute risk information inside the organization.

Summary of the risk management practices in the case companies

The maturity of risk management practices varied between the different case companies. Saturn clearly had the most advanced procedures and methods to manage project risks. The other two companies had also realized the need for managing project risks, but the actual implementation of risk management was still unfinished. The biggest difference between Saturn and two other case companies was that Saturn had established clear practices and instructions for risk management. Additionally the whole organization of Saturn had adopted a risk-aware approach to all project management functions.

Saturn also had specific tools for risk management purposes. They had a tool for identification as well as for assessment purposes. Neptune used group-working tools especially for risk identification, but their use was less systematic than at Saturn.

Saturn's approach for project risk management aims at holistic practices. It has succeeded in creating a working environment where risk management has a central role in the management of the whole organization. The two other case companies have also realized the importance of project risk management, but are not yet systematically practicing it. Establishing effective risk management is a difficult task for an organization but both Jupiter and Saturn are developing their risk management to the right direction.

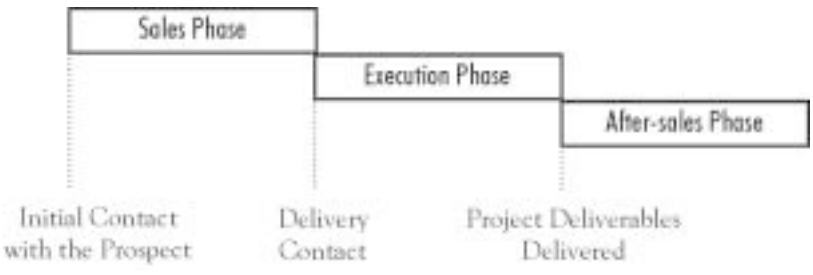


Figure 2. Life cycle of a delivery project

The role of software in holistic risk management

Organizations like Saturn, who have adopted project risk management as an integral part of their business, are according to our beliefs ready to introduce sophisticated risk management software to support the risk management actions. On the other hand organizations with a fairly low level of risk management maturity are not likely to gain significant benefits by introducing extensive software for risk management purposes. These kinds of organizations should first concentrate on developing clear practices for risk management, which could then be supported by appropriate software.

What is seen important in a risk management software

According to the results of the first phase of the research and development program one of the main functionalities of holistic risk management software is that all the risk information in the organization is managed through a centralized system. Transferring risk information within and across projects is essential when aiming at holistic and effective risk management practices. A centralized database would facilitate the use of past experiences and transference of risk information between project parties.

In addition to the capability to store and distribute risk information the comparability of risk information is important. Comparability is especially important when deciding which projects are worth implementing and which are too risky to be implemented. If risks are managed with a single solution the commensurability of risk information can be improved. The use of software will not totally remove subjectivity from risk analyses, but comparing the information is much easier if the information is produced using same principles and it is presented in a similar manner.

Improving holistic risk management with a software solution

If software is used to improve risk management, the organization should have established processes and practices for risk management before proceeding to the implementation of the software. The selected practices can then be supported by appropriate software. With a suitable software application the organization can make the risk management process more structured. The software should not force the organization to a certain process but adapt to the specific needs of each user group. The decision of the used process and practices has to be made within the company.

When aiming at holistic risk management the introduction of extensive software is not the first step. However holistic risk management in terms of project life cycle and organizational coverage requires effective applications to be flexible and effortless. Thus one should bear in mind the role of software as a support tool for risk management when developing risk management practices. In today's information society the implementation of adequate software is almost unavoidable when aiming at holistic risk management. Noticing the role of software in risk management early enough facilitates the implementation of the software when it becomes topical.

In Conclusion

Project risk management has followed the general development of managing project-oriented business and it is evolving from single project focus to more extensive approach of general management. To gain full benefits of the novel perspective in risk management, it should be developed towards a holistic approach in terms of project life cycle and organizational coverage. In delivery project environment this means that risk management should be extended to sales and after-sales phases instead of the traditional strong focus on execution. Additionally other project parties than the project manager should be involved into the risk management process. When implementing holistic risk management practices the introduction of proper software tools should be considered to facilitate knowledge transference and the adoption of commonly understood risk management procedures.

References

Artto K. A., 1998. TU-22.120 Project Management Basic Course - course material, Helsinki University of Technology, Department of Industrial Management, Espoo, Finland, 210 pages

Artto K. A., 2001. Management of Project-oriented Organization - Conceptual Analysis, In: Artto K. A., Martinsuo M., Aalto T. (Eds), Project Portfolio Management: Strategic Management through Projects, Project Management Association Finland, Helsinki, Finland, 176 pages

McNamee D., 1999. Risk Management Today and Tomorrow [online]. Alamo, USA, Retrieved March 31st, 2002, URL: http://www.mc2consulting.com/risknz.htm

Norris C., Perry J., Simon P., 2000. Project Risk Analysis and Management [online], The Association for Project Management, Buckinghamshire, UK, Retrieved March 31st, 2002, URL: http://www.eurolog.co.uk/apmrisksig/publications/minipram.pdf

Royer P. S., 2000. Risk Management: The Undiscovered Dimension of Project Management, Project Management Journal, Volume 31, Issue 1, pages 6-13

Turner J. R., 1999. The Handbook of Project-based Management: Improving the Processes for Achieving Strategic Objectives, 2nd Edition, McGraw-Hill, London, UK, 529 pages

Vähäkylä J., 2002. Main Functionalities of Effective Project Risk Management Software, Master's Thesis, Helsinki University of Technology, Department of Industrial Engineering and Management, Espoo, Finland

Ward S., 1999. Assessing and Managing Important Risks, International Journal of Project Management, Volume 17, Issue 6

Jussi Vähäkylä

EC Project Solutions Ltd
Särkiniementie 3 A
00210 Helsinki, Finland
Mobile Phone: +358 40 5854000
Fax: +358 9 6963555
E-mail: jussi.vahakyla@ecprojectsolutions.fi

Olli Kuismanen

EC Project Solutions Ltd
Särkiniementie 3 A
00210 Helsinki, Finland

Mobile Phone: +358 40 7665678
Fax: +358 9 6963555
E-mail: olli.kuismanen@ecprojectsolutions.fi

Tuomo Saari

EC Project Solutions Ltd
Särkiniementie 3 A
00210 Helsinki, Finland

Mobile Phone: +358 40 5059159
Fax: +358 9 6963555
E-mail: tuomo.saari@ecprojectsolutions.fi

Delivering Improved Project Management Maturity Through Experiential Learning

J Rodney Turner, Erasmus University Rotterdam, The Netherlands
Anne E Keegan, Erasmus University Rotterdam, The Netherlands
Lynn Crawford, University of Technology Sydney, Australia

Keywords: Project Management Maturity, Procedures, Project Review and Benchmarking, Project Support Communities, The Spiral Staircase Career, Centralization, Deferral, Attenuation

This paper describes experiential learning practices adopted by project-based organizations, and considers whether they deliver improved project management maturity. We describe practices adopted to increase organizational and individual competence, and show that they are linked to increasing maturity as suggested by a widely accepted maturity model. In particular, successful project-based organizations capture experiences through post-completion reviews, and codify them in project management procedures. We also show that successful project-based organizations ensure their project managers obtain a broad range of practical experiences following a spiral staircase career, and how they support the development of individual competence through project management communities. We critique the practices adopted, particularly showing how they use variation, selection and retention to enhance the learning experiences, and consider the impact of the centralization of the responsibility of learning and the attenuation and deferral of the learning experience on improving maturity.

Introduction

Research shows that fewer than 15% of project management personnel have formal qualifications in project management, (Crawford and Gaynor, 1999). Thus, 85% percent have obtained their knowledge through on the job experience. This begs the question of whether this experience is effective in increasing the project management competence of both the individuals and the organizations they work for, and whether it leads to increasing project management maturity of the organizations. There is evidence that many project-based organizations fail to obtain experiential learning at both the organizational and individual levels, (Pinto, 1999; Gibson and Pfautz, 1999). Pinto reports that many organizations repeatedly make the same mistakes on their projects, having failed as an organization to:

- capture their learning from successes and failures on past projects,
- expose apprentice project professionals to organizational learning gained through projects
- encourage project teams and professionals to reflect on their own experiential learning

On the other hand Gibson and Pfautz describe success in turning around the management of IT projects within the R&D Department of a pharmaceutical company through the:

- formalization of the project management process
- adoption of post-completion reviews
- implementation of project management support and mentoring networks

In the classically managed organization (Morgan, 1995; Huczynski, 1996), individual and organizational learning is the realm of the functional hierarchy, (Turner and Keegan, 1999). Functions own and maintain the firms' knowledge, and provide people with careers as they climb the ladder up the functional silo. In this way, individuals are exposed to the practices of the function, and learn the firm's business processes through experience. Project-based organizations, in reducing the significance of the functional hierarchy, lose its ability to act as a repository of experiential knowledge within the organization, and to provide experiential learning to individuals, (Keegan and Turner, 2000; Pinto, 1999; Gibson and Pfautz, 1999)

In this paper, we report experiential learning practices adopted by successful project-based organizations to develop the competence of both individuals and the organization, and consider whether they contribute to increasing project management maturity of the organization. We critique the practices adopted, considering whether they lead to learning through variation, selection or retention, and the impact of the resulting centralization, attenuation and deferral or the learning (Keegan and Turner, 2001; Cooke-Davies, 2001) on its efficacy. We define a project-based organization as one in which the majority of products made or services supplied are against bespoke designs for customers.

In the next section, we describe the role of experience in the development of the project management competence of individuals and organizations, and how project management maturity of organizations is defined. We consider practices adopted by project-based organizations to structure learning experiences for individuals, and why this needs to be broad and sweeping in nature, (the spiral staircase career). We then describe practices adopted by project-based firms to capture experience from projects, and feed that back into the management of future projects and the development of individuals. We consider the strengths and weaknesses of those practices adopted, and their effectiveness increasing project management maturity.

Experiential Learning in Project Management Competence Development

Kolb (1984) defines learning as:

> *the process whereby knowledge is created through transformation of experience.*

Experience is the raw material of learning and knowledge creation, and the extent to which it contributes to competence development is dependent upon the structures and strategies used by individuals and organizations to learn by experience. Learning is more than acquiring new knowledge. Transformative learning involves the questioning of prior experience and values in a way that enables modification of ideas and behaviours (Mezirow, 1997). Kolb's experiential learning cycle (Knowles et al, 1998) has become well accepted as a way of explaining the role of experience in learning, Figure 1.

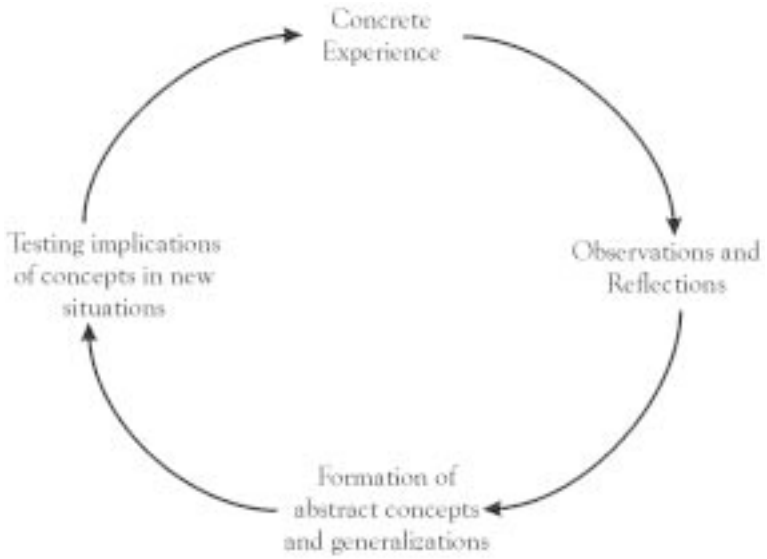


Figure 1. Kolb's experiential learning cycle

The model shows that experience alone is not enough. Experience needs to be accompanied by structured reflection and observation, leading to abstract concepts and generalizations, enabling the learner to develop theories for performance improvement. The Kolb model highlights the importance of experiential learning in project-based organizations where the unique nature of projects means the ability to test concepts in new situations is essential to competence development, (Crawford, 2001). Learning from experience is complex and dependent upon the learner, the task and the context. Experiential learning and competence development, on the job, requires an active partnership between the learner and the organization (Boud and Walker, 1997). This includes the preparedness and skills of the individual in learning from experience, the work experiences, guidance, support, and encouragement provided by the organization and the project management competence and approach to transformative experiential learning of the organization in terms of its structures and systems.

Competence development of project personnel

Thus experiential learning is a key contributor to the competence development of individuals and organizations. Most project personnel hold a qualification or first degree (Crawford and Gaynor, 1999; PMI 1999). However, project management degree qualifications are rare (Turner and Huemann, 2001), and an international cross industry sample of project personnel found less than 15% currently hold any form of project management qualification or certification (Crawford and Gaynor, 1999). Thus experiential learning is the only source of competence development of the majority of project management personnel, and so if project-based organizations do not make a deliberate and sustained attempt to support the experiential learning of their project personnel, they will achieve the outcomes reported by Pinto (1999).

Professional associations have attempted to codify the pathway of project management competence development through standards and associated certification programs, (Crawford, 2001). Several standards have been developed to describe the practice of project management, and to provide a basis for assessment of project management competence for professional certification or registration. These include:

- A Guide to the Project Management Body of Knowledge (PMI, 2000)
- ICB: International Project Management Association (IPMA) Competence Baseline (Caupin et al, 1999)
- Australian National Competency Standards for Project Management, (AIPM, 1996)
- PRINCE 2, (CCTA, 1996).

The standards themselves do not prescribe how project management competence should be developed, but the associated certification programmes do. Evidence of competence required by the certification programmes includes:

- evidence of academic and other qualifications (not necessarily in project management)
- exams (multiple choice, short questions, essays)
- self assessment
- peer review through interviews
- exercises, tasks and simulations
- evidence of experience (project report, record of experience, portfolio of evidence of competence)

Table 1 shows how this model of competence development of project personnel matches the Kolb Learning Cycle. It also shows where the organizations investigated by Pinto (1999) are failing to support the experiential learning of individuals (and the organization), and how the work of Gibson and Pfautz (1999) supported it.

Evidence of experience is required by all certification programmes and is the key factor in determination of the level at which certification is awarded. The most rigorous programmes in this regard are those associated with performance based competency standards, including Australian and European certification programmes (AIPM, 1996; Caupin et al, 1999) and the United Kingdom National Vocational Qualifications in project management (OSCEng, 1997; MCI, 1997; CISC, 1997). These require assessment of portfolios of evidence of competence by a registered workplace assessor. The experience requirement of professional certification programmes, particularly those associated with performance based competency standards, highlight the important role of the organization in competence development and recognition. Unless project personnel work within project competent organizations using accepted project management practices and provide developmental opportunities for staff, it will be difficult for them to provide evidence of experience necessary to achieve professional certification.

Competence development of project-based organizations

Not only are we concerned with the competence of individuals, but also with the organization (Gareis and Huemann, 2000). Although, as indicated above, there are widely accepted standards for the project management competence of individuals, there are no equivalent standards for the project management competence of organizations. This is currently being addressed through the development of Organizational Project Management Maturity Models (OPM3) (Schlicther and Duncan, 1999). Meanwhile, there is considerable agreement that corporate project management competence requires the following (Graham and Englund, 1997; Hoffman, 1997; Kerzner, 1998; Frame, 1999; Gareis and Huemann, 2000):

- Strategic alignment of projects
- Top management support
- An effective project management information system
- Clearly defined and well formulated project management procedures
- Project performance review and benchmarking
- A plan for project management selection and development
- An effective internal project management community

Table 1 also shows how these support the Kolb Learning Cycle.

The organizational Project Management Maturity models, OPM3, (Ibbs and Kwak, 1997; Schlicther and Duncan, 1999; Gareis and Huemann, 2000) attempt to define the project management competence for organizations by the level of maturity they have reached against three of the themes in the list above:

- processes and procedures
- performance review and benchmarking
- project management support and mentoring

Table 2 shows the five levels of maturity defined. The model is based on the SEI Capablity Maturity Model for software engineering, (Humphrey, 1989; Paulk et al, 1991)

Thus, we see that experiential learning is considered to be the main vehicle for project management competence development of individuals and organizations. The experiential learning of individuals should be structured within competent project-based organizations and relevant contexts. To aid this process, the organization needs to plan project management selection and de-

Kolb Learning Cycle	Certification requirements	Failures reported by Pinto (1999)	Success reported by Gibson et al (1999)	Organizational development
Concrete experience	Project portfolio	To expose apprentice project personnel	Post completion reviews	Project Manager development
Observation and reflection	Self assessment	To capture and reflect on experience	Post completion reviews Project support & mentoring networks	Performance review Benchmarking Project community
Abstract concepts	Exams	To capture experience To expose project staff	Formalize project process	Information system Procedures
Testing of concepts	Interviews, exercises			
Other	Academic qualifications			Strategic alignment Management support

Table 1. Project management competence development and the Kolb Learning Cycle

No	Level	Theme	Attainment
1	Initial	Procedures	Ad-hoc processes
		Review	
		Support	No guidance, no consistency
2	Repeatable	Procedures	Individual processes for the most often used
		Review	
		Support	Minimum guidance
3	Defined	Procedures	Institutionalized processes across the board
		Review	
		Support	Group support
4	Managed	Procedures	Processes measured
		Review	Metrics collected, experience collected
		Support	
5	Optimized	Procedures	Continuous improvement
		Review	Data collected, defects analyzed and patched
		Support	Continuous improvement

Table 2. Organizational project management maturity model OPM3.

velopment within a supportive project management community. To develop its own competence, the firm needs competent individuals, and effective project management systems and procedures, based on project performance review and benchmarking, again within a supportive project management community. In this paper we review how practice in project-based organizations matches this theory, and whether they will indeed deliver increasing project management maturity.

Observations on the Experiential Learning of Individuals

We have observed different experiential learning practices in organizations from different industries. In reporting individual development practices we concentrate mainly on organizations drawn from Groups A and B above, namely:

- The Engineering Construction Industry (ECI) with a long history of project-based management
- High Technology Industries, including computers and telecommunications, some of which are more recent entrants

In the former there is greater emphasis on experiential learning, with formal education primarily being given post-experience. In the latter, individuals still gain most of their competence from experiential learning. However, there is a greater emphasis on early formal education, and particularly on certification. This difference reflects the lower maturity of the latter industry.

Features of the Engineering Construction Industry, ECI

In companies with a long history of project-based management, considerable effort is devoted to the development of project managers. We have spoken to several main contractors from the ECI with 50 years' history of undertaking contracts for clients. The ECI entails mainly mechanical construction of process plant in the oil, gas, petrochemical and power industries. The size of contracts ranges from $US 100 million to $US 2 billion, and the work is often undertaken for large companies, including oil companies and utilities. The contracts usually have tight margins, so companies that have been in business for 50 years can be considered successful. Several features typify project managers and their development in the ECI:

(a) It can take fifteen years to develop a project manager capable of managing a $US 100 million contract, and twenty-five years to develop a project director to manage a $US 1 billion contract. Potential project managers and directors are often identified in their mid twenties and developed over these periods.

(b) Project managers are viewed as a key, value-adding resource, providing firms with their main competitive edge. Several respondents mentioned the ability to add value for clients as a key competence for project managers. Project managers are highly valued and have the longest tenure with these firms. Project management is viewed as a senior role, with project managers more highly valued than functional managers

(c) Most senior executives and directors of these firms are former project managers.

Identifying and recruiting potential project managers

Potential project managers are usually drawn from the ranks of design engineers. The methods of selecting them are primarily ad-hoc, the managers of project managers acting intuitively when deciding who will make good project managers within the industry. A variety of criteria emerge as bases for identifying potential project managers. One respondent mentioned that a key criteria was:

> *people who are vocal with their ambitions*

Another impact on the recruitment and selection of project managers is the cyclic nature of the industry; design engineers come and go. Some are recruited from university, but many join the firm to work on specific contracts. They tend to be drawn for the firm's network of previous project workers and broader industry contacts. There are few formal selection and recruitment practices in evidence. However, experience derived from past projects is often used as a critical indicator to decide whether people fit with the culture of the organization.

Development of Future Project Managers - The Spiral Staircase Career

The role of project managers in the ECI is viewed as being very eclectic, requiring a broad range of knowledge and experiences, including:

- management of the project process
- management of contractual relationships with clients, suppliers and sub-contractors
- management of the technology
- management of people in the project team
- management of the business
- management of different cultures for international projects

It is not possible to develop them by restricting their experiences to one function. Thus, rather than seeing project managers climbing the ladder up

the functional silo, they have broad, sweeping careers, being exposed to a number of functions, perhaps moving back to functions they have fulfilled before in a more senior role. We have labelled this the spiral staircase career. During their career, a future project manager may spend time as:

- a design engineer in the early stages
- a lead engineer of a design team, starting as a lead engineer on a small project and progressing to larger projects, perhaps after an interval elsewhere
- manager of the design function
- a project or contract engineer on a project, progressing to larger projects at later stages
- an assistant project manager, then a project manager on small project , project manager on larger projects, and eventually project director

A future project manager can spend time as manager of the design function. In most of the companies we spoke to, the manager of the design function may not necessarily be the most senior person in the department. A highly experienced lead engineer may be on a higher grade than the departmental manager. However, it is accepted that they have different roles to fulfil, and they respect each other's position.

Managing the Process of Developing Individuals

Although considerable effort is put into the development of project managers, like many things relating to their careers in this industry, the process tends to be fairly ad-hoc. The process is managed in two ways:

- through mentoring by the design department manager
- by an informal committee planning future requirements

An individual's development is seen as a partnership between the individual and the firm; an individual must take responsibility for seeking out their own development opportunities, but they will be supported in their development by senior project managers, and by opportunities for appropriate learning being made available.

While an individual is working as a design or lead engineer, they have an annual review with their departmental manager. Through that review they identify their future career aspirations, and development needs. That may include training or work experiences. Having identified work experiences required, opportunities are sought to satisfy those. The firms tend to maintain an informal committee of senior project managers and project directors, who plan the future requirements for project managers, and track the development of people within the firm. They too seek out opportunities to match the development needs of specific individuals.

A dilemma these firms often face is between keeping individuals working on their current project or moving them to the appropriate career opportunities as they arise. The solution is not easy. Nobody is indispensable, and so often someone will be moved to the new project that provides him or her with the development opportunity that suits their current need. This may create an opportunity for another individual to replace them in the vacancy created. However, if a project is at a critical stage, then the person may be retained on the project, and the opportunity lost. The fact that firms are willing to move people shows commitment to the individual, and encourages them to stay with the firm. (In high technology industries, named individuals are often required to work on projects, blocking their development opportunities, and thereby reducing their loyalty to the firm.)

The Role of Formal Tuition

Courses for project managers are seen as an essential part of their development, but training tends to be post-experience. Project managers are first given experience on the job, and then sent on courses to enhance their understanding. We shall see in the next section, new recruits, and new project engineers are expected to work closely with the company's project and quality procedures. Thus they are given formal guidance, on the job, about the correct ways of working within the context of the company's projects. Later they are given formal tuition into the knowledge behind those procedures. Early training is provided in company, and relates to the firm's ways of working. Later training is more specific to the individual. It may be provided by courses from an industry provider, such as the Construction Industry Institute (in the US), the European Construction Institute (in Europe), or the Engineering Construction Industry Training Board, (in the UK), or it may be via a university masters course.

The role of functions

These organizations tend to create a project organization project-by-project, (Turner and Keegan, 2000). The knowledge of the organization is retained within a functional structure, from which the projects draw resources. Thus the functional organization is significant both as a repository of knowledge for the organization and as a competence pool for projects.

Features of the High Technology Industries: Knowledge-based Firms

In high technology industries, (which includes firms from Group B and telecommunications contractors from Group A), the process of training and developing project managers tends to be more formal. Formal education and training, often linked to certification, plays a more significant role. These organizations view themselves as knowledge-based firms, and often have a strong project focus, in some cases functions have been eliminated entirely. In these situations, experiential learning poses unique challenges. The projects tend to be smaller than for the ECI, with projects often being part of a larger programme or portfolio of projects (Turner and Keegan, 2000). Project managers therefore tend to be younger and more junior, increasing the need for more rapid development through formal education.

These industries also tend to suffer from a no home syndrome. Because the projects are smaller and shorter duration, people tend to move quickly between projects, usually working on more than one at a time. (There is a greater sense of permanence at the programme or project portfolio level, but project managers do not feel so attached to that.) This also means that project managers do not tend to return to their functions between projects, increasing the sense of detachment from them as well. Indeed we spoke with one firm, the Viennese subsidiary of a global information systems supplier, that had eliminated functions entirely, adopting a purely project-based approach. There was nowhere in this organization to act as repositories for learning, and it was only able to do this because it received support from the European head-office, including its centres of excellence, (see below).

Experiential learning practices we

observed are in this industry are:

- pairing of project personnel
- a strong emphasis on certification
- the use of project mentoring and support networks

Pairing in the absence of 'Nellies'

A common practice adopted in this industry to overcome the leaking away of valuable knowledge and experience and to aid individual learning is 'pairing'. Where feasible, firms assign two people to undertake a project role where strictly one might do, especially to complete a novel task. This has two benefits. First, the two may develop a better, more innovative solution for the client, both because two heads are better than one, and because the individuals can think more creatively if they are not rushing to meet a deadline. Secondly, once the task is complete, there are two people who have knowledge of it, doubling the firm's experience and ability to train others. Thus, the practice of pairing reflects the novelty of the industry. While 'sitting next to Nellie' has been a classic training and learning practice for millennia, (Plato mentions it in The Republic and The Laws, Jowett, 1999), there are very few Nellies in high technology companies. So rapidly changing are the technologies and solutions these firms offer their clients, there are few experienced people with whom newcomers can be paired to provide mentoring and coaching opportunities. 'Nellies' are created by pairing people who learn from each other through experimentation, rather than by transfer of learning from an experienced individual to an apprentice. Although there may be some redundancy, there is a greater chance that knowledge will be captured more effectively than if a person works alone. This system also ensures that knowledge is developed and learning captured continuously over the timescale of the project instead of simply at the end.

Certification

The absence of prior history is also evident in the strong emphasis high technology firms place on certification of project managers. The majority of people seeking certification from the Project Management Institute of North America are from the IS/IT industries, (Crawford and Gaynor, 1999; PMI, 1999), and many organizations from the industry, including some from our sample, use it as a key step in measuring the development of project personnel.

Project support and mentoring networks

Another practice, reflecting the rate of change within the industry is the use of project support and mentoring networks, as reported by Gibson and Pfautz (1999). A common practice is a quarterly or monthly gathering of project managers, at which they hear about developments in the management of projects, and also providing an opportunity to meet with other project personnel, and share experiences. These were most evident in the IS/IT industry, but are in fact used by firms from across our sample. The form they take may vary, including:

- a quarterly conference held by an EPC contractor from the telecommunications industry
- an informal, quarterly dinner-lecture held by the projects group of a Dutch bank
- membership of the European Construction Institute for EPC contractors from the Engineering Construction Industry, the ECI providing regular meetings

These project management communities fulfil an important role in the absence of functions, assuming some of the roles of a project management functions, especially in distributing learning as we see later.

Summary

Table 3 summarizes our findings practices adopted for the experiential learning of individuals, showing how they relate to Kolb's experiential learning cycle, and what the certification programmes look for.

Observations on the Experiential Learning of Project-based Organizations

In the project-based organization, individual learning is useless without practices to ensure the organization owns and retains knowledge. The firm can engage in formal learning, with the maintenance of company libraries for instance, but it must adopt experiential learning practices to learn how to manage the unique features posed by its projects. Not only do many of the orga-

Kolb Learning Cycle	Certification requirements	Selection in the ECI	Development in the ECI	Development in the IS/IT industry
Concrete experience	Project portfolio	Does the face fit	Spiral staircase career Managed process	Pairing Certification
Observation and reflection	Self assessment	Overt ambition favoured	Spiral staircase career Support networks Mentoring	Pairing Certification Support networks
Abstract concepts	Exams		Post experience training	Certification
Testing of concepts	Interviews, exercises	Staff used as contractors initially	Spiral staircase career	Certification
Other	Academic qualifications	Engineering qualifications favoured		

Table 3. Findings on the experiential development of individuals in the project-based firm.

nizations we have interviewed put significant effort into the development of project managers, they also put effort into their development as organizations. Capturing, recording and disseminating experience are key to developing organizational competence, and feeding that into the development of project managers and other project management professionals. In the organizational project management maturity model, OPM3, (Table 2), there are three themes for increasing project management maturity, which we have observed in practice:

1. the use of internal project management procedures and systems, including:
   - documented procedures
   - project management information systems
2. project performance review, including:
   - end of project reviews
   - benchmarking
3. distribution of the learning through support networks including:
   - project management self-support groups or conferences
   - the use of the INTRANET
   - centres of excellence
   - moving people around the organization

The use of Internal Project Management Procedures

Internal project management procedures are a key way organizations capture knowledge and experience. Many of the companies in our sample use them to capture best practice within the firm. They are the collective representation of the firm's experiences.

Most organizations treat the procedures as flexible guidelines, to be tailored to meet the needs of individual projects. Every project is different, and so requires a unique procedure (Payne and Turner, 1999). The standard procedures represent captured experience and best practice, but they do need to be tailored project by project. Hopefully that tailoring is marginal, but it needs to be consciously done. It is part of a project manager's tacit knowledge built up through their own experiences (Polanyi, 1961; Nonaka and Takeuchi, 1995) that enables them to know how and where the procedures need to be tailored to the needs of individual projects. People who have the lack of maturity that makes them want to follow procedures to the letter are perhaps not yet ready to practice as project managers.

One firm from the ECI told us that new project personnel are told to follow the internal procedures strictly on their first project (when they will be in a support role - sitting next to Nellie). On subsequent projects, they can gradually reduce the amount they refer to the documentation, as they internalize the firm's good practice. They are also allowed to adapt the procedures to the needs of the individual projects as their experience grows.

Ericsson have a procedure called PROPS, which should be used on all projects, although it is not mandatory. PROPS is also designed to be tailored to the needs of individual projects. It represents good practice in Ericsson, but that good practice is flexible enough to be adapted to the size and type of project. PROPS is continually updated to reflect new experiences, and the changing technology and nature of projects. It was first published in, 1987, and is now in its third edition. The product development manager for PROPS is located in Ericsson's project management headquarters in Stockholm.

The United Kingdom's government has developed its internal project management procedure, PRINCE 2, (CCTA, 1996). PRINCE 2 certification is becoming mandatory to bid for many projects in both the public and private sector in the UK. In this way the government is contributing to not only the increasing competence of public sector projects through the capturing of best practice, but also to the increasing project management competence of the society, (Gareis and Huemann, 1999).

Organizations which have not captured their own experience in project procedures are able to use industry standard procedures, such as PRINCE 2, ISO 10,006, (ISO, 1997), and the PMI Guide to the Body of Knowledge, (PMI, 2000). There are apocryphal stories of people applying PMI's Guide to the PMBoK® to the letter on every project, and their project performance falls. This is not a fault with the PMBoK®, but with the way it is applied.

End of Project Reviews

End of project reviews play a vital part in capturing experience. PRINCE 2 and ISO 10,006 suggest a review be conducted at the end of every project, and company procedures updated to reflect that learning. Ericsson's PROPS procedure requires this, as does ABB's procedure. The OPM3 shows at higher levels of maturity organizations continually benchmark their procedures and processes, gathering data about project performance, storing that as historical data to help plan future projects, and thereby improving overall project performance. However, our data reveals less than satisfactory use of end project reviews. Many firms find the practice difficult to enforce, and where it is enforced, it is a meaningless box-ticking exercise. An ICT contractor in New Zealand told us that post-completion reviews were an essential part of their quality assurance procedures, but there was no check on the quality of the outputs. Further, where reviews are conducted, it can be difficult to transmit the learning to the organization, for three reasons (Keegan and Turner, 2001; Cooke-Davies, 2001):

A project may last for several years. Valuable learning experiences take place at the beginning of the project, but are not captured until the post-project review at the end, if at all. This problem has been observed in most of the companies taking part in our study.

When learning is successfully captured, it needs to be transmitted to the organization. Updating internal procedures may achieve that. However, it may be several years between issues of the procedures, delaying distribution of the learning. A more subtle problem is how to ensure people work to the current version. People become less reliant on the procedures as their experience grows, so they may not quickly assimilate the new issues. . We discuss below practices adopted to distribute learning in other ways.

There is attenuation of the learning as it passes from one project to the next. New knowledge from the current project (variation) needs to be captured in the end of project review (selection), recorded (retention), and then transmitted to new projects through procedures or the project management community (distribution). Figure 2 shows the attenuation in knowledge at each of these steps, (Cooke-Davies, 2001).

Benchmarking

Another way of learning is benchmarking project performance. It is usually not effective to benchmark projects internally, but with projects

undertaken by other firms in the industry. Gareis and Huemann (1998, 1999) describe benchmarking of high technology companies and projects, and of the project oriented society. The European Construction Institute and the American Construction Industry Institute are benchmarking projects in the ECI in the two continents, and have about 4000 projects in their database. None of our sample specifically mentioned benchmarking. However, we know that one is part of Gareis and Huemann's programme, and all of our sample from the ECI are part of the ECI/CII programme.

Practices adopted by Project-based Organizations to distribute Experiential Learning

We saw above there can be a delay between learning experiences being gained on projects and being captured in post completion reviews. Further delay and attenuation occur between experiential learning being captured and recorded in the new project procedures and their dissemination and adoption. Successful project-based organizations adopt practices to ensure the learning experiences are gained by the organization at large before they are eventually reflected in the procedures. This is essential in the absence of functions.

Project Management Self-support Groups or Conferences

We discussed the role of self-support groups as part of individual learning. We see again their significance in fulfilling the role of the functions where they are of reduced significance.

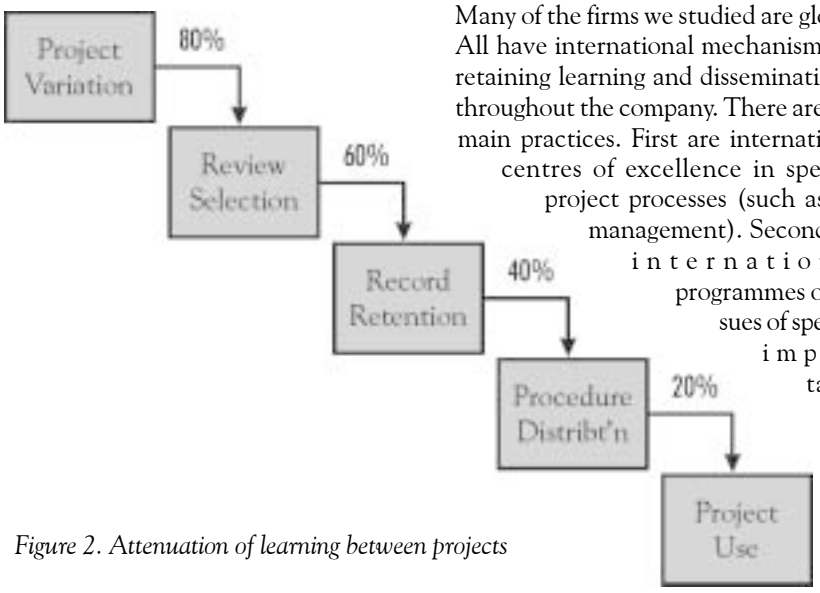


Figure 2. Attenuation of learning between projects

The use of the INTRANET

Many organizations are experimenting with the use of the INTRANET, (Cooper et al, 2001). Ericsson have developed the concept of the virtual project office on a central server. Project plans, progress reports, issues registers, etc are posted in the e-project office. The system is supported by a powerful search engine. If someone has a similar project, or problem, they can search and interrogate existing or completed projects. It is up to the person with the problem to search. This is different to what Digital did in the early 1990s. Then a person with a problem would e-mail everybody else in the organization, and it was up to the person with the solution to respond. This often did not work because the people with the solutions were too busy. In Ericsson, it takes project managers no longer to develop and maintain plans and issues register in the e-room than elsewhere. Another tactic is to award people points when they post information in the e-room, and to charge them for accessing it. In that way people are encouraged to keep the information in the e-room current.

There is however an issue with the viscosity of knowledge and learning. We saw above the problem of deferral, learning taking years to spread to the organization. With the INTRANET it can spread too quickly; yesterday's hearsay can become today's perceived wisdom. Cooper et al (2001) suggest that it is essential that there be gatekeepers who review all information before it is posted on the INTRANET; fine, but expensive, and yet to be tested.

Centres of Excellence and International Programmes

Many of the firms we studied are global. All have international mechanisms for retaining learning and disseminating it throughout the company. There are two main practices. First are international centres of excellence in specific project processes (such as bid management). Second are international programmes on issues of specific importance to companies at a given time (such as Euro conversion). The centres offer advice to operating companies and record changes in standard practice. For example, within Ericsson, the Project Management Institute in Stockholm is responsible for maintaining their PROPS procedure and running quarterly conference discussed previously. A similar group exists in ABB, also based in Sweden. Where local deviations are examined and determined to be successful, the Centres of Excellence will codify these, provide training, and retain the learning within the company.

Moving People around the Organization

Another technique used for spreading experience is to move people around the organization. By posting people in another town or country, experience is transferred as people make contacts with new colleagues. This is a slow method of transferring experience, but it is effective. Similar expatriate secondments are very common in the ECI.

The role of functions

Most of the organizations we have interviewed have not eliminated functions. The functions remain in a central competence pool, to act as a service and supplier of resources to projects. Functions appear to be essential to the learning and development of individuals and organizations. As we have seen, there are various specialist forms of functions used, such as self-support networks and centres of excellence.

Summary

Table 4 shows how our observations compare with the theory of development of project-based organizations as presented in Table 1.

Conclusion

The majority of project personnel receive their learning through experience on the job, (Crawford and Gaynor, 1999), and yet, as Pinto (1999) reports, many project based organizations are failing to support the experiential learning of individuals and of the organization. In this paper we have reported on practices adopted by project-based organizations in supporting the experiential learning of individuals in the organization, and of the organization as a whole. Some of the organizations we have observed are over sixty years old, and so their practices have supported a

lengthy history, and some have international reputations as successful firms. Hence we can conclude that against these criteria the firms observed can be judged as successful, and so the practices as those used by successful firms.

We have seen that the experiential learning practices adopted by project-based organizations match the three themes of increasing organizational project management maturity, Table 2:

1. recording organizational learning through project management procedures
2. capturing experiences through post-completion reviews, and improving knowledge through comparison, benchmarking, and metrics
3. distributing learning through project management networking, communities and knowledge

But how do these practices use variation, selection and retention to enhance the learning experiences, and what impact do centralization, deferral and attenuation have on their efficacy?

Procedures

Procedures are the main way by which organizations retain their knowledge, and distribute it to individuals in the organization, especially new starts. However, they can also be tools for variation and selection, allowing new approaches to be incorporated into the firm's procedures, and deciding which should be retained. We spoke to a company supplying equipment to the power distribution industry. At a biennial audit into their procedures by their prime customer, they were criticized for not having incorporated risk management into their procedures since the audit two years previously. At the time, risk management was being more widely incorporated into project working than previously.

The centralization of the writing of procedures is a strength, as it ensures conformity and consistency of learning. In every firm we spoke to it was the responsibility of a central department to maintain the company standard procedures. However, it is the responsibility of the project teams to develop the project specific version of them, ensuring that the learning is distributed to individuals.

The main issue is of one of attenuation and deferral. Ericsson published the first and second edition of its PROPS procedure just two years apart in the late 1980s. The third edition was then published six years later in the early 1990s, and they are working on the fourth edition now. Between the second and third and third and fourth editions there is a potential six year delay before new learning is incorporated into the procedures. A similar pattern is evident in the UK Government's PRINCE 2 process. However, there is a balance between changes being too rapid and too slow, (viscosity of information). The procedures are the repositories of the knowledge that has been tried and tested and proven to work, (the role of the functions in the classically managed organization). They primarily fulfil the roles of selection and retention, and not variation, and hence slow changes are appropriate. PRINCE 2achieves this through occasional patches between editions. More frequent changes should be distributed via the project management community.

Kolb Learning Cycle	Theory from Table 1	Theory observed	Theory not observed	Other practices observed
Concrete experience	Project manager development	Yes		Pairing Overseas posting
Observation and reflection	Project community	Networks Conferences		Post completion review Benchmarking
Abstract concepts	Procedures Information system	Used Internet		Centres of excellence
Testing of concepts				
General	Strategic alignment Management support	Networks	Not mentioned	

Table 4 Findings on experiential learning in the project-based organization.

Reviews

The main role of the reviews is the selection of learning for retention. The projects themselves are the vehicles for variation, and through the reviews the project teams should select those learning experiences for recording and distribution. There are two problems with reviews. The first is they are not centralized. They are the responsibility of the project teams, and often do not happen due to the pressure of the next project, even though they are nominally compulsory in many organizations. The other problem is one of attenuation and deferral of the learning from the review. We have already seen that only 20% of learning reaches future projects, Figure 2, (Cooke-Davies, 2001).

It is in reviews that the greatest weakness occurs in experiential learning in project-based organizations. We have spoken to many organizations that would claim to be at level 3 or 4 in maturity, and their use of procedures and distribution of learning through the project management community would justify that. However, they fail to achieve continuous improvement because of the weakness in the review step. Kolb's learning cycle is broken at the reflection.

Communities

The role of the project management communities is neither variation, nor selection, nor retention, but distribution of knowledge. They replace the functions in the traditional organization in that role. We have also seen that because it is appropriate that updates to the company's procedures should be infrequent, to provide stability, the communities are the method of achieving more rapid distribution of current knowledge. Cooke-Davies' (2001) data for attenuation of project management learning would suggest that the communities are not working as well as they might, but that 20% of learning is reaching future projects would suggest that they are having some effect.

There is also a growing problem with modern technology, particularly the INTRANET, of learning moving too quickly through the organization. The use of gatekeepers may reduce that happening, but it is yet to be proven.

Prof J R Turner and Dr A E Keegan

Dept of Marketing & Organization
Faculty of Economics
Erasmus University Rotterdam
Room H15-3
Burgemeester Oudlaan, 50
3062 PA Rotterdam, The Netherlands

Tel: +31-(0)10-408-2723
E-mail: turner@few.eur.nl
keegan@few.eur.nl

Dr Lynn Crawford

Dept of Design Architecture & Building
University of Technology Sydney
PO Box 123, Broadway
NSW 2007, Australia

Tel: +61-(0)2-9514 8017
E-mail: lynn@aipm.com

References

AIPM. 1996. *National Competency Standards for Project Management. Spit Junction, NSW: Australian Institute of Project Management.*

Boud D. and Walker D. 1997. *Experience and Learning in the Workplace: Reflection at Work. Geelong, Victoria: Deakin University.*

Caupin G., Knöpfel H., Morris P. W. G., Motzel E. and Pannenbäker O.. 1999. *IPMA Competence Baseline, Version 2.0. Zurich: International Project Management Association.*

CCTA. 1996. *PRINCE 2: Project Management for Business. London: The Stationery Office.*

CISC. 1997. *Raising standards: Construction Project Management: NVQ/SVQ Level 5. London: The Construction Industry Standing Conference.*

Cooke-Davies T., 2001. *'Project close-out management - more than just 'good-bye' and move on', in D. Hilson and T. M. Williams, (eds), A Project Management Odyssey, Proceedings of PMI Europe 2001, London: PMI UK Chapter.*

Cooper K., Lyneis J. and Bryant B., 2001. *'Learning to learn, from past to future', in D. Hilson and T. M. Williams, (eds), A Project Management Odyssey, Proceedings of PMI Europe 2001, London: PMI UK Chapter.*

Crawford L., 2001. *Project Management Competence: the value of standards, DBA Thesis, Henley-on-Thames: Henley Management College.*

Crawford L and Gaynor F., 1999. *'Assessing and developing project management competence', Learning, Knowledge, Wisdom, Proceedings of the 30th Annual PMI Seminars and Symposium, Philadelphia. Sylva, NC: Project Management Institute.*

Dodgson M., 1993. *'Organizational learning: a review of some literatures', Organisation Studies 14(3). pp.375-394.*

Frame J. D., 1999 *Project Management Competence: Building Skills for Individuals, Teams and Organizations. San Francisco: Jossey-Bass Publishers*

Gareis R. and Huemann M. 1998. *'International research project PM-benchmarking: benchmarking of the PM-process', Project Management: Professional Magazine of the Project Management Association Finland 5(1). pp. 34-35.*

Gareis R. and Huemann M., 1999. *'IPMA Research: PM-competence of the project oriented society', Project Management: Professional Magazine of the Project Management Association Finland 4(1). pp. 34-35.*

Gareis R. and Huemann M. 2000. *'Project management competences in the project-based organization' in J. R. Turner, and S. J. Simister (eds) The Gower Handbook of Project Management, 3rd edition. Aldershot: Gower.*

Glaser B. G. and Strauss A. L., 1967. *The Discovery of Grounded Theory. Chicago: Aldine Publishing Company.*

Gibson L. R. and Pfautz S., 1999. *'Re-engineering IT project management in an R&D organization - a case study', in K. A. Artto, K. Kähkönen, and K. Koskinen, (eds) Managing Business by Projects, Proceedings of the NORDNET Symposium. Helsinki: University of Technology Helsinki.*

Graham R. J. and Englund R. L. 1997. *Creating an Environment for Successful Projects: the Quest to Manage Project Management. San Francisco: Jossey-Bass Publishers.*

Hoffman E. J., 1997. *'NASA project management: modern strategies for maximizing project performance', Project Management Journal 27(3):. pp. 4-5.*

Huczynski A. A., 1996. *Management Gurus: what makes them and how to become one. London: International Thomson Business Press.*

Humphrey W. 1989. *Managing The Software Process, New York: Addison-Welsey*

Ibbs C. W., and Kwak Y.-H., 1997. *The Benefits of Project Management: financial and organisational rewards to corporation. Sylva, NC: Project Management Institute.*

ISO. 1997. *ISO10,006: Quality Management - Guidelines to Quality in Project Management. Geneva: International Standards Organization.*

Jowett B., 1999. *The Essential Plato. Book-of-the-Month Club.*

Keegan A. E. and Turner J. R., 2000. *'Managing human resources in the project-based organization', in J. R. Turner, and S. J. Simister (eds) The Gower Handbook of Project Management, 3rd edition. Aldershot: Gower.*

Keegan A. E. and Turner J. R., 2001.*'Quantity versus quality in project based learning practices', Management Learning, special edition on Project-based Learning 32(1). pp. 77-98.*

Kerzner H., 1998. *In search of excellence in project management: successful practices in high performance organizations. New York: Van Nostrand Reinhold.*

KnowlesM. S., Holton E. F. III and Swanson, R. A., 1998. *The Adult Learner, 5th edition, Houston, TX: Gulf Publishing Company.*

Kolb D. A., 1984. *Experiential Learning: Experience as the Source of Learning and Development. Englewood Cliffs, NJ: Prentice-Hall.*

MCI. 1997. *Manage Projects: Management Standards - Key Role G. London: Management Charter Initiative.*

Mezirow J., 1997 *Transformative Learning: Theory to Practice. San Francisco: Jossey-Bass Publishers.*

Morgan G. 1997. *Images of Organization, 2nd edn. Thousand Oaks, CA: Sage Publications.*

Nonaka I. and Takeuchi H., 1995. *The knowledge-creating company. New York: Oxford University Press.*

OSCEng. 1997. *OSCEng Levels 4 and 5: NVQ/SVQ in (generic) project management. London: Occupational Standards Council for Engineering.*

Paulk M. C., Curtis B. and Chrissis M. B., 1991. *Capability Maturity Models for Software, Pittsburg, PA: Carnegie Melon University.*

Payne J. H., and Turner J. R., 1999. *'Company-wide project management: the planning and control of programmes of projects of different types', International Journal of Project Management 17(1). pp. 55-60.*

Pinto J. K., 1999. *'Managing information systems projects: regaining control of a runaway train', in K. A. Arrto, K. Kähkönen, and K. Koskinnen, (eds) Managing Business by Projects, Proceedings of the NORDNET Symposium. Helsinki: University of Technology Helsinki.*

PMI. 1999. *The PMI project management fact book. Sylva, NC: Project Management Institute.*

PMI. 2000. *A Guide to the Project Management Body of Knowledge, 4th edition. Newtown Square, PA: Project Management Institute.*

Patton M. Q., 1980. *Qualitative Evaluation Methods. London: Sage.*

Polanyi M., 1967. *The Tacit Dimension. New York: Doubleday Anchor.*

Schlichter J. and Duncan W. R. 1999. *'Excellence through standards: an organizational PM maturity model', PM Network 1999(February): 18.*

Turner J. R. and Huemann M., 2001. *'The maturity of project management education in the project oriented society', Project Management: International Project Management Journal, Finland 7(1), to appear.*

Turner J. R. and Keegan A. E., 1999. *'The versatile project-based organization: governance and operational control', The European Management Journal 17(3). pp. 296-309.*

Turner J. R. and Keegan A. E. 2000. *'The management of operations in the project-based organization' Journal of Change Management 1(2). pp. 131-148.*

A Bayesian Approach for the Bidding Phase to Estimate the Cause Probability of an Uncertain Event

Enrico Cagno, Politecnico di Milano, Italy
Franco Caron, Politecnico di Milano, Italy
Mauro Mancini, Politecnico di Milano, Italy

Keywords: Project Risk Management, Bidding Phase, Bayesian Approach

The process of purchasing a complex industrial asset includes various phases, where bidders compete with each other and negotiate with the buyer, until one bidder is awarded the contract. This environment stresses the necessity of a deep project risk management during the bidding phase, using all possible information available in the company in terms of both historical data and experts' judgement. The paper proposes a method for the integration of this two kinds of information.

Introduction

The development of project management techniques during the last decades in different markets (information technologies, telecommunications, manufacturing), as well as its improvement in the engineering and contracting field, has increased the competitiveness between industries since more and more companies started to use and disseminate their competence in project management.

In this context the conceptual phase of a project requires more and more attention from the top management and from researchers since it is the period of time where all kind of decisions have big impact on the development of the project in terms of cost, time and technological performance. It can be said that the nature itself of a project is now developing since for example, the growing market of telecommunications (characterised by a smaller projects than that of the engineering and contracting field) determines the development of projects with aggressive planning and low delivery times.

Time conceded for the bidding phase and decisions regarding the overall project must be taken always in a shorter way. The proposal manager has so the problem to balance two main conflictual aims: the proposition to the client of a competitive bid (e.g. with low prices and short delivery times) in order to win the tender (and eliminating other competitors) but at the same time the proposition of something realistic, that means that would be realised respecting the performance promised in the contract in terms of cost time and technological performance.

This role of the competitive strategy makes clear the relevance assumed by risk management in this period of the project (Uher T.E. and Toakley A.R. 1999). The proposal manager has to cope with all kind of risks and opportunities offered by the tender. If the project, for example, regards the realization of processes or a products that are on the boundaries of the core business of the company there is the opportunity to explore new markets and to acquire new clients but at the same time the risk to promise in the bid something outside company experience, with a possible consequence of many problems during the bidding phase itself (for example approximate quantification of the budget needed) or during the implementation phase (e.g. delivery delay) or operation period of the industrial plant realised (e.g. technological performance obtained).

All these considerations put relevance on the uncertainty that characterises the bidding phase and this uncertainty has two different sources (Chapman C. and Ward S. 2000):

- The uniqueness of a project, that determines a scarcity of historical data and previous experience to base estimates on (e.g. the same industrial plant realized in different countries with different legal system or different climatic conditions can have too many different aspects in terms of technological solutions, raw materials or behavioural characteristics of the local manpower used to realised it)

- The fact that the scope of work is not precisely defined since it is very difficult to predict all kind of conditions that will be present during the realization of the project (e.g. local political stability, weather conditions, financial stability of the vendors and so on)

The risk analysis tries to cope with this two kinds of problems studying and using methodologies that reduce the forecasting uncertainty of the bidding phase that emerges in two different forms:

- Uncertainty about expected values for project parameters in terms of cost, time and performance given a set of major assumptions about project context (i.e. given a definite project scenario)
- Uncertainty about major assumptions about project itself and project context (i.e. about possible project scenarios)

In the first case we have a "minor" variability (e.g. in resources cost due to market price fluctuations) which can be included in the cost estimation process. In the second case we have major risks i.e. hopefully rare events affecting basic assumptions about project scenario (e.g. a dramatic delay in delivering a critical item to the site), risks which should be appropriately analysed and managed. The measure used for this second form of uncertainty is the exposure to a risk (expressed in different measurement units:, time, money …), defined as:

$$E = P \cdot I$$

Where: E is the exposure to the risk; P is the probability that a cause, that determine an uncertain event will happen; I is the impact of the uncertain event in terms of time, cost and technical performance.

For example the social instability of the nation where the plant will be installed (cause) can generate the temporary interruption of the activities done by local manpower (uncertain event) that can generate a delay in the project completion (impact). Focusing on the cause element it can be argued that too many discussions on the definition of the real cause of an event can be done (e.g. the social instability of the nation involved also will have one or too many causes), but this is just a problem of detail level of the analysis that changes among different companies, and inside the same company, by the type of project or by the time for bidding conceded by the client. Moreover, analysing the causes of risk makes it possible to create a common action strategy for somehow similar risks.

Causes and impacts of an uncertain event should be specifically identified in order to define corresponding mitigation actions that reduce or remove the cause (prevention) and the impact (protection), in order to create a risk chain formed by: cause, impact and action (Hillson D. 2000). In particular as regards:

- Cause: if several causes can generate the same risk, the term joint causes (logical link AND) is used if all causes are required for the risk to occur, and separate causes (logical link OR) if, on the contrary, each cause alone can determine the risk (Sharma K. et al. 1997). The delayed delivery of a supply is an example of separate causes, from the delay in planning and development or from a dispute with the suppliers.
- Impact: a risk may have effects on one or more project aspects. In a dual case, where several risks have consequences on the same item, the term series of impacts is used; when single effects together produce an overall effect, the term parallel impact is used, when the severity of the impact is equal to the maximum values of single effects (Cagno E. et al. 2001)
- Action: Risk Response actions are therefore identified. This may be done a priori, if the actions are taken from as early on as the bidding phase (for example changing the product or bid configuration), or subsequently (contingency plan) if the actions are taken only as a result of the risk or its premonitory events occurring (Project Management Institute 2000). A priori actions are divided into preventive actions - acting on the cause - and protective actions - acting on the impact; subsequent actions into planned and unplanned. The most significant are the a priori actions. As we are still in the bidding phase, the margin for action is far wider-ranging than subsequent to the initial project stage, with more freedom to act (Raz T. and Micheal E. 1997).

As concerns risk management and the risk chain in particular, in terms of calculating exposure for single risks identified, we decided to focus on the phase of identifying and calculating the probability of the cause. Since during the bidding phase the real problem is the scarcity of data the best way to prepare the bid is using both historical data stored in the company database and subjective opinion coming from the experience gained in the realization of other projects. Therefore a Bayesian model has been considered which could integrate data from historical observations and opinions expressed by sector experts in order to achieve a strictly mathematical model which can easily be applied to any company context.

The Bayesian Approach

In developing a risk analysis approach, the historical knowledge collected during previous experiences (a fundamental requirement for formalising company know-how) has to be stored and reused. This does not rule out the need, however, to integrate this data with subjective evaluations. Being able to use a knowledge base certainly has various benefits: above all individuals' and corporate knowledge on different phenomena can be enhanced and further investigated: this allows for a more realistic planning and so makes project management easier.

During the bid preparation phase in particular, using information from previous experience helps to:

- Seize market opportunities
- Prepare more competitive offers, which can meet customer needs more accurately
- Highlight hidden problems and avoid past errors from being repeated
- Consider more realistic and achievable time, cost and technical performance aims

Due to the non-repetitive nature of projects, the estimate process must be based on integrating available historical data (generally very scarce because of the project's uniqueness) with subjective evaluations made by experts (based on previous experience with the same type of projects). Integrating historical data and expert subjective evaluations, for predictive purposes, represents an intrinsic problem of the project management

process and this can be tackled with a Bayesian approach.

Applying risk analysis techniques means that uncertainties have to be represented through the probability of events happening (using the previous terminology, the probability of a cause leading to specific impact).

In the so-called subjective or Bayesian interpretation of the theory of probability, the definition of probability as a limit of the frequency is replaced by the measurement of the "degree of belief" of an individual in relation to a particular event.

Probability is therefore a measurement based on the entire set of information available to an individual in relation to the event which the probability has to be estimated for.

This interpretation of the concept of probability allows us to break through two barriers of the classical theory of probability:

- The theoretical impossibility of defining probability for events without any available tests
- The impossibility of changing probability estimates based on further information added to the previous level of knowledge

As mentioned previously, a project is by its very nature unique, so even if we hypothesize to repeat a project exactly in the same way, for a technically identical plant, some aspects cannot be practically the same, such as the environmental, logistic or economic conditions. In view of this, using historical data alone seems to be an unjustifiable misrepresentation. Using probabilities generated from databases, even when these are available, may at the most be a useful reference but certainly cannot be considered as a "true" estimate for the future value.

With a Bayesian approach, the probabilities generated from expert opinions are systematically included in the analysis. This raises the problem of updating the degree of current knowledge (a priori probability), in view of new information to obtain a probability value which takes account of the entire information set ("posterior probability"). This can be done by applying Bayes' theory expressed by (Hines W.W. and Montgomery D.C. 1990):

$$P(E_i|F) = \frac{P(E_i)P(F \mid E_i)}{\sum_j P(E_j)P(F \mid E_j)}$$

If the initial subjective opinion of the expert is that Event E1 has the probability of occurring P(E1) (a priori probability), this value represents the subjective degree of confidence about the actual event happening. By using the Bayes ratio we can reasonably modify this subjective piece of information considering the realisation of event F in the past. The fact that the event happened results in a change to the initial subjective degree of confidence changing from P(E1) to P(E1|F) (posterior probability). For the sake of being complete, note that P (F|E1) (likelihood function) is the probability which measures the degree of reliability of historical data relative to event F happening (Siu N. and Kelly D. 1998).

If we consider that we are planning the construction phase of an industrial plant and we are making an estimation of the scheduling time we can ask to an expert the probability of a delay in the delivery time of one of the main items (e.g. a compressor), in order to obtain the prior probability. Then we can control in the historical database of the company how many times in previous projects that particular supplier delivered the item with a delay, in order to obtain the likelihood function. The Bayesian approach define the way to tune the information coming from different sources, since it is based on the hypothesis that historical data can't be sufficient to predict the future since it is impossible to recreate exactly the same condition to repeat an experiment.

The application of Bayesian approach to project risk management met some difficulties in the past since the statistical underground to apply is not so confident to project managers, for this reason a new approach to the bidding phase as been developed in order to simplify the way to apply this model to the bidding phase.

A Weighted Average Model

The purpose is to systematically define the contribution from past project data as well as expert opinion; this must represent the starting point for attributing a probability to a given cause occurring for a specific uncertain event.

We shall first consider the past. The cause may or may not have occurred. As a result, a variable with a value of just one or zero is obviously the most suitable for representing the reality of what has happened in the past.

So we shall first define a random variable X distributed as a Bernoulli distribution of parameter P:

$$X \approx Bern(p)$$

with

$$P(x=1) = p$$

$$P(x=0) = 1-p$$

As stated previously, this random variable represents data from past projects, with a series of ones and zeroes that indicate whether the cause has occurred or not. The first consideration can be done on what kind of project can be considered similar to the current in order to control if a particular cause occurred or not. For example, analysis on the common characteristic of the project realised by the company can be done, focusing on the kind of industrial plant, the level of innovation, the type of client, the geographical position of the site and so on. This means that if we consider for example the possible delay in the engineering phase we will consider as reference those projects delivered in the past with a level of technological innovation similar to the current, while if we consider possible delay related to difficulties in the management of local manpower we will consider as historical references projects realised for example in the same geographical area. This aspect is very important because it is possible to enlarge the number of projects to be used as reference based on the particular aspect of the project we are analysing.

We shall therefore assume that the number of past projects considered for the particular aspect we are analysing is n; so we have n random variables distributed by a Bernoulli distribution:

$X1,X2,\ldots,Xn \rightarrow f(x;p)$

For example n = 7 and the number of projects where the particular cause analysed emerged is 3. The classical view of the probability will suggest to consider that the probability that the cause will emerge in the new project will be p = 3/7 = 0,4286.

We shall now turn our attention to the experts. If asked to express an opinion about the probability of a cause occurring, they will usually attribute a value from 0 to 1, with some kind of variability. So it is probably suitable to assume that the experts' opinions are distributed as a beta distribution of two

parameters a and b, since this function is very flexible to the variation of its parameters:

$$p \approx Beta(\alpha;\beta)$$

with the mean and variance:

$$Ep = \frac{\alpha}{\alpha+\beta}$$

$$VARp = \frac{\alpha\beta}{(\alpha+\beta+1)(\alpha+\beta)^2}$$

The aim is to calibrate the probability of the cause happening as indicated by experts in view of past events:

$$\Pi(p \mid \underline{x}) = \frac{f(\underline{x};p)\Pi(p)}{\int f(x;p)\Pi(p)dp}$$

Using Bayesian approach it is a not so easy because generally it is too much difficult to compute the expression of the integral at denominator, but in some case there are "conjugated functions" that can be used to simplify that computation. It can be demonstrated that if the prior distribution for p is a Beta function and the likelihood P(x|p) a Bernoulli or Poisson function, the posterior distribution is simply a Beta function with modified parameters (Robert C.P. 1996), that is:

$$p \mid \underline{x} \approx Beta(\alpha + \sum_{i=1}^{n} x_i; \beta + n - \sum_{i=1}^{n} x_i)$$

So the expected value for the posterior probability P(p|x) is

$$Ep \mid x = \frac{\alpha + \sum_{i=1}^{n} x_i}{\alpha+\beta+n} \Rightarrow$$

that can be also written

$$Ep \mid x = A\frac{\alpha}{\alpha+\beta} + B\frac{\sum_{i=1}^{n} x_i}{n}$$

where:

$$A = \frac{\alpha+\beta}{\alpha+\beta+n}$$

and

$$B = \frac{n}{\alpha+\beta+n}$$

are the weighted mean parameters. So the expression E[p|x] is the expected value of the probability of a cause happening that emerges from the combination of historical data and experts' opinion.

The above equation can be written simply as:

$$P_i = AP_{esp} + BP_{DS}$$

whereby:

Pi represents the a posteriori probability of the i-th cause considering both past projects and experts' opinion.

P_{esp} is the a priori probability expressed by the experts

P_{DS} is the probability deriving from historical data defined as the ratio between the sum of the x_i and n (i.e. the historical frequency).

In particular, the expression of the a posteriori probability, calculated in this way, can be assimilated to a weighted average, where the two weights are a combination of the parameters α,β deriving from experts' opinion and n, which is the number of past projects where the risk was considered. The importance given to the mathematical implementation of this approach derives from the common difficulty, registered in different real cases, to obtain a judgement from experts suitable for the use in a Bayesian approach. The method described aims to solve this problem by the definition of the prior distribution by a Beta function that has in this case the advantage to be correlated to the Bernoulli function and so the posterior function is yet a Beta function with modified parameters.

This model resulted so confident to the proposal managers involved in the research project since by the definition of the two weights A and B, they have an immediate vision of the importance of their judgement in respect to historical data. For this reason a sensitivity analysis has been developed using part of the database of the company involved in the research project trying to define the field of application in terms of number of project to be considered as referential and degree of belief of expert judgement expressed by the prior distribution variance.

Sensitivity Analysis

In order to assess the accuracy of the proposed model, and above all its implementation in a real case, sensitivity analysis has been conducted on the variation of parameters: α, β and n. To assess the model's consistency the values assumed by the two weights A and B have been compared in relation to variations of the relevant model parameters.

The parameters which were varied are α and β (related to experts' judgement) as well as the number of projects n (derived from historical data). In reality, asking an expert to indicate directly the two beta distribution parameters is very difficult in practical terms, if not impossible. So we asked the expert the probability of the cause of the event occurring and a variance of this probability. There are many studies about the way to express experts' judgements (Cagno et al 1999, Vose D. 1996) but in this case, since we asked experts yet involved in other similar research projects, the approach based on the standard deviation results sufficient for our purposes. The expert therefore indicates two numbers p (probability for example p=0.6) and k (variance for example k=0.1). From these two values, and by applying the following equations:

$$\begin{cases} p = \dfrac{\alpha}{\alpha+\beta} \\ k = \dfrac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)} \end{cases}$$

with simple mathematical steps α and β can be calculated in relation to p and k:

$$\begin{cases} \alpha = \dfrac{p}{1-p}\dfrac{p^3-2p^2+(1+k)p-k}{k} \\ \beta = \dfrac{p^3-2p^2+(1+k)p-k}{k} \end{cases}$$

At this stage, some simulation runs have been lunched to assess the variation of the A and B weights, in respect to the variation of α, β and n.

In figure 1, with a graph of weights A (experts) and B (data records), the probability p was varied, while values k and n remained constant; to be more precise k was set as being equal to 0.01 and n equal to 5, which in reality seems to be a realistic number of projects.

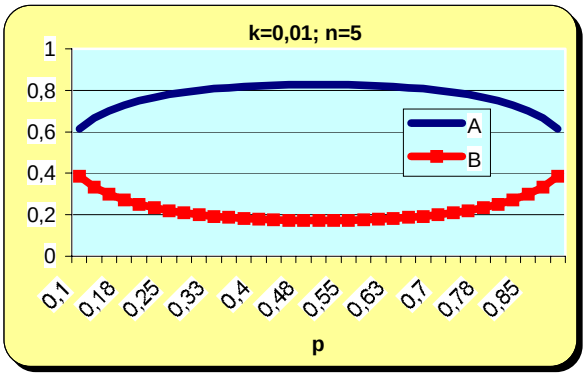


Figure 1

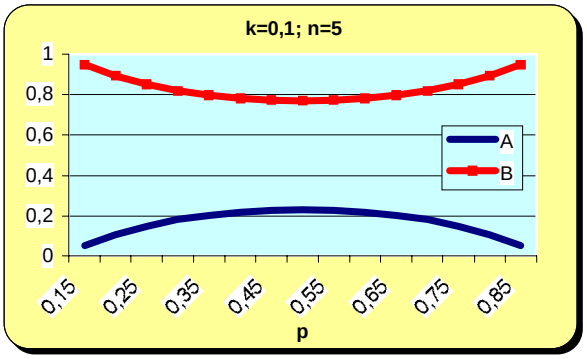


Figure 2

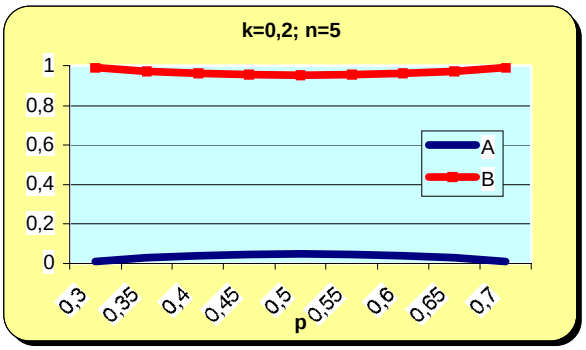


Figure 3

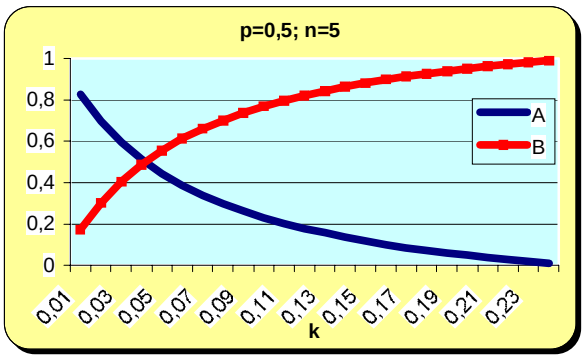


Figure 4

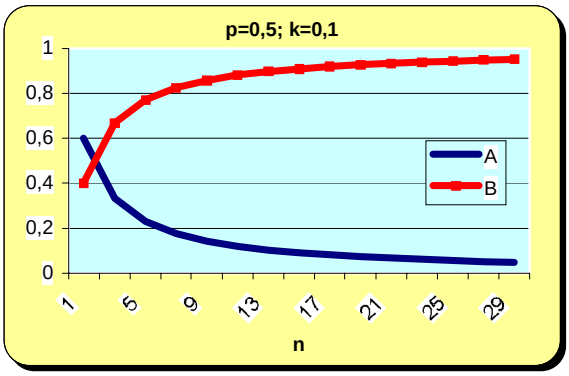


Figure 5

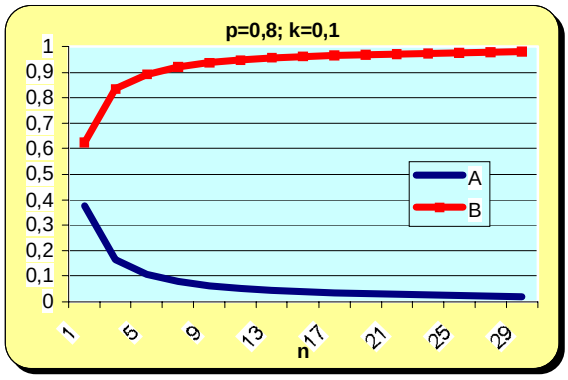


Figure 6

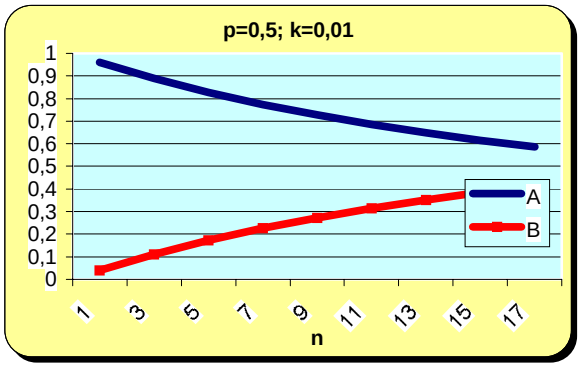


Figure 7

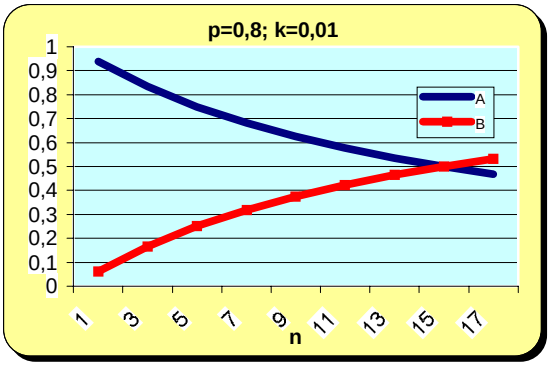


Figure 8

Note that term A exceeds the term B for every p value. This is because k (variance) is very low, i.e. it means that our expert is very sure about the p value attributed to the possibility of the cause of the occurring event.

The above results can be explained in a better way by figures 2 and 3; we can note how term B exceeds term A as the variance k increases.

This seems particularly consistent with reality, because if the expert is not at all sure about the probability, the weighted average would certainly be closer to the value obtained from historical data.

Figure 3 shows, as is the case for k=0.2, that the weighted average will

certainly be closer to historical data, even if the number of projects is particularly high (n=5), however this is perfectly in line with the expected trend that the proposed model must follow.

Figure 4 shows that for a probability p equal to 0.5 and a number of projects which is equal to 5, term B is greater than term A above a variance of 0.05, while below this value the experts' opinion has a greater weight than historical data.

A further parameter to vary is the number of projects n. As can be seen in Figures 5 and 6, as the number of projects vary, term B is nearly always greater than term A, with a high variance k.

The opposite result can be seen in figure 7 and 8 for low variance values (k=0.01), the value of weight B is always less than A where the number of projects is less then 17, number which is difficult for companies to actually achieve.

To sum up, the values assumed by the weights A and B seem to have a trend which mirrors reality; this validates the proposed model and verifies its applicability to different company contexts, achieving the aim of calculating the initial probability of the cause of an event as the weighted average of expert opinion and past project data.

Conclusions

The paper concerns the integration of historical data and experts' opinions about uncertain events that must be considered during the bidding phase. In this period of a project there is scarcity of information since the project is not yet defined, but at the same time decisions taken at this moment will heavily affect the entire project. For this reason it is very important to gain all kind of information stored in the company database derived from past experience and find the best way to combine them to estimate the probability of the events that will characterise the project.

The Bayesian approach seems to cope with the problem of integration of historical data and expert opinions, so that a Bayesian model (based on the representation of experts' opinion by a Beta function) has been tested in this field. The "weighted average" model obtained is based on two weights that are a combination of the parameters α,β (deriving from expert opinion) and n (which is the number of past projects considered as references for the present one). This approach seems to be very simple and familiar to proposal managers that generally aren't so closer to statistical approaches during the bidding phase.

To define better the application boundaries of the proposed approach a sensitivity analysis have been conducted to test the model and assess how the value of the mean weights acquired coherent values, when all main parameters (α, β, n), change.

Enrico Cagno, PhD (Engr)

Politecnico di Milano
Department of Management Economics and Industrial Engineering

P.zza Leonardo da Vinci 32
20133 Milan - ITALY

Tel: +39 02 2399 4730
Fax: +39 02 7063 8377
E-mail: Enrico.Cagno@polimi.it

Prof.Franco Caron

Politecnico di Milano
Department of Management Economics and Industrial Engineering

P.zza Leonardo da Vinci 32
20133 Milan - ITALY

Tel: +39 02 2399 4812
Fax: +39 02 7063 8377
E-mail: Franco.Caron@polimi.it

Mauro Mancini, PhD (Engr)

Politecnico di Milano
Department of Management Economics and Industrial Engineering

P.zza Leonardo da Vinci 32
20133 Milan - ITALY

Tel: +39 02 2399 4980
Fax: +39 02 7063 8377
E-mail: Mauro.Mancini@polimi.it

References

Artto K. A., Kähkönen K., Pitkänen P. J., 2000,
Unknown soldier revisited: a story of risk management, 1st Edition, Project Management Association Finland, Helsinki, Finland, 114p.

Cagno E., Caron F., Mancini M., 2001,
Risk Analysis to Assess Completion Time of a Tram-Line, Project Management vol 7. No 1, pp. 26-31.

Cagno E., Caron F., Mancini M., 1999,
Developing a Knowledge-based system for Project Risk Management, Managing Business by Projects, Project Management Association Finland, Vol 2, pp 858-869.

Chapman C., Ward S., 2000,
Estimation and evaluation of uncertainty: a minimalist first pass approach, International Journal of Project Management, Vol 18, pp. 369-383.

Grey S., 1995,
Practical risk assessment for Project Management, Wiley & Sons, Chichester, 140p.

Hillson D., 2000,
Project risk: identifying causes, risks and effects, PM Network, September 2000, Texas, pp. 48-51.

Hines W.W., Montgomery D.C., 1990,
Probability and Statistics in Engineering and Management Science, Wiley&Sons, Chichester, 312p.

Project Management Institute, 2000,
A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute, Pennsylvania, 211p.

Raz T., Michael E., 2001,
Use and benefits of tools for project risk management, International Journal of Project Management, Vol. 19, pp. 9-17.

Robert C.P., 1996,
The bayesian choice, a Decision-Theoretic Motivation, Springer texts in statistics, New York, 436 p.

Sharma K., Krishna H., Singh B., 1997,
Bayes estimation of mixture of hazard-rate model, Reliability Engineering and System Safety, Vol 55 (1), pp. 9-13.

Siu N., Kelly D., 1998,
Bayesian parameter estimation in probabilistic risk assessment, Reliability Engineering and System Safety, Vol 62 (1-2), pp 89-116.

Uher T. E., Toakley A. R., 1999,
Risk management in the conceptual phase of a project, International Journal of Project Management, vol. 17(3), pp. 161-169.

Vose D. 1996,
Risk Analysis - A quantitative Guide, Second Edition, Wiley & Sons, Chichester, 418 p.