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Are project management standards ignoring the characteristics and needs of different types of projects?

Usually a standard is understood as a norm or requirement. As such it can help us to evaluate the quality of operations, and, to develop the current processes further. For projects and their management a standard can also work as a common framework for unified operations and practices over organizational limits and even over national boundaries.

On the other hand standards and standardization have their limits and shortcomings. Standards present almost without an exception a consensual understanding and wisdom. They can thus be too much based on past experiences and knowledge. Standardization as a process has often an idiosyncrasy by trying to harmonize and homogenize the object in question. There is a danger that this anchors thinking and solutions in a way which can hinder the development of the profession itself.

International and national project management standards are instances where we can see kind of characteristics of standards discussed above. Harmonization and homogenization have produced elegant definitions of a project and the processes how the projects can be managed. On the other hand the knowledge captured in these standards should explain also how management requirements change or can change between projects of different scale and complexity. It is acknowledged widely that different projects need different project management solutions but the project management standards are almost completely failing to include this rather fundamental principle.

Typologies of Projects are the theme of this Project Perspectives issue. By this we are approaching research results and knowledge to cover different types of projects, their categories and relating project management solutions. Our profession is all the time expanding to cover projects of different disciplines, projects of varying scale, projects of varying degree of complexity and furthermore projects of varying roles within the involved stakeholders. These are examples of dimensions which can be used for categorizing projects. To embrace this diverse world of projects successfully it seems that we need a new kind of standardization paradigm. This paradigm should move clearly towards inclusion of knowledge and solutions that can successfully explain the wide variety of different projects and link those to their particular management solutions. Otherwise the linkage from a generic standard to the actual practice can be almost completely missing. It is our main message that the developers of international and national project management standards should put attention on project typologies and how these could help to explain the world of different management solutions.

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A Global System For Categorizing Projects

Most organizations recognize that the projects they fund and execute fall within different categories, but the discipline of project management has not fully recognized that these different types of projects often exhibit different life cycle models and require different methods of governance: prioritizing, authorizing, planning, executing and controlling. In spite of this de facto categorization of projects by practitioners, no systematic method or system exists for identifying the several basic categories of projects, and the many variations in the key characteristics that can exist within those categories. This paper summarizes some of the research done to date on this subject, briefly discusses the need for and uses of an agreed project categorization system, and proposes a first approach to establishing a number of broad categories based on the projects or results being produced by the projects.

The Need For Project Categorization

Projects and Project Management

The project management literature, including much research, deals with project management in general, but remains at a level that does not to date examine the projects themselves: the common denominators for the discipline of project management. There are these various types of projects that can be used to categorize projects within the context denominators for the discipline of project management. Knowing what purpose will be served by the projects often exhibit different life cycle models and require different methods of governance: prioritizing, authorizing, planning, executing and controlling. In spite of this de facto categorization of projects by practitioners, no systematic method or system exists for identifying the several basic categories of projects, and the many variations in the key characteristics that can exist within those categories. This paper summarizes some of the research done to date on this subject, briefly discusses the need for and uses of an agreed project categorization system, and proposes a first approach to establishing a number of broad categories based on the projects or results being produced by the projects.

The categorization of projects is beneficial and useful to organizations, but it needs to be practically and not theoretically oriented. Focus groups confirmed that there are intended and unintended consequences of that need to be considered in the development of classification systems, such as loss of autonomy, creation of barriers and silos and effects of visibility or invisibility due to inclusion or exclusion from a classification system. (Crawford et al 2002)

Categorization versus Classification

These basic PM functions vary with specific categories of projects. Use of practical project categorization methods in this area include:

- Select/improve project planning, scheduling, executing, and controlling methods: The ‘best practice’ for each of these basic PM functions varies considerably for different project categories.
- Select develop PM software applications: The strengths and weaknesses of currently available PM software application packages will vary according to the specific project category. One purpose of an agreed categorization system is the existence of the project attributes and their various combinations.

Four Possible Categorization Methods

Youker (1999) provides a very useful discussion of the alternative ways to categorize projects for practical purposes. There are four basic ways in which we can set up a classification system of projects:

1) geographical location
2) industrial sector (Standard Industrial Classification System)
3) stage of the project life cycle, and
4) product of the project (construction of a building or development of a new product).

The most important and the most useful breakdown is by type of product or deliverable that the project is producing, such as building a building, developing a new product, developing a new computer software program, or performing a maintenance turnaround or outage on a chemical plant or electric generating station.

Defining The Purposes Of Categorizing Projects

Strategic Project Management

The most effective method of categorizing projects for strategic management purposes will not be the same as the best categorization method for operational project management. These strategic purposes include:

- Project selection: Determining which potential projects are to be funded and executed.
- Prioritize selected projects: Determining the relative importance of selected projects to assist in allocating scarce resources.
- Define Performance: Determining the most effective way of grouping projects within specifically defined project portfolios.
- Manage project portfolios: Designing, implementing, and operating the project portfolio management process of the organization.
- Allocate resources to portfolios and projects within portfolios: Deciding the best deployment of money and other limited resources across all project portfolios and among the projects within each portfolio.
- Other: No doubt other strategic PM uses can be identified.

Operational Project Management

This area of usage includes: Case studies related to each of the agreed project categories will be more

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- Attributes of projects
  - Application area or product
  - Stage of life-cycle
  - Grouped or single
  - Strategic importance
  - Strategic driver
  - Geography
  - Scope
  - Timing
  - Uncertainty
  - Risk
  - Complexity
  - Customer
  - Ownership
  - Contractual

Any of these, or any combination of them, could be used to categorize a group of projects, depending on the purpose at hand. Perhaps the reason that little progress has been made to date in developing an agreed categorization system is the existence of this wide variety of project attributes and their various combinations.
effective in the focused educational and training courses and programs.
- Organize speaker tracks at congresses: One of the major purposes for participating in large congresses on PM is to hear a specialized certification of project managers: the most popular current PM certification programs (PMI and IPMA) purport to certify individuals in some aspects of PMM without regard for any specific project categories.
- Develop specialized certification of PM support positions: Certification of project estimators and schedulers, as examples, for large engineering design and construction projects will require proof of very different knowledge, skills and capabilities than the equivalent support positions in research and development, new product development, or software development projects.
- Develop PM career paths for individuals: Career planning and development of PM career paths differ widely for many of the basic project categories that can be identified.
- Other: Certainly there will be other purposes and uses related to people development of a systematic definition of project categories.

Prioritizing Purposes and Uses
Each organization will benefit from examining the various purposes and uses that are important to them, and determining which purport to certify individuals in some aspects of PM without regard for any specific project categories.

Characteristics Of A Practical Project Categorization System
Hierarchical and Multi-Dimensional
A practical system for project categorization must be both hierarchical and multi-dimensional. The resulting categories must be based on the same hierarchical approach used in systematically defining a project, as in developing a project/work breakdown structure (P/WBS):

**Category levels**

1. Major category
2. Sub-category 2
3. Sub-category 3
4. Sub-category 4

Recommended Categories and Sub-Categories

Eleven recommended basic project categories are listed in Table 1, plus a twelfth category for all others, oriented primarily to products or services. Projects within each of these specific categories have very similar life cycle phases and utilize similar authorizing planning, budgeting, scheduling, monitoring and controlling procedures and tools throughout their life cycles no matter where in the world they are located. Subcategories are also identified within most of these basic categories. In most cases there will be differences—in some cases significant—between the project life cycle management process for the basic category and at least some of its subcategories. Additional major categories may also be required to assure that all conceivable projects of significance to the international PM community are included.

Not Mutually Exclusive or Rigorously Consistent
It should be noted that these categories are not necessarily mutually exclusive: many projects will include aspects of two or more categories. For example, most communications systems projects include at least the adaptation of information system software. Many facilities projects also include communications systems, and vice versa. In such cases the project probably should be classified in the more dominant category, or—if justified by their size, complexity, or risk—defined as two or more projects (of different categories) within a program, with each project having a different life cycle definition.

Classifying Projects Within Categories and Sub-Categories
A wide range of projects within each project category or sub-category exists in large organizations. It is desirable for purposes of the proposed system to further classify projects within categories or sub-categories using some of the attributes identified by Crawford et al (2004) cited earlier, or some of the following classifying characteristics:

**Project Size**
Project size can be measured in several dimensions: amount of money or other scarce resources (skilled people, facilities, other), scope and geography are the most tangible and obvious. Larger projects in any of these dimensions usually carry greater risks, of course.

**Project Size**
- Major and Minor Projects Within a Category
- It is useful to identify at least two classes of projects within each category. The distinction between these major and minor classes will be noted in the following definitions.

**Major Projects**
- Those whose large size, great complexity and/or high risk require:
  - Designation of an executive Project Sponsor.
  - Assignment of a full-time Project (or Program) Manager;
  - The full application of the project management process specified for the particular project category for major projects (all specified forms, approvals, plans, schedules, budgets, controls, reports, frequent project review meetings, with substantial levels of detail in each)

**Minor Projects**
- Those whose size, simplicity and low risk allow:
  - One project manager to manage two or more minor projects simultaneously.
  - Less than the full application of the complete project management process for the project category (selected basic forms, approvals, plans, schedules, budgets, controls, reports, less frequent project review meetings, with less detail required in each).
  - No formal assignment of an executive Project Sponsor.

**Examples**

<table>
<thead>
<tr>
<th>Project Categories</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerospace/Defense Projects</td>
<td>New weapon system; major system upgrade.</td>
</tr>
<tr>
<td>4. Event Projects</td>
<td>Acquisition and integrate competing company.</td>
</tr>
<tr>
<td>5. Facilities Projects</td>
<td>Major improvement in project management.</td>
</tr>
<tr>
<td>6. Information Systems (Software) Projects</td>
<td>Form and launch new company.</td>
</tr>
<tr>
<td>7. International Development Projects</td>
<td>Consolidate divisions and downsizer company.</td>
</tr>
<tr>
<td>8. Media &amp; Entertainment Projects</td>
<td>Major litigation case.</td>
</tr>
<tr>
<td>10. Research and Development Projects</td>
<td>Next generation wireless communication system.</td>
</tr>
</tbody>
</table>

**Table 1. Recommended project categories/sub-categories, with each category (or subcategory) having similar project life cycle phases and one unique project management process (Archibald 2003, Fig. 2.3, p.35 – with addition of Category 11).**
Project Complexity
The complexity of a project is indicated by the:
- Diversity inherent in the project objectives and scope;
- Number of different internal and external organizations involved, which is usually an indication of the number of required specialized skills;
- Sources of technology, and/or;
- Sources of funding.

“Mega” Projects
“Mega” Projects or Programs are extremely large, complex projects (usually programs, in fact) that are so unique in their size, scope, risk and duration that they require specially designed organizational arrangements (usually joint ventures, often including both private companies and governmental agencies.) As these are broken down into their component elements it is usually practical to identify a number of major and minor projects within one or more categories that comprise the mega project/program.

“Commercial or Delivery” Versus “Transformational” Projects
It is important to differentiate between commercial (or standard, somewhat repetitive) projects and transformational projects (or programs) that create strategically important changes to the organization, which are often enterprises within the enterprise and include both projects and on-going operations.

Project Life Cycles: Searching For Common Processes
Within each project category and sub-category we must identify the commonly used models for project life cycle phases and decision points. These will form the basis for identification of common management processes within each life cycle phase.

Defining Project Life Cycles
The purposes of designing and documenting the overall project life cycle for each project category are to:
- Enable all concerned with creating, planning and executing projects to understand the process to be followed during the life of the project;
- Capture the best experience within the organization so that the life cycle process can be improved continually and duplicated on future projects.

- Enable all the project roles and responsibilities and the project planning, estimating, scheduling, monitoring and control methods and tools to be appropriately related to the overall project life cycle management process.

Life Cycle Phases and Decision Points
There is general agreement that the four broad, generic project phases are (common alternative terms are shown in parentheses): - Concept (initiation, identification, selection.)
- Definition (feasibility, development, demonstration, design prototype, quantification.)
- Execution (implementation, realization, production and deployment, design/construction/commission, installation and test.)
- Closeout (termination, including post-completion evaluation.)

However, these generic life cycle phases are so broad and the taxes so generic that they have little value in documenting the life cycle process so that it can be widely understood, reproduced, and continually improved. What is needed is the definition of perhaps five to ten basic phases for each project category, usually with several sub-phases defined within each basic phase, together with an appropriate number of decision points (approval, go/no-go, hold/hold) in each.

Conclusions
1. Different project categories require different governance, management, planning, scheduling and control practices.
2. Each project category and many sub-categories differ in:
   - Maturity of related PM methods and practices
   - How PM methods of planning, authoring, scheduling, contracting, and controlling the work are adopted and adapted
   - Most effective life cycle models
   - Degree of uncertainty; technology, funding, environmental, political, other.
   - How the project manager role is assigned and conducted
   - Experience and technical knowledge needed by the project manager
   - Plus others...

3. A globally agreed project categorization system is urgently needed and will have many practical uses: Selecting the best PM methodologies and life cycle models Defining project management systems and developing systematic methodologies for their creation Tailoring education and training curricula, materials, and case studies Developing specialized PM software applications Certifying project managers and PM support specialists Others;

4. Application of “One-Size-Fits-All” PM methods causes many project failures: - “Best practices” must be identified for each agreed project category In the absence of agreed categories, the wrong PM methods are often applied This is a root cause for many project failures.

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The difference between Different Types of Projects

Robert Youker
USA

As the Project Management profession moves into working on many different types of projects we are going to have to move to a new level in the project management body of knowledge and develop extensions that define the differences in requirements and approach for different kinds of projects such as construction, new product development, and information systems. This paper attempts to define the unique characteristics of different types of projects as well as establish a typology or taxonomy of different kinds of projects. The classification is based on the product or deliverable of a project. A list of characteristics is developed that defines the difference between projects such as:

- Degree of uncertainty and risk (construction vs new product development)
- Level of sophistication of workers (construction, vs information systems)
- Level of detail in plans (days or hours for maintenance vs months for research)
- Degree of new technology involved (research vs administrative projects)
- Degree of time pressure (maintenance or big event vs construction)

The paper then defines the essential characteristics of the basic differences between types of projects and outlines how the project management approach must vary for each different type of project. This will serve as a start toward developing one dimension of the needed extensions for the body of knowledge (BDK). A project management professional must know something about different types of projects and how the project management approach must differ for different types of projects. Filling out this taxonomy must be a high priority for the profession. Hopefully the profession can work together to share knowledge and come up with an agreed typology.

Introduction
How should we categorize different types of projects? The dictionary defines typology as the study of types within systematic classification. It defines taxonomy as the science, laws, or principles of classification. It defines classification as the systematic grouping into categories by shared characteristics or traits. The project management profession needs a classification system for different types of projects so that we may communicate effectively across the entire world. There are many different potential purposes for a system of classification. One useful objective for a list of different types of projects is to segment the market for marketing purposes. Another is to define the different management approaches needed for different projects. The system of classification might change based on the purpose. Another purpose would be to select the right project manager based on the requirements of a specific project.

Other research
Shenhar and Wideman in several papers have proposed a system of classification based on three variables of (1) Degree of uncertainty at initiation, (2) Complexity based on degree of interconnectedness and (3) Place based on the need for speed in the available time frame for the project. In a second paper they added the dimension of an intellectual product (white collar) versus a craft product (blue collar). These papers present several very useful analyses but they do not give us a complete list of different types of projects nor do they define all the differences between the different type projects. Archibald has carried this much further in several papers as listed in the References.

Alternative parameters for categorizing projects
There are four basic ways in which we can set up a classification system of projects as follows: (1) geographical location, (2) industrial sector (Standard Industrial Classification System), (3) stage of the project life cycle (See Figure 1) and (4) product of the project (construction of a building or development of a new product). The most important and the most useful breakdown is by type of product or deliverable. The project is producing such as building a building, developing a new product, developing new computer software program or performing a maintenance turnaround or outage on a chemical plant or electric generating station. Each of these types of projects has more in common with other similar projects producing the same type of product than with other types of projects. Conversely there is much less commonality between different types of projects in the same industrial sector or company. For example there is much more commonality between projects for developing a new software system in a construction company and a bank than there is between three projects in the same bank for constructing a new building, developing a new product and developing a new computer software system. Figure 1 presents a list of projects of products with a slightly different result based on Russ Archibald’s approach. Please note in Figure 1 that a phase of the project life cycle like Feasibility Study is a project in its self and very different from a later phase like construction. Please also note on Figure 1 that projects have to also be related many times to the business function in the organization.

Major Types of Projects Based on Product of Project
Here is a list of nine different types of projects based on the product they produce. The profession should think of other products of projects not listed here and come up with an agreed list. I have combined some like Defense/Aerospace with other types of projects and come up with an agreed list.

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Product of Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Administrative</td>
<td>installing a new accounting system</td>
</tr>
<tr>
<td>2. Construction</td>
<td>a building or a road</td>
</tr>
<tr>
<td>3. Computer Software Development</td>
<td>a new computer program</td>
</tr>
<tr>
<td>4. Design of Plans</td>
<td>architectural or engineering plans</td>
</tr>
<tr>
<td>5. Equipment or System Installation</td>
<td>a telephone system or a IT system</td>
</tr>
<tr>
<td>6. Event or Relocation</td>
<td>Olympics or a move into a new building</td>
</tr>
<tr>
<td>7. Maintenance of Process Industries</td>
<td>petro-chemical plant or electric generating station</td>
</tr>
<tr>
<td>8. New Product Development</td>
<td>a new drug or aerospace/defense product</td>
</tr>
<tr>
<td>9. Research</td>
<td>a feasibility study or investigating a chemical</td>
</tr>
</tbody>
</table>

Table 1. Different types of projects based on the product they produce.
1. Stability of scope: H M L (High-medium-low)
2. Degree of uncertainty or risk: H M L
3. Type of worker: Craft (blue collar) vs. Knowledge workers (white collar)
4. Importance of time (Pace): H M L
5. Importance of cost: H M L
6. Level of new technology: H M L
7. Series of projects or one of a kind: Series or one off
8. External contract or internal work: External or internal
9. Level of detail in plans: H M L

Table 2. Parameters for project classification.

Major variables or parameters or attributes

The following is a list of different characteristics that relate to different projects. It was developed by analyzing the nature of the nine different types of projects. It also draws on previous work as listed in the references.

Common characteristics of the major types of projects

Let us now look at the different approaches that are necessary to manage each of the nine basic types of projects.

1. Administrative: Administrative projects involve intellectual workers. The scope may change as the project proceeds.
2. Construction: Construction projects are contract business where the scope is laid out in detail before the project starts and the level of risk is small. The workers are all essentially craft or blue collar. In most cases time pressures are moderate and cost is a very important variable. The processes of construction are well known and the foremen very experienced.
3. Computer Software Development: Software projects are notorious for having the scope change radically during the project. Often they are pushing the state of the art which introduces high risk. Programmers are famous for individualistic behavior.
4. Design of Plans: The design of any kind of plan is an intellectual endeavor. By the nature of the exploratory nature of design the scope may not be well defined at the beginning because the client may not have yet decided just what they want. Quality is of a higher priority than either time or cost.
5. Equipment or System Installation: Scope is well defined and speed is essential. Risk should be low if the project was well planned.
6. Event: Event projects are project where scope may change during the project and uncertainty is high. Time is critical to meet a specific date. It is probably a complex project. The Olympics or a relocation to a new building are research projects but it is all the more essential to set goals and to measure progress against those goals.

Other variables common to all types of projects (secondary factors)

The following factors are important in projects but are not specific to any one of our list of project types. They could relate to any of the types. These factors could be used in other classifications of projects.

1. Size
2. Duration (Length of time)
3. Industrial sector
4. Geographical location
5. Number of workers involved
6. Cost (large, medium or small)
7. Complexity
8. Urgency
9. Organizational design

Conclusions and Recommendations

The most useful classification of types of projects is by the product of the project. This paper presented a list of nine different types, which should be expanded as more persons contribute ideas. The profession should adopt this breakdown as a basic segmentation of the Project Management business and use it in a number of different places. Our organizing the breakdown at annual conferences. The list of projects and their different attributes (Figure 1) needs to be worked on and agreed upon.

The interest groups for each of these types of projects should expand the sketches in this paper of the nature of their projects and required approaches. Another dimension of a taxonomy not mentioned in this paper is the list of subjects or topics of the practice of Project Management similar to the BOK.
A Contribution to Developing a Complex Project Management BOK

This paper proposes a project typology focused on system of systems (SoS) projects, which are recognised as complex in a hierarchy of simple, complicated, and complex. Three types of complex systems are proposed: traditional SoS projects, such as defence or air transport, in which a developing project incorporates an existing independent asset; SoS projects which address wicked problems and hence require use of soft system methods to determine stakeholders, boundaries and a solution process; and, integration of assets, such as states or enterprises into an encompassing system. Context, leadership and personal style types suitable for each are proposed. Some tools are referenced. Soft system methods to explore solutions to wicked problems are outlined.

Introduction
While traditional projects have had available various bodies of knowledge to assist planning and execution, including the PMBOK® Guide (PMI 2008), IPMA’s Competence Baseline, ISO 21500, APM (2006), PRINCE2TM (2009) and the Japanese RUP (IPMA 2004), complex projects do not yet have a BOK to guide their development. This has been under development since September 2009 by several dozen contributors and reviewers, carefully chosen from the Systems engineering field including many members of the International Council on Systems Engineering (INCOSE).

There are many relevant research papers to assist practitioners and researchers and these include Gorod, Sauser and Boardman, 2008, Sauser, Boardman E. Gorod, 2009, Keating et al. (2003), Firesmith (2010), Bar-Yam (2003, 2004) and White (2008), and other references in this paper. Furthermore, all of these bodies of knowledge have a reductionist flavour and none explicitly recognise SoS projects. Furthermore, even more complex projects than the ‘traditional’ SoSs, such as addressing terrorism, international disputes, and climate change, which require a soft system methodology to identify stakeholders, boundaries and possible solutions, are not addressed in a BOK. This seems remarkable since there is an International Journal of System of Systems Engineering (IJSE).

This paper recognises a hierarchy of Simple, Complicated and Complex projects and explores three types of complex projects, these being:
- Traditional SoS projects in which there is inclusion of an existing system into a new project, the existing system being independent and autonomous (Type A complexity);
- SoS projects which require systems thinking to determine stakeholders, project boundaries, and soft systems methods of Checkland or Systems Dynamics to develop a potential solution (Type B);
- Integration of independent assets into a larger system (for example a corporation or a food supply) into a system in order to reduce waste (Type C).

Understanding System of Systems projects
It is now recognised that a new form of projects has emerged, these being system of systems (SoSs), which are complex projects (Types A–C). There is no satisfactory definition of complexity. Ashby (1956) pointed out that complex systems were self-organising. They are unpredictable and uncontrollable and cannot be described in any complete manner. However, there is a number of texts focusing on systems of systems as applied to projects. Jamshidi (2009), Aigner et al. (2010), and Braha et al. (2006) are a few. There are many relevant studies and papers with a number of annual conferences in a number of countries based on system of systems.

Lane and Valerdi (2010) define a SoS as ‘a very large system using a framework for architecture to integrate constituent elements, (which) exhibits emergent behaviour, with constituents systems; [they are] independently developed and managed, [with] new or existing systems in various stages of development/evolution, [they may] may include a significant number of COTS products, and their own purpose, and, can dynamically come and go from the SoS’.

Norman and Kuras (2006:209) provide an example of a SoS in which this independence and autonomy is described. The Air and Space Operations Centre (AOC) of the US, which provides tools to plan, task, and monitor all the operations in Afghanistan and Iraq, is composed of 80 elements of infrastructure including communication, battle network, engines, servers, and databases. The systems:
- Don’t share a common conceptual basis;
- Aren’t build for the same purpose, or used within specific AOC workflows;
- Don’t share and acquisition environment which pushes them to be stand-alone;
- Have no common control or management;
- Don’t share a common funding which can be directed to problems as required;
- Have many customers in which the AOC is not only one:
  - Evolve at different rates subject to different pressures and needs;

SoSs have been further described as having:
1. Operational Independence of the Individual Systems;
2. Managerial Independence of the Individual Systems;
3. Geographic Distribution
4. Emergent behavior

In the authors’ view the issue of inclusion of autonomous and independent systems is a technical aspect because this requires significantly different methods of management. Heylighen (2002) points out that complex projects are self-organising.

Categorisation of simple, complicated and complex projects
Categorisation processes
Addressing SoSs is assisted by developing granularity in describing complexity. Snowden and Boone (2007) take-up the classification of systems into categories of simple, complicated, and chaotic. This is used by Glouberman and Zimmerman (2012) as well in the classification of health care systems. Tools for distinguishing complicated and complex projects are provided by Cotsafis (2007). The test to identify whether it is a complicated or complex project depends on whether the system can be explained by reduction (ie there are equations, or obvious hierarchical relationships between the system and its components).

Abstract

This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2011 World Congress.

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Dr. Brian E. White
Dr. S. Jimmy Gandhi
Dr. Brian Sauser
Australia
Complicated and complex projects are separated by the following test:
1. Identify the degrees of freedom in the system (the number of variables or parameters, interdependence).
2. Decide if it is simple or complicated – how many degrees of freedom are there?
3. Check the number of control tools and see how many control tools there are.

If the number of control tools is less than the number of degrees of freedom, the system is complex (Type A, B or C).

In reasonably ‘traditional’ SoS projects the goal in integrating the systems is to integrate the legacy system into the SoS (Norman and Kurz, 2008). Such as SoS is labelled Complex system Type A. Examples are:
- Gliberman & Zimmermann (2002) for health-care
- De laurentis for transport (Jomshidi, 2009: 520-541)
- Thiesen and Herder for infrastructure (Jomshidi, 2009: 257-274)
- Bhasin and Hiskens for electrical power systems (Jomshidi, 2009: 385-408)
- Bohmian for Defence (Jomshidi, 2009: 218-232)
- Wilber for air traffic (Jomshidi, 2009: 232-256)

Some more detailed examples of SoSs include:

New York Cabs The SoS is the overall cab service (Sauzer, Boardman and Gorod (2008)). Each operator conforms to each of the first four elements noted in section 2. The overall cab service maintains its integrity, if one of the operators exercises their autonomy by choosing not to participate in the service at a particular time the overall service is maintained by others stepping into the role.

Electricity power systems. An integrated electric power supply system is a more complex example of an SoS. Each generator and distribution system has the autonomy to be part of the system or not, and if one or more drop out of the system for any reason (eg assets-into-operation, software assurance)

The second method incorporates assumptions specification and assumptions rating in which case assumptions are categorised on the basis of least certain to most certain and least important to most important, thus allowing the more likely assumptions to be accepted.

Identification of stakeholders and addressing overlapping issues, with lack of clarity about purposes, context uncertainty about the environment and social constraints (Jackson, 2003:137). This will be discussed further as Type B Complexity.

Applying SoS tools to technical problems is a requirement of the participative and solution-based approaches. It recognises that in trying to grasp the whole system we invariably fall short and produce an abstracted view of the real system which can be used to inform policy and decision making.

Some tools are better suited to the analysis of type B SoS are:
- Systemic design (Boardman and Sauser, 2008)
- Incremental commitment (Boehm and Lane, 2003)
- Architecture (Doisy et al, 2009)
- Methodology and the Design Structure Matrix (Baldwin and Clark, 2004)
- Governance (Morris, Place & Smith, 2006)

The world’s major problems or projects:
There is a further aspect which leads to the conclusion that complex projects require a different approach to traditional projects. Projects such as terrorism, international disputes, the European debt crisis and control of illicit drugs, can be seen as wicked or messy problems and thus require a systems thinking approach (Jackson, 2003: 3).

This systems thinking approach initially distinguishes them from SoS Type A and we call this Type B.

Bar-Yam (2003) sees complex systems as:
- Those which have interdependent parts; the whole is more than the sum of the parts
- Systems that identify the system behaviour by just considering the parts separately
- Furthermore, there is an interplay of behaviour and multiple scales, and between this system and its environment (Korba & Hiskens, 2009)
Some examples of interactive behaviours challenging the management of SoS are noted by Bar-Yam include:
- Military operations in Iraq and Afghanistan: if the army does this, will the insurgents do X or Y, and what will the general population do?
- Reducing their harmful effects of climate change (if a carbon tax is imposed how will oil producers, and public users react?) Will users of oil change their use on the basis of what effect will have on overseas suppliers?
- Bar-Yam (2003:5) also points out that the military and intelligence communities have realised the benefits of networked and distributed control and information systems. However he comments that this form of approach fails when dealing with such systems. He is supported by Snowden and Boone (2007) and their work on the baleful effects of coalitions.
- Furthermore, Bar-Yam reports very significant losses, amounting to multi-trillions of dollars through treating complex projects as traditional command and control systems (Bar-Yam, 2004:224). Bar-Yam’s work is supported by Mihm and Loch (2006), De Rosa et al (2008) and White (2009). Jackson on complex tasks:
Complexity is defined by Jackson as a number of interconnected issues, with lack of clarity about purposes, context uncertainty about the environment and social constraints (Jackson, 2003:137). This will be discussed further as Type B Complexity.

Applying SoS tools to technical problems is a requirement of the participative and solution-based approaches. It recognises that in trying to grasp the whole system we invariably fall short and produce an abstracted view of the real system which can be used to inform policy and decision making.

Clarification of boundaries of a complex system:
Critical System Heuristics (CSH) focuses on the identification of overlapping interests for every move but strategic SoS decisions are made at high level (Mofath, 2003).

For a complete by DelRosa et al (2008) enable us to realise why complex projects cannot be managed as reductionist based projects, analyse the reductionist principles, because traditional projects have assumptions of:

Closed systems assumption - the assumption that the system is insulated from changes and disturbances outside the system;
Superpositionality - the assumption that we can decompose systems into parts and add each part together so that the whole is greater than the sum of the parts (jackson, 2003: 3);
Central or hierarchical control assumption - Traditional projects assume central control which is exercised through a contract between the principal and the general contractor and subsequently further contracts between the general contractor and subcontractors. In contrast, the complexity of enterprise systems overwhelms the ability of any one authority to control the whole (DeRosa et al, 2008:3);
Linear causation assumption - this assumption is that the enterprise behaviour as resulting from separable and linear chains of causes and effects (eg value chain, kill chain, etc) But in real complex systems causation and influence are networked, creating a web of positive and negative feedback loops that together create equilibrium (DeRosa et al, 2008:3);
Systemigram (Boardman and Sauser, 2008) Some more detailed examples of SoSs in Industry:

- De Rosset et al (2008) pick up the issues of a situation that the system is insulated from changes and disturbances outside the system;
- Superpositionality - the assumption that we can decompose systems into parts and add each part together so that the whole is greater than the sum of the parts (jackson, 2003: 3);
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- Linear causation assumption - this assumption is that the enterprise behaviour as resulting from separable and linear chains of causes and effects (eg value chain, kill chain, etc) But in real complex systems causation and influence are networked, creating a web of positive and negative feedback loops that together create equilibrium (DeRosa et al, 2008:3);
- Problem formulation on the basis of a bottom up process;
- Decisions taken as far down the hierarchy as is possible is there is expertise to resolve them;
- The use of experience to support judgement with no aspiration to replace it;
- The treatment of human elements as active subjects;
- Problem formulation on the basis of a bottom up process;
- Decisions taken on the basis of the system and its environment (Korba & Hiskens, 2009).
Ulrich identified twelve boundary questions in the ‘ought’ mode:
1. Who ought the client (beneficiary) of the system be?
2. What ought the purpose of the system be?
3. What ought the system’s measure of success be?
4. Who ought the decision maker be? (ie have power to change the System’s measures of success)
5. What components (resources and constraints) of the system ought to be controlled by the decision taker?
6. What resources and conditions ought to be part of the systems environment (ie NOT to be controlled by the system’s decision taker)?
7. Who ought to be involved as designer of the system?
8. What kind of expertise ought to flow into the design of the system?
9. Who ought to be the guarantor of the system’s measure of success?
10. Who ought to belong to the witness representation of those affected by the design of the system?
11. To what degree and in what way ought the affected system’s designed be with issues such as terrorism, managing climate change, addressing illegal drugs, disputes between countries which are traditional enemies, and others, require very different methods, primarily including the use of systems thinking methods, especially Checkland’s Soft Systems Methodology (SSM), to identify a potential solution (Jackson, 2003).

The first step is to understand the concept of different perspectives that are possible to draw out of the rich picture. The SSM process of development of a solution

Checkland’s (1981) basic process to address wicked problems is to use the seven step approach, which is called a soft system methodology (SSM), shown in figure 2.

Development of a solution

Checkland’s (1981) basic process to address wicked problems is to use the seven step approach, which is called a soft system methodology (SSM), shown in figure 2.

Van Haperen (2002) has developed a methodology that enables coherent development and definition of user requirements. Traditional system development and engineering methods are no longer sufficient and more qualitative methods and techniques need to be embraced. An evolutionary relationship exists between the methodologies and techniques used to define requirements, to design and develop the system and to assess its effectiveness. Wilson (1990) highlights that organisations, rather than dealing ‘with how to solve a problem, firstly should concern themselves with determining ‘what the problem is’. Worrill (2001) highlights that ‘adequate performance in complex, high-risk, tactical operations requires support by highly capable management’. Measuring performance, developing systems and conducting operational testing that cope with such complex conditions are a challenge. Hence, Complex Type B projects, dealing with issues such as terrorism, managing climate change, addressing illegal drugs, disputes between countries which are traditional enemies, and others, require very different methods, primarily including the use of systems thinking methods, especially Checkland’s Soft Systems Methodology (SSM), to identify a potential solution (Jackson, 2003).

The first step is to understand the concept of different perspectives that are possible to draw out of the rich picture. The SSM process of...
Some tools are suggested to assist project management.

Conclusions
It can be seen that it is possible to categorise projects into four types, these being simple, complicated, which can be developed in a reductionist manner, and a third type being complex projects, which can be broken up into three different types. Type A being a SoS such as defense, which include autonomous and independent systems, which are addressed by integration of independent system into the larger system of systems; and Type B which requires a soft system approach to define stakeholders, establish boundaries and develop a solution. Type B projects use Checkland’s soft system methods, or system dynamics, before a solution is developed in a similar manner to Type A projects. A third type of complexity, Type C is the integration of autonomous and independent assets, such as an enterprise or a state in a federation (for rivers or road systems) into a larger system, in order to reduce wastage and increase benefits.

Some tools are suggested to assist project management. Finally once a solution has been developed the project can then resort to traditional project management techniques for development and implementation.

<table>
<thead>
<tr>
<th>Complexity Type</th>
<th>Context</th>
<th>Leadership Style</th>
<th>Tools</th>
<th>Choice of staff</th>
<th>Project Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple</td>
<td>A local and small project.</td>
<td>Top down</td>
<td>Scope development, WBS, Scheduling</td>
<td>Likes clear instructions</td>
<td>Repair of ship, Building a house, Managing a marketing campaign</td>
</tr>
<tr>
<td>Complicated and reductionist</td>
<td>Cause and effect relationships discoverable but not immediately apparent, Expert diagnosis required, More than one right answer possible, Known unknowns, Fact-based management</td>
<td>Top down</td>
<td>Tools for simple projects PLUS, PMPBOK or IPMA ICB PLUS systems engineering tools for technology-based projects</td>
<td>Likes clear instructions</td>
<td>Design and produce a jet engine</td>
</tr>
<tr>
<td>Complex Type A</td>
<td>Flux and unpredictability, No right answers, emergent instructive patterns, Unknown unknowns, Many competing ideas, A need for creative and innovative ideas, Pattern-based leadership</td>
<td>Top down</td>
<td>Balancing internal context with external environment, Architecture development, Requirements management, Incremental commitment, Addressing unk unks, Developing modularity, Systemgram, Managing governance, Identifying patterns</td>
<td>Abstract reasoning, Business acumen, Comfortable with ambiguity, Emotional Intelligence, Systems thinking, Understanding perspectives Helmsman (2010)</td>
<td>Integration of healthcare systems, Airport traffic management, Infrastructure integration, Space exploration, Electrical power systems integration, Defence system integration, Commercial airline development.</td>
</tr>
<tr>
<td>Complex Type B</td>
<td>A wicked problem</td>
<td>Probe, sense and respond, Create environments and experiments that allow patterns to emerge, Increase levels of interaction and communication, Use methods that can help generate ideas, Open up discussion as through large group methods, Encourage dissent and diversity, and manage starting conditions and monitor for emergence (Snowden &amp; Boone 2007)</td>
<td>Type A tools but preceded by: - SAST - CSH - SSM - SD</td>
<td>Abstract reasoning, Business acumen, Comfortable with ambiguity, Emotional Intelligence, Systems thinking, Understanding perspectives Helmsman (2010)</td>
<td>Managing terrorism in Afghanistan, Managing multi-national integration for climate change, Managing international disputes, Solving the illicit drug problem.</td>
</tr>
<tr>
<td>Complex Type C</td>
<td>An attempt to reduce wastage</td>
<td>Not clear yet</td>
<td>Not clear yet</td>
<td>Business acumen, not territorial, opportunity focused</td>
<td>Integrating road and river systems between states Distributing food from rich countries to poor integrating transport systems.</td>
</tr>
</tbody>
</table>

Table 1. Aspects of project types

References
Eyes Wide Shut:
Expanding the view of portfolio management

This conceptual paper examines our existing world-view portfolio is defined as the management of that portfolio from that of project and new product development portfolios to other portfolios that exist in an organisation, as the asset portfolio, resource portfolio and ideas portfolio. Portfolios do not exist in isolation in an organisational context, but instead overlap and interact. This paper argues that there is a need to move another step higher, and examine the relationships between portfolios of projects and related activities across an organisation in order to optimise outcomes across the organisation. We propose the need for ‘enterprise portfolio management’ and suggest that this approach has the potential to improve organisational efficiency, and in the longer term could be a source of competitive advantage.

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Introduction
Project portfolio management (PPM) is an emerging aspect of business management that promotes and facilitates a holistic perspective to optimise benefits across the project portfolio. The goals of PPM are to align projects with strategy, maintain a balance of project types, and ensure that the project portfolio fits with resource capability so that the organization can sustain the maximum value from project investments (Cooper, Edgett, & Kleinschmidt, 2001; Read & Rollins, 2003). Some of the PPM concepts have their theoretical underpinnings in business finance (Markowitz, 1952; McFarlan, 1998; Kendall & Rolls, 2003) and the evolution of PPM approaches have been heavily influenced by the field of product development (Cooper, Edgett, & Kleinschmidt, 1999; Killen et al., 2008; Killen, Hunt, & Kleinschmidt, 2008).

The rise of PPM follows decades of improvements in project management skills and capabilities and may be considered the biggest leap in project management since the development of PERT or CPM (Levine, 2005). As the field of project management has matured, attention has shifted to multi-project management and techniques for each domain have a different focus and approach. In the longer term Muller (2003) suggests that ‘operations’ within an organisation are defined for the management of routine and continuous improve projects and a portfolio of projects might exist in an engineering or research and development division, as highlighted in Figure 1. While project portfolio management concepts are most commonly applied to the management of project portfolios in organisations, there are many other opportunities to apply portfolio management approaches to other sets of entities. Portfolio management concepts and approaches are being developed, applied and tailored to a wide range of project-focused areas including the information technology, and product development sectors (Killen, 2008; Buttrick, 2000; Center for Business Practices, 2004; Dye & Pennybacker, 2000; Killen & Rolls, 2003; Office of Government Commerce, 2003; Morris & Jamieson, 2004; Milosevic & Sivaranjani, 2006). In a limited fashion, portfolio management concepts are also being applied to other areas such as financial investments and corporate strategy (for example, the BCG matrix (Makka, 2001) and the BCG matrix for new product development activities to apply portfolio management tools and techniques could be extended and adopted by a much broader selection of organisational functions: the organisation’s pool of resources, and associated risks, resources and priorities (PMI, 2008). The focus of PPM is ensure efficient use of a common and shared pool of resources (International Project Management Association, 2008) and to ensure that the organisation’s strategic objectives are achieved (Office of Government Commerce, 2009).

Traditionally PPM discourse has focussed on the project portfolio as the primary unit of study. While there have been significant developments in portfolio and organisational studies at the project level, developments in organisational theory and associated studies still appear to be somewhat limited in their coverage and scope at the portfolio level. Project portfolios have found a home at the functional level in organisations, particularly in IT (McFarlan, 1998; Weil & Broadbent, 1998) where the portfolio consists of IT specific projects; and NPD (Cooper, Edgett, & Kleinschmidt, 1999) where the portfolio consists of new product development projects. Although the PPM (2008) definition of the project portfolio, however, there has been little or no discussion that identifies what form the ‘other work’ or project portfolio management concepts are not evident in the management of ‘operations’. Likewise there is only limited adoption of portfolio management concepts at the strategic business unit or corporate strategy levels in an organisation. The organisation has a unique set of possible portfolios of entities that could benefit from portfolio management applications and right to the commonly defined project
portfolios described above, an organisation could, for example, manage resources, assets or ideas from a portfolio perspective. Other types of organisational portfolios are also possible; however, for this discussion, the resource, asset and idea portfolio concepts will be discussed initially, followed by a discussion of the linkages between the portfolios.

We will start by examining the resource portfolio.

The Resource Portfolio

An organisation’s resources include all assets, capabilities, organisational processes, knowledge and knowhow and knowwhy controlled by an organisation to conceive and implement strategies that add speed and effectiveness (Barney, 1991). Extending this concept, Krebs (2009) suggests the notion of a resource portfolio, drawing the link between cross-organisational resource management and portfolio management approaches, with resource portfolio management being focused on managing the common pool of ‘talent’ in the organisation ensuring there is an available pool of resources to work on both current and future projects across the organisation.

Whilst the idea of resource management and forecasting is not a new concept in project management (for example, see Cleland & Ireland (2007) or Shefner & Dvir (2004)) or project portfolio management more broadly (Mikkola, 2001), the idea of a resource portfolio (as distinct from Barney’s (1991) resource-based view of the firm) remains somewhat poorly examined, with much of the discourse examine only human resources.

Traditionally, as part of a regular ongoing business process, both operational managers (for business as usual activity) and project managers (for project activity) forecast and define their financial and human resource requirements for projects, programs and other work (PMI, 2008), taking into account historical patterns, trends, aspects of capabilities of such resources. Taking a resource portfolio view, short, mid-term and long-term resource forecasts can be used to determine the desired future level of resources, across the organisation. These forecasts take into account not only periods of normal operations but also for peak periods of demand, based on project and operation work that has been prioritised and strategically-linked. When combined, an organisational resource demand profile can be developed.

These resource demands are fulfilled through the allocation of resources from the resource portfolio. In the language of demand management and strategy (Kendall & Rollins, 2003; Engwall & Jerbrandt, 2002), once the resource supply and demand forecast has been developed, decisions can be made as to whether portfolio workload is to be limited to the available resource supply, or whether additional resources are required to cover the deficit. Plans can then be made to develop or acquire the required types and level of human resources can be put in place, balancing supply and demand (Timmer & Cachon, 1994). Potentially, project portfolio selection techniques and models can be used for resource prioritisation and selection. This approach would enable the alignment of resources to the organisation’s strategies and priorities so that they are allocated to the business-critical projects and activities, rather than to a large number of small, low profile projects or low priority operational activities (Engwall & Jerbrandt, 2002). Using an enterprise portfolio management approach, resource prioritisation and planning can be done effectively across the entire resource pool.

Let us now examine the Asset Portfolio.

The Asset Portfolio

Traditionally, assets have been viewed as systems, buildings, equipment or other physical assets, practices and processes (American Association of Cost Engineers, 2006). Extending the traditional view, an asset portfolio would also be comprised of knowledge-based components, such as the pool of an organisation’s intellectual property. The resource portfolio is not an isolated entity, but interfaces with other portfolios in the organisation.

Krebs (2009) suggests a linear approach, resource portfolio and asset portfolio. New product development and maintenance / enhancement activities draw upon the required resources, assets or ideas from the resource portfolio and may draw resources away from other priority activities, jeopardising the ability of the organisation to achieve strategic objectives (Engwall & Jerbrandt, 2002). The asset portfolio will now be examined.

The Ideas Portfolio

The existence of an Ideas Portfolio draws on the concept of ideation and the ‘fuzzy-front end’ (Cooper, 2007) that is examined extensively in new product development literature (see Cooper, 2005). This portfolio is a systematic approach to transforming ideas into businesses opportunities by enriching the right ideas to maturation, ensuring the multiple ideas concepts. This approach helps organisations stimulate idea generation and choose which products should be given limited investment availability and limited resources (Cooper et al, 1999). The proposed approach suggests that ideas form the ‘fuzzy-front end’ of the new product development life and therefore the ideation occurs in a wide range of project environments. For example, new ideas are regularly generated for process, service delivery or operational improvements. Rather than using an ideas portfolio which needs only in the new product development portfolio and then into the project portfolio (Figure 2), there may be organisational benefits of a more holistic definition of an ideas portfolio that includes product, service and process ideas. Alternatively an organisation may manage several ideas portfolio (one for each area) or strategically select types of ideas is becoming increasingly difficult due to the blurring of the boundary between product, services and processes (Crandall & Crandall, 2008; Howells & Tether, 2004). Therefore we suggest that there may be benefits in implementing a holistic ideas portfolio that collects all types of ideas and interacts with other organisational portfolios so that each idea has the opportunity to be considered, prioritised, selected and actioned within the relevant domain.

Portfolio Interactions

The proposed holistic portfolio approach (Figure 5), links multiple organisational portfolios and focuses on ensuring that each portfolio maintains alignment with overarching organisational priorities. The approach operates at a plan-organisational level and within the context of the external environment, reflecting the dynamic nature of decision-making in response to environmental shifts.

The proposed approach illustrates how organisational priorities flow through to a range of organisational portfolios, such as the idea portfolio, NPD portfolio, project portfolio, resource portfolio and asset portfolio. These organisational priorities and the portfolios are not singular, linear or static, but are linked and dynamic in nature.
Interactions between portfolios are central to organisational processes. For example, in the idea portfolio raw ideas are conceived and pass through an idea generation, idea screening, idea refinement and idea selection. Valid ideas are prioritised and flagged for development at which point they flow through a Stage-Gate into the relevant portfolio such as the NPD portfolio (after Larsson (2007) and Cooper (2005)). Through the new product development or IT project processes, additional ideas may be conceived and may pass back into the idea Portfolio for screening. The idea portfolio, the NPD portfolio and the IT project portfolio all consume organisational resources (from the resource portfolio) and as such interact with the resource portfolio. The management of these linkages and interactions creates a high-level challenge. The traditional wisdom has suggested that projects be prioritised, however, project priorities may not align with resource priorities. If the resource portfolio lens is used to examine the situation, a different set of priorities and organisational strategies may become apparent. If the relative priorities amongst the various portfolios are not regularly reviewed then the application of PPM concepts is not likely to be effective. Our aim is to identify and promote practices to facilitate integration across multiple portfolios and to evolve the model over time to provide a framework that may assist managers to improve organisational performance and bridge the gaps between ‘projects and operations’.

**References**


Project Perspectives 2013

Michael Young

Michael Young is an award-winning project and program manager with significant experience managing high risk and complex projects in Australia and throughout the Asia-Pacific across many industry sectors including IT, transport and logistics, education and training, government and not-for-profit. Michael is a Certified Practicing Project Director. Fellow of the Australian Institute of Project Management (AIPM), is an AIPM endorsed assessor, certified Gateway Review team member and is currently leading the development of the Australian National Competency Standards for project portfolio management. He is a former national board member of AIPM and is currently completing his PhD. Michael currently chairs the AIPM Standards Committee, the AIPP Knowledge and Research Council and is also a member of the AIPM Professional Development Council and the National Project Reference Group for the development of vocational project management qualifications in Australia.

Michael’s research interests include project management competencies, organisational project delivery capabilities, strategy implementation and project portfolio management.

Dr Catherine P Killen

Catherine Killen is a leader in Project Portfolio Management (PPM) research. Catherine’s significant contributions to the field include the identification of PPM as a dynamic capability and the extension of PPM practice through exploration of new approaches - such as the use of network mapping to improve understanding of project interdependencies. Catherine joined UTC after 10+ year career in industry, she maintains strong links with industry and has convened a special interest group of 80 PPM professionals and researchers since 2005.

Catherine completed a PhD in Management on "Project portfolio management for product innovation in service and manufacturing industries" at the Macquarie Graduate School of Management, Sydney, in 2008. Her earlier degrees are in Engineering Management and Mechanical Engineering.

Dr Raymont Young

Dr Raymont Young is a fellow of Chartered Secretaries Australia, an Assistant Professor at the University of Canberra and an adjunct at the University of Sydney. Prior to academia he was a CEO within Fujitsu Australia and a management consultant with Deloitte. His research in project governance focuses on the interaction between project managers and stakeholders. His research has been published by Standards Australia and he is a major contributor to Australian and International Standards on the governance of IT and projects enabled by IT (AS8016, IS08350).

Project Perspectives 2013


Methods and Tools of Success Driven Project Management

Advanced project management methodology called Success Driven Project Management integrates scope, time, cost and risk management suggesting reliable tools for project planning and performance management. After brief step by step instructions on SDPM application we will discuss risk simulation approaches that may be used for setting reliable project targets, their strong and weak sides. SDPM suggests to use optimistic estimates for creating working plans and manage project time and cost buffers. In SDPM project buffer is the difference between target and scheduled values. During project execution buffer penetrations are estimated by analyzing success probability trends. Since success probability depends not only on project performance but also on changes in the project environment, it is necessary to consider project environment changes discussed in this paper. This model will be used for setting performance targets for project management team that include additional management reserves.

Step 4 – Set project sponsor targets

Management reserves for unknown unknowns are usually created basing on past performance data. When these data are missing or not reliable project sponsor targets are set using the same risk simulation model but with higher probability to be achieved (usually in 90–95% probability range). So project has a set of targets – tight targets for project team, reasonable targets for project management team that include sufficient contingency reserves, and more comfortable targets for project sponsor that include additional management reserves.

Step 5 – Estimate buffer penetrations

It is natural that project will be late to optimistic schedule and project/phase buffers will be penetrated in the process of project execution. It is necessary to be able to estimate if these buffers are still sufficient and if project performance was better or worse than expected. The natural way for estimating buffer penetrations is calculation of current probabilities to meet the targets. These new probabilities are higher than initial, project performance was better than expected though success probabilities depend not only on external factors. If project performance was perfect but new risks were identified, success probability may become lower because initial contingency reserves did not cover these new risks.

Step 6 – Analyze success probability trends

Current success probabilities show project status but project status information is not sufficient for decision making. Decision making should be based on the analysis of project trends. If the probability to meet project target is rising then cost buffer was consumed slower than expected, in other case project buffer was consumed too fast and project success is endangered. Management decisions shall be based on the trend analysis. Even if current status is good (success probability is high) but the trend is negative corrective actions shall be considered.

Success probability trends are the best integrated performance indicators – they take into account project risks, they depend not only on performance results but also on the project environment changes.

Figure 1. Accuracy and Precision

PDPM, Project Driven Project Management

This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2011 World Congress.

Introduction
Success Driven Project Management (SDPM) is project management and performance analysis methodology developed in Russia in 90s and since then successfully used in many projects, programs, and organizations in Russia, East Europe and Brazil. SDPM is supported by Russian PM software Spider Project but its basic approaches can be used with other PM software tools.

SDPM methodology has some common features with Critical Chain project management but there are also many differences as discussed in this paper.

SDPM Methodology Steps

Step 1 – Define integrated project success criterion

With multiple success criteria decision making is complicated – increasing one of them may decrease another. There is a need for some weighting factor that may be used for decision making. It is necessary to be able to measure overall benefits of projects and portfolios, to be able to compare options and to select the best management decisions. We suggest to set one integrated criterion of the project/portfolio success or failure. One of the potential approaches is to use money for measurement of everything. For example, defining the cost of one day for project acceleration and delay we will be able to estimate if it is profitable to pay more for faster performance and if project performance was successful if its finish was late but certain amount of money was saved.

Step 2 – Create optimistic project schedule model

Optimistic model is based on optimistic estimates of all project parameters and includes only most probable (with 90% probability or larger) risk events.

This model will be used for setting performance targets for project workforce. It is clear that optimistic targets will not be achieved but in any case performance targets shall not include contingency reserves or they will be lost (Parkinson Low).

Step 3 – Simulate risks and set reliable targets for project management team

Project management team shall have time and cost buffers for managing certain risks and uncertainties. Project or phase buffer is a difference between target value and the value for the same parameter in the optimistic schedule. Targets shall be set using risk simulation. These targets shall have reasonable probabilities to be met (usually in 70–80% probability range).

Project and phase targets and buffers may be created not only for integrated project success criterion but also for other parameters like project cost and duration, they can be set for the project as a whole and for certain project phases. Probabilities to meet project/phase targets are called success probabilities.

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SDPM Methodology Steps

Step 1 – Define integrated project success criterion

With multiple success criteria decision making is complicated – increasing one of them may decrease another. There is a need for some weighting factor that may be used for decision making. It is necessary to be able to measure overall benefits of projects and portfolios, to be able to compare options and to select the best management decisions. We suggest to set one integrated criterion of the project/portfolio success or failure. One of the potential approaches is to use money for measurement of everything. For example, defining the cost of one day for project acceleration and delay we will be able to estimate if it is profitable to pay more for faster performance and if project performance was successful if its finish was late but certain amount of money was saved.

Step 2 – Create optimistic project schedule model

Optimistic model is based on optimistic estimates of all project parameters and includes only most probable (with 90% probability or larger) risk events.

This model will be used for setting performance targets for project workforce. It is clear that optimistic targets will not be achieved but in any case performance targets shall not include contingency reserves or they will be lost (Parkinson Low).

Step 3 – Simulate risks and set reliable targets for project management team

Project management team shall have time and cost buffers for managing certain risks and uncertainties. Project or phase buffer is a difference between target value and the value for the same parameter in the optimistic schedule. Targets shall be set using risk simulation. These targets shall have reasonable probabilities to be met (usually in 70–80% probability range).

Project and phase targets and buffers may be created not only for integrated project success criterion but also for other parameters like project cost and duration, they can be set for the project as a whole and for certain project phases. Probabilities to meet project/phase targets are called success probabilities.

Step 4 – Set project sponsor targets

Management reserves for unknown unknowns are usually created basing on past performance data. When these data are missing or not reliable project sponsor targets are set using the same risk simulation model but with higher probability to be achieved (usually in 90–95% probability range).

So project has a set of targets – tight targets for project team, reasonable targets for project management team that include sufficient contingency reserves, and more comfortable targets for project sponsor that include additional management reserves.

Step 5 – Estimate buffer penetrations

It is natural that project will be late to optimistic schedule and project/phase buffers will be penetrated in the process of project execution. It is necessary to estimate if these buffers are still sufficient if project performance was better or worse than expected. The natural way for estimating buffer penetrations is calculation of current probabilities to meet the targets. If these new probabilities are higher than initial, project performance was better than expected though success probabilities depend not only on external factors. If project performance was perfect but new risks were identified, success probability may become lower because initial contingency reserves did not cover these new risks.

Step 6 – Analyze success probability trends

Current success probabilities show project status but project status information is not sufficient for decision making. Decision making shall be based on the analysis of project trends. If the probability to meet project target is rising then cost buffer was consumed slower than expected, in other case project buffer was consumed too fast and project success is endangered. Management decisions shall be based on the trend analysis. Even if current status is good (success probability is high) but the trend is negative corrective actions shall be considered.

Success probability trends are the best integrated performance indicators – they take into account project risks, they depend not only on performance results but also on the project environment changes.

Figure 1. Accuracy and Precision

PDPM, Project Driven Project Management

This is an updated and edited version of a paper that was first time published in the proceedings of IPMA 2011 World Congress.
Project buffers and Critical schedule

Target dates do not belong to any schedule. Usually they are between most probable and pessimistic dates. A set of target dates and costs for project phases (analogue of milestone schedule) is the real project baseline. But baseline schedule does not exist! It means that application of usual project performance measurement approaches (like Earned Value Analysis) is complicated. Without certain schedule and cost baselines it is impossible to calculate Planned and Earned Value. If we select some schedule (Optimistic or Most Probable) as the project management baseline the values of Performance Indices that are lower than 1 do not mean that project performance is worse than expected.

We recommend to use optimistic schedule for setting tasks for project work force and manage project contingency reserves. The schedule that is calculated backward from the target dates with most probable estimates of activity durations we call Critical schedule.

The difference between start and finish dates in current and critical schedules we call start and finish time buffers (contingency reserves). The difference between project (phase) cost that has defined probability to be met and optimistic cost of the same project (phase) we call budget. Tips and cost material buffers show contingency reserves not only for a project as a whole but also for any activity in the optimistic project schedule.

Project Performance Management

Project/Program/portfolio planners shall keep performance archives to be able to get trends at project/program/portfolio parameters. We recommend to manage projects, and portfolios basing on the analysis of performance trends:

- If some project is 5 days ahead of the baseline but one week ago it was 8 days and one month ago 20 days ahead of the baseline then some corrective action shall be considered.
- If the project is behind the schedule but the distance becomes smaller then project team improved project performance process and corrective actions are not necessary.

So trend analysis shows short term performance results and helps to make timely management decisions. Project management team usually analyses trends of main project parameters like duration, cost, and profit.

Earned Value Analysis is another method that is used for estimating program/project performance. But this method shall be used very carefully and only in combination with other methods because:
- the real situation may be distorted.
- project managers are motivated to do expensive jobs ASAP and low cost jobs ALAP.
- it does not consider if activities that were performed were critical or not.
- it does not consider project risks.

We consider success probability trends as the really integrated project performance indicators.

Success probabilities may change due to:
- Performance results
- Scope changes
- Cost changes
- Risk changes
- Resource changes

Thus success probability trends reflect not only project performance results but also what happens around the project.

Success probability is a measure of buffer penetration. If in the middle of the project half of the project buffer was consumed it does not mean that the project is performed as expected. If most risks were behind then success probability will become higher and it will tell us that project buffer consumption was lower than expected, if success probability went down then buffer consumption is too high and it is necessary to consider corrective actions.

Success probability trends may be used as the only information about project performance results. The team in situation sufficient for performance estimation and decision making.

We call Management by Trends methodology Success Driven Project Management.
Success probabilities depend on project performance, scope changes, risk changes.

Success Driven Project Management and Critical Chain Project Management
Both SDPM and CCPM suggest to set tight schedule for project work force and create and manage project time buffer. Both methods suggest to prioritize projects managing project portfolios. But there are also many differences described below.

Working Schedule
CCPM suggests to use 50% probability estimates for Critical Chain schedule development. But using 50% probable estimates means that activity duration estimates still include some reserves and these reserves will be lost due to Parkinson Law.

SDPM suggests to use optimistic estimates in the schedule that is used for project workforce management.

Project Buffers
CCPM suggests to estimate excessive contingency reserves that people added to most probable activity duration estimates, take them away, summarize and put in a dummy activity that is called Project Buffer and follows the last activity of the Critical Chain.

SDPM uses risk simulation for setting reliable targets and project time buffer is the difference between project optimistic and target finish dates. Project time buffer does not belong to any chain. Besides, SDPM suggests to set targets for project costs, materials, and integrated success criterion. Cost Buffers, Material Buffers and Project Success Criterion Buffer are managed together with Time Buffers.

Critical Chain Protection
CCPM suggests to create feeding buffers on activity paths that precede Critical Chain activities to protect Critical Chain. CCPM proposes that Critical Chain shall never change.

SDPM does not protect any chain – project schedule is regularly recalculated and risks analyzed. Change of Resource Critical Path during project execution is usual. Besides, Resource Critical Paths in optimistic, most probable and pessimistic schedules may be different.

Portfolio Planning
CCPM suggests to “pipeline” projects in the portfolio (to perform them one after another) to avoid multitasking.

SDPM suggests almost the same – always apply priorities to the portfolio projects when calculating portfolio schedule. But if resources are available they may be used in the projects with lower priorities. Besides there are special cases when multitasking is useful.

Buffer Penetration Estimation
CCPM does not suggest reliable quantitative methods for analyzing buffer penetrations. Suggested methods are qualitative. Dividing buffer into three zones (green, yellow, red) is one of them. Entering yellow zone means an alert, red zone penetration requires considering corrective actions.

SDPM estimates buffer penetrations by success probability trends. If the trend is negative then project buffer is consumed faster than expected. If in the middle of the project execution project buffer is half consumed it may mean excellent performance if most risks are behind and poor performance if most risks are ahead.

Conclusions
Success Driven Project Management is powerful methodology that provides project managers with reliable tools for integrated scope, time, cost and risk management. It includes risk planning and simulation for setting reliable project targets and selecting optimistic estimates for creating working schedules and budgets. The differences between target and scheduled finish dates, between target and optimistic project cost are called time and cost buffers.

SDPM suggests buffer penetration by calculating probabilities to meet set targets (success probabilities) and analyzing their trends. Negative trends show that buffer penetrations are larger than expected and corrective actions shall be considered.

Success probabilities depend on project performance, scope changes, risk changes. Success probability trends are perfect project performance indicators that supply management with reliable integrative estimates of project performance.

Reference List

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Project Management Methodologies: An Invitation for Research

Having existed for millennia, project management has attracted increasing research interest in the last three decades. In this time the details leading to project success have been researched extensively. Surprisingly little attention has been paid to the popular practice of establishing and employing structured collections of project management processes and best practices, usually in an attempt to enhance project effectiveness and increase the chances of project success, typically known as project management methodologies. This paper provides a review of extant research, identifies central emphases, and proposes a definition of the concept. Research aiming to improve the understanding of project management methodologies is crucial for practitioners as well as researchers operating in the field of project management: In addition to increasing the chances of project success and enhancing project effectiveness, an improved understanding of project management methodologies is likely to provide clues towards a formal theory of project management.

Introduction

Project management has become increasingly recognized since the 1950s through global efforts connected to the Apollo space program, the Concord aircraft, the English Channel tunnel and the Sydney Opera House (Morris & Haugh, 1987; Morris 1994; Packendorf, 1995; Bredillet, 2007). Many practical works, such as the PMBOK Guide (PMM, 2008) and the PRINCE2 (OGC, 2005), and research papers have been published to identify the factors leading to project success. Concurrently many organizations have been collecting project management processes and best practices and compiling them into structured collections known as project management methodologies. It appears these collections have, up to now, received very limited research: Papers mentioning project management methodologies usually leave the concept undefined, and few systematic approaches to the study of project management methodologies exist. In this paper, we provide an analysis of published research covering or relating to project management methodologies. This paper aims to increase interest in project management methodologies by reviewing extant research, identifying central emphases, and proposing a definition of the concept.

This paper describes an analysis of published research covering or relating to project management methodologies through questions: How much published project management methodology research exists? What emphases, if any, does this research have? Is it possible to propose a definition of the concept based on these materials? This paper is a part of a greater research endeavour into project management methodologies, theory of project management, and the connection between the two. This paper comprises three main sections: The first one provides a review of extant research covering or relating to project management methodologies, the second one identifies the central emphases, and the third one proposes a definition of the concept.

Method

This research method applied can be best described as a form of discourse analysis, focusing on extant papers covering or relating to project management methodologies, published in the English language in top-rated peer-reviewed research journals such as International Journal of Project Management, Project Management Journal, and International Journal of Managing Projects in Business. Discourse analysis, a method for examining language, is employed as it is well suited for scrutinizing texts on management study, and widely applied when studying management issues including professional and organizational identities, strategic sensemaking and institutional logics (The editors, 2010).

Results

Review of extant research relating to project management methodologies

Packendorf (1995) notes project management methodologies, such as PRINCE, have been set up by the public sector, such as government agencies, to control project budget, schedule and quality disasters. Laufer et al. (1996) identify principles project managers use in turbulent projects: Adjusting the project management methodology according to extant circumstances is a key component towards project success. Conroy and Soltan (1997) find contemporary project management tools un- able to provide sufficient decision-making and conflict-handling support, and devise a project management methodology for assisting project managers with multiple disciplines. Clarke (1999) finds structural project management methodologies a potential way to achieve significantly improved benefits from projects. White and Fortune (2002) analyse project practitioners’ experiences, and report PRINCE(2) the most common methodology. Crawford et al. (2003) describe government encouragement for employing formal project management methodologies, developed in a “hard” project environment, and in an effort to increase project effectiveness, and develop a “soft” system project management approach for integrating soft systems methods into project management methodologies. Investigating determinants for project manager communication, Müller (2013) refers to project management methodologies as credible collections of project management best practices. Penwyn and Grant (2003) note project practitioners often implement project management processes as well as integrated support processes to prepare project staff for implementing project effectively: “In general, companies should be working to es- tablish all project management processes as organizational standards. This … requires the development of formal, documented standards that are applied throughout the company …” (p. 9).

Crawford (2006) investigates organizational project management capability, and finds project management a recurring theme in the literature. Crawford describes a case organization realizing methodology variances between different sites: “The drive for all sites to employ the same methodology faces resistance and feelings some processes are unreasonable for certain projects and project managers: “A sense of tension between managers and employees and standardization and corporate pressure for performance, allied with project management methodology’s reluctance to follow process, emerges from the text” (p. 81).

Jaafari (2007) focuses on the health of large projects and programs often implement project management methodologies, noting sick projects and project managers: “A sense of tension between managers and employees and standardization and corporate pressure for performance, allied with project management methodology’s reluctance to follow process, emerges from the text” (p. 81).

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methodologies and standards, proceed in an organized manner. Hobbs and Aubry (2007) report statements such as “A PMD is an entity that develops and implements a standardized project management methodology” (p. 255). McHugh and Hogan (2010) recognize methodologies that comply with PMI standards and methodologies target enhancing project effectiveness and increasing the chances of project success. This belief is not widely agreed with, as individual tools and techniques are usually considered independent of methodology (Hobbs and Aubry, 2007).

Hobbs and Aubry (2008) note the dilemma between the desire to standardize processes and the need for project management flexibility. Studying centralised project management office contribution to virtual project team success, Curlee (2008) identifies organisational processes as critical project management methodologies, Pons (2008) identifies the stage-gate type project management methodologies suitable for managing uncertainty in project development projects, and notes the arguments some researchers make against project management methodologies in new product development projects, as well as the requests for more trial-and-error development, empirical, and co-operative methods.

Hill and Maaninen-Ossin (2008) advise against blind use of the PMBOK Guide (PMI, 2008) for reaching project targets: “The access to different tools and methods creates doubts as to whether the project is being planned and executed in a controllable manner. However, although the planning and the use of formal tools are useful, there will always be deviations that need to be managed” (Sjöberg & Høyer, 2009). McHugh and Hogan (2010) report client demand for a realistic methodology, usa king best practices, enhanced recruitment, and contracting possibilities the main drivers for an organisation to obtain benefits not available from employing them individually. Project management methodologies may include logic, structures, tools, techniques and methods outside the discrete processes in the methodology.

Discussion

This study identifies several papers covering or related to project management methodologies. Surprisingly, none of the focal papers scrutinize the concept, nor define it appropriately when interpreting it. Clearing the number of papers mentioning project management methodology related research has not been published. It is astonishing to find a concept, which is so popular among project management practitioners, and so widely considered to have the ability to cure many of the most persistent project management problems, to be so scarcely researched. Understanding the author of this paper was available to all relevant papers due to the wide variety of names employed, this situation results most likely from the divide between the practical and the theoretical fields of project management.

A number of secondary emphases emerge from this study. Standardization vs. flexibility, centralised vs. externalised, voluntary vs. involuntary use relate to strategies...
for increasing methodology effectiveness. Point of inflection and light methodology relate to optimizing methodology structures and contents on tactical level. The difference between methods and methodologies is defined by coherence of functions: Organizations may employ tools, techniques and methods to enhance project work, however, these must be systematic and coherent, be employed in a coordinated way, and reinforce one another in order for the resulting system to be considered a methodology.

Organizational fit and contingencies relates to the concept of contingency theory, according to which organizational structures and ways of working must fit organizational backgrounds and circumstances in order for the organization to operate effectively and succeed. This is exactly what project management methodologies are all about: Even a collection of recognized project management processes and best practices must be applied, as opposed to blindly followed, according to relevant backgrounds and circumstances. It is no surprise contingency management is recognized as a platform for a theory of project management (Bredillet, 2007; Artto and Kujala, 2008; Söderlund, 2010). It is very likely project management methodologies can offer clues for establishing such a theory.

The results of this study indicate insufficient research has been published regarding project management methodologies: Further research is necessary to enhance understanding and to explore the implications of this important concept. For practitioners this means increasing project effectiveness. The main issues which should be considered in future research include:

- Project management methodology logic, structures, dimensions and contents
- The connection between backgrounds and circumstances, methodologies and projects
- The connection between project management methodologies and theory
- The identified and accepted benefits of project management usage

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References


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**Next generation of Meeting Tools for Virtual Project Teams**

Advanced educational virtual project teams (I. www.apicollege.edu.au) work combining two-dimen-

sional (2D) tools like Adobe Connect, Google Group, Yahoo Group, and Skype. But to technologically

support virtual teams working on projects like risk assessment, product design and improvement,

benchmarking, best practices, or strategy planning, three dimensional (3D) meeting tools are needed

which benefit from technological specifics that only space (3D) provides. This paper analyses the lat-

est 3D-meeting tools (SecondLife, Google Lively, HiPiHi, etc.) and considers benefits and drawbacks.

3D-meeting tools offered by Alpine Executive Centre reveal strengths for: Setting priorities, resource

allocation, socializing and other outcomes relevant for virtual project teams having to manage inter-

active tasks like risk assessment, product improvement, strategy planning etc. Conclusion: Meetings

in 3D-virtual worlds have potential to be almost as effective as real world meetings. Drawbacks to

virtual meetings can be overcome with the right process, expert facilitation, and special 3D-meeting

tools (SecondLife, Google Lively, HiPiHi, etc.) and considers benefits and drawbacks. This paper analyses the lat-

est 3D-meeting tools (SecondLife, Google Lively, HiPiHi, etc.) and considers benefits and drawbacks.

3D-virtual worlds attract increasingly attention

Virtual 3D-worlds offer to many real-life

success factors and how these environments

might evolve — to brighten the future of dis-

dpersed project teams.

A selection of reviewed literature

**Potential of virtual worlds**

A yearly online research conducted by the Universities of Eindhoven/NL and Hong Kong

provides insight into virtual teams working on developments (IT, software related fields). This

online research produces reports that integrate

on an Asian, American and European perspective

(Contraxxi, A. Vogel, D. Benneilmans, T. van

Genuchten M., 2010). 3D-virtual worlds are

going far beyond kinky games or sexy pin ups.

The following current research questions il-

lustrate the potential of 3D-virtual worlds: How can dispersed units be better supported via

3D-virtual worlds? How do virtual worlds help to

interact with customers in an efficient fashion?

Education via virtual worlds flourish — yet how can differing needs of students, instructors and

sociability of meeting tools and 2nd

Figure 1. Due to 3D space it is obvious what you are invited to do. ‘Voting grid tool’ lets participants present via their ‘avatar’, soon to their own personal beaming ‘alter ego’ vote on multiple criteria by standing on the voting platform. Combined voting results are calculated and displayed instantly in real time.

Meeting tools in virtual worlds

Based on research results several improvements to the virtual world were

 incorporated. Based on an user interface, ‘structure of the meeting process’ and ‘collaboration’. Overall results indicate that providing space/3D is good for ‘brainstorming, idea organizing’ and ‘voting’. Personal feedback obtained during the virtual meetings also indicate positive at-

titude towards ‘3D-meeting tools’. The participants were receptive of the tools and expressed their interest to use them again for a range of purpos-

e (Molina Orrego 2008). Question: What kind of 3D-design do the favored meeting tools have? Will they work for virtual project teams too?

User profile

The potential benefits which 3D- virtual worlds offer to many real-life domains such as business, project management and education, attract

researchers and practitioners. Yet the values of virtual worlds cannot be realized without a sufficient number (1) of users. Results show that people are willing to install their personal

‘avatar’ (SecondLife) and enter virtual

worlds “because of three types of motivations: functional, experiential, and social. Comparative analysis by gender, age, education, and experi-

ence suggests that (1) female users are more inclined to do shopping, re-

searching, and exploring within virtual worlds, whereas male users are more concerned with using it. SecondLife for making money; (2) younger users are more likely to use virtual worlds for entertainment, while older users use it for creating and education; (3) relative to their counterparts, expe-

rienced users are more aware of the values of virtual worlds for creating, education, and commerce” (Zhou, Z.; Jin, K.; Vogel, D. E; Fang, Y., 2010).

Once artificial ‘avatars’ are overcome and natural beaming-technology (a tip-to-toe jumpsuit with electrodes or personal scanner device which transfers a real (!) representation of ‘alter ego’) is available, attraction of entering 3D-worlds may increase dramatically especially for virtual project

team members.

The effect of space (3D)

Having animated your ‘avatar’ (soon you will be able to beam your natural ‘alter ego’), the question now is: How does 3D, i.e. space, provided by vir-

tual worlds affect participants? How are particularly ‘3D meeting tools’ perceived by users? To what extent do users consider the 3D user interface easy to apply and understandable?

Introduction

Virtual 3D-worlds attract increasingly attention in non-gaming applications. SecondLife, Google Lively, HiPiHi, etc. are but a

few of the over many 3D-products and environ-

ments. At the same time, it looks like while many people try out some of these applications, not many people return regularly. Why? Because most virtual settings – be it 2D or 3D – still lack a

transformation, idea organizing and ‘voting’. Personal feedback obtained during the virtual meetings also indicate positive attitude towards ‘3D-meeting tools’. The participants were receptive of the tools and expressed their interest to use them again for a range of purposes (Molina Orrego 2008). Question: What kind of 3D-design do the favored meeting tools have? Will they work for virtual project teams too?

Meeting tools in virtual worlds

Based on research results several improvements to the virtual world were added. Three dimensional (3D) meet-

ing tools offer technological specifics that only space (3D) can provide. Following virtual offices, de-

signs 2010 for dispersed business units and project teams, reveal how 3D-virtual worlds can be exploited for virtual project teams. New features of the virtual worlds are at their best when they need no further explanation and provide instant understanding and familiar-

ity. Subsequently, screen shots from virtual worlds illustrate how virtual of-

fices providing meeting tools look like.

Method

This paper reviews a selection of current litera-

ture on doing real work in 2D- and 3D-virtual worlds. Aims is to build an understanding of suc-

cessful applications of 3D-virtuality, critical success factors and how these environments might evolve — to brighten the future of dis-

persed project teams.
These screen shots show that since 2010 “attendees of virtual project or business meetings have the opportunity to augment the existing co-presence benefits of 3D including voice for presentations and interviews” (Adams, 2010). Adding voice to your ‘alter ego’ participating in virtual meetings jumps the curve. The latest 3D-meeting tools enhance the feeling of ‘co-presence’ and ‘importance’ which virtual worlds once suffered. Finally they provide features that eliminate the negative impacts on ‘cohesion’, ‘performance’ and ‘satisfaction’.

Practice of project meetings in virtual worlds

Cruical question still is: Does business networking and socializing are an important aspect of meetings where participants get to know each other, share information and build trust.

Real-world project meeting planners regularly allocate specific times for networking and socializing. Research in progress (Adams, Nibreka G., or Seepen B., or Mulders R.) report that for business meetings people today enjoy the 3D-virtual world (T.. Alpine Executive Centre) more than other meeting platforms, including web-based shared workspaces and video conferencing. Participants entering the 3D-virtual executive centre benefit from the combination of thorough preparation, expert facilitation, appropriate tools and creative meeting processes.

Facilitating virtual project meetings

What are the roles and skills of an expert facilitator? Entering a virtual world equipped with the latest 3D-meeting tools does not by itself make for a successful project meeting. Although collaborating in a virtual environment saves 50% of labor hours and 90% of project time, this is only accomplished when skilled facilitation is provided. The same dynamics that influence ‘cohesion’, ‘performance’ and ‘satisfaction in a group can be even more prevalent in a virtual world meeting as it can be a highly interactive experience. It’s the facilitator’s job to help the group dynamics to become and remain positive throughout the meeting. Therefore some facilitation skills are required to make appropriate use of 3D-meeting tools. According to research (Veil C., Saunders S., Hunt A., Kayaglnah D. & Van Donna M., 2004) the facilitator should be able to: Conduct meetings with several tools: ‘brainstorming’, ‘idea organizing’, ‘decision making’ and ‘reinforce the project manager’s objectives concerning the outcome of the meeting. Inform participants precisely about what exactly is going on in the joint working process; Handle expectations and dynamics of large as well as small virtual groups; Identify key issues that are of interest to virtual project meetings; Use techniques for exploring issues, more in-depth such as by pointing out contradictions in arguments or supporting critical reflection on practice; etc.

Experience of project meetings in virtual worlds

Comparative research on collaborating in 3D-virtual worlds is prevalent. Can a project meeting in a virtual world be better than a project meeting in the real world? Yes, five reasons:

Convenience, Right People, Costs: Virtual meeting participants can simply take a break from their current tasks and connect with their colleagues there or do something else and what they are doing. This convenience not only saves a lot of money. It also can help to fit the diary of someone who travels spatially right in front of you, being dynamically updated as discussions continue (Adams, 2010). This sort of dynamic two-way interaction is not possible in the real-world, neither with a whiteboard nor a flipchart.

Process, Structure: A common problem with any meeting is a lack of structure, discipline and process. We all hear about meeting agendas not being followed or nonexistent, and of long-winded presentations. Project members often complain of decisions not made, or follow-up that never happens. “Although these complaints are not exclusive to the virtual world, they are a problem in the virtual world because virtual meetings typically require degree of direct facilitation.” It ensures the likelihood that a feasible structure is built into the virtual meeting of the project (Adams, 2010).

Mental Presence: Virtual-world meeting participants may be absent physically, but are more likely to be present mentally. A virtual-world meeting participants can be present physically but absent mentally. “When someone in a virtual-world meeting they have to stay engaged to know what’s happening. So unlike in the real world, where people involved at the same time” (Adams, 2010). The paradox is that the more participants can be immersed in the virtual meeting the more actively engaged they will be. It’s do the impossible: In the virtual world you can do things you can’t do in the real world. Avatars’ or ‘beamed after ego’s’ “convenient with each other and with objects, and objects can interact with ‘avatars’/‘alter ego’ and other objects. Imagine in the real world having an idea that you can identify on a physical object, then pass that object with your idea around for others to see and hold. In the virtual world you can sort those ideas physically into a collection of categories arranged so participants can walk around, move, sort, edit and comment on them. You can do that in the real world. Try to visualize a virtual-world meeting where you express your opinion on issues and see the results of your opinion and those of your colleagues displayed spatially right in front of you, being dynamically updated as discussions continue (Adams, 2010). This sort of dynamic two-way interaction is not possible in the real-world, neither with a whiteboard nor a flipchart.

Discussion

In agile context there is an urgent need to technologically support virtual teams working on projects like risk assessment, product design and improvement, benchmarking, best practices, or strategy planning. Technical solution is an executive centre benefit from technological specification on a physical object, then pass that object with your idea around for others to see and hold. In the virtual world you can sort those ideas physically into a collection of categories arranged so participants can walk around, move, sort, edit and comment on them. You can do that in the real world. Try to visualize a virtual-world meeting where you express your opinion on issues and see the results of your opinion and those of your colleagues displayed spatially right in front of you, being dynamically updated as discussions continue (Adams, 2010). This sort of dynamic two-way interaction is not possible in the real-world, neither with a whiteboard nor a flipchart.

Yet what are the drawbacks in virtual project meetings? And what are the remedies for remote project teams? According to the objectives from our literature research mentioned above this challenge is at present best met by meeting services offered by Alpine Executive Centre. It facilitates highly demanding work sessions of dispersed teams of your colleagues displayed as well-designed text-capturing tools and a linked database with report producing capabilities.

Figure 2. Again due to 3D/space it’s obvious what you are invited to do: Participants (at present via their ‘avatar’, but soon via their beamed ‘alter ego’) can brainstorm with a 3D-meeting tool in a virtual world.

Figure 4. How to support the feeling of ‘place’ and ‘co-presence’: Small groups of ‘avatars’ (soon beamed ‘alter ego’), can choose among differently designed virtual locations for meetings.

Figure 3. How to support the feeling of ‘presence’ and ‘importance’: Everyone – ‘avatar’ or soon beamed their ‘alter ego’ – actively engaged by using spatial (3D) meeting tools.
More Time – Travel Offsets: Accomplishing tasks in a virtual-world project meeting takes longer than a real-world meeting. This is because participants have to simultaneously manage many tasks that are not required in the real world. To keep up with proceedings in a virtual meeting, participants have to: Make their own contributions, read public and private text messages, and manage their own voice and camera view. However, it’s worth noting that time differentials are appreciably offset when you consider the amount of travel time that is eliminated from everyone’s schedule.

Limited Topics – One Subject: It is more difficult to accomplish everything you might like in one virtual project meeting as compared to a real-world project meeting. Drilling down to a decision may involve for example: surfacing issues, identifying causes, proposing solutions, prioritizing solutions, and assigning actions. To deal with drill-down scenarios like this in a virtual project meeting requires careful planning and execution so activities occur in manageable chunks. This is where well-designed meeting tools and expert facilitation play a big part in the success of virtual meetings.

Lost Importance – Point of Reference: One unfortunate drawback of virtual business or project meetings is that these meetings frequently lose their degree of importance and their impact becomes insignificant. Virtual project meetings frequently take on a persona of a temporary or ad hoc event and eventually get lost in a hazy repository of routine business activities. So it is important to promote the virtual project meeting as an ‘event remembered’, along with the ‘venue of choice’, a unique place in one’s mind.

Conclusion

Since 2010 meeting tools are offered to take advantage of the three dimensional potential of virtual worlds – including instant voice messaging via do-it-yourself-made ‘avatars’. This is accomplished by supporting the visualization of parallel contributions and by enabling the visualization of the meeting process. By making the 3D-interface of meeting tools understandable and easy to use, it is now possible to increase sociability and the feeling of co-presence, while actively engaging the participants in the meeting process. The space (3D) provided in virtual worlds improve the feeling of meeting at ‘a place’, where ‘everybody can see each other’. The interactive 3D-tools keep activities interesting and fun while helping to drive a manageable process with documented protocols that are instantly available to the dispersed project members. Working in this virtual group each action of a remote project member has a visible contributing effect on the results.

So meetings in virtual world have the potential to be almost as effective as real world meetings. Drawbacks to virtual meetings can be overcome with the right process, expert facilitation, and special 3D-meeting tools. Networking and socializing in handsonely designed 3D-virtual environments (‘scenic places like the Alps’) can work just as it can in the real world. To overcome the constraints of the artificial looks of ‘avatars’, a beam-to-technology is coming up for 2014. It may apply tip-to-toe jumpsuits with electrodes or personal scanner devices which transfers a representation of body and facial movements into the 3D-world. Thus you can beam your natural ‘alter ego’ into the 3D-world.

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Introduction
In this conceptual paper, the author explores one of the key themes of the International Project Management Association (IPMA) Congress – the Future. The project management profession has a longstanding legacy that allows us to reflect on the past so we can better envision what is yet to come. In this paper, the author examines the nature and historical role of project management, the forces that have defined the role of the project manager in society, and the challenges that lie beyond our immediate horizons. Stanley Kubrick provided images of inspirational projects that future project managers might one day deliver, while Ridley Scott gave us a far bleaker view of the failed legacy of project managers of the future.

An historical view of project management in human history
Homo Sapiens evolved over approximately two million years in Africa and then undertook an amazing journey over the last one hundred thousand years across Africa, Europe, the Americas and Australia (Lahr & Foley, 1998). Motivated by the search for food, and perhaps curiosity, Homo Sapiens ventured out of the security of Africa into an unknown landscape. Evolutionary forces allowed those who managed risk well to survive and procreate and to orchestrate larger and more complex undertakings. The Chinese and the Egyptians built complex civilisations thousands of years ago, and the Romans spread an empire across Europe and northern Africa. Columbus recognised the patterns of the winds on either side of the equator and risked everything on a project to cross the Atlantic and to forge a new route to the East Indies. His assumptions were correct, although he discovered the West Indies to his surprise – it pays to be flexible in defining key project objectives (“Christopher Columbus,” 2011). The outcome of that one project changed the pattern of trade routes across the world forever (Law, 1986).

Such undertakings have illustrated the evolution of what we now regard as project management. Key stakeholders have articulated or organisational (or national) goals and objectives, allocated responsibility for achieving those objectives to those with leadership and vision, allocated resources to facilitate the required change, developed new technologies to support the mission, identified and managed risk as best they could, and put in place an integrated strategy to see the project through to its conclusion. We are riding on the shoulders of thousands of leaders across the eons who have tested their instincts with little or no framework of knowledge, and either lived to tell the tale for the benefit of others, or disappeared without trace.

The more recent history of project management
Numerous authors (Fondahl, 1987; Snyder & Kline, 1987; Stretton, 1994; Uri  & Urtl, 2000;) have traced the more recent history of project management from its formalisation around the time leading up to World War 2, the development of sophisticated tools for better management of time, risk and costs, and the utilisation of computer technologies for improved performance and communications amongst stakeholders. Concepts such as project, program, portfolio and enterprise project management have raised the profile of project managers in the corporate world significantly to the point where senior job advertisements now commonly require some level of project management skills for executive positions across all sectors. There is an increased tendency towards organisational structures that embed dedicated project managers across organisations or within defined project management offices to secure organisational objectives (Faukner, 2002; Kwok & Bo, 2000).

Key skill sets have matured over the years from those that reflected a predominantly tools-focused role to one of coordinator and facilitator (Crawford, Pollock & England, 2006) with an emphasis on relationship management and strategic alignment. The focus has changed from the technical and quantitative processes to those more qualitative skills (Smith, 1999) that are seen as essential to achieve project outcomes. Project managers, who once mainly came from the quantitative sectors of engineering and construction, now come from a much wider range of sectors including business, health, education, science, information systems and research.

What will future projects look like?
What horizons do we adopt when we talk of the future? Using a cinematic perspective, do we look at the near future represented by Stanley Kubrick’s ‘2001: A Space Odyssey’ – a calendar date that has been and gone, but a scenario that has yet to pass? HAL has not quite taken over our future as Arthur Clarke might have thought but technology and ‘ubiquitous computing’ (Lyytinen & Yoo, 2002) continue to dominate the essence of future projects. In 2012” and the ‘The Day After Tomorrow’ (http://en.wikipedia.org/wiki/The_Day_After_Tomorrow) rapid climate change is the main challenge for future project managers. In ‘Blade Runner’, Phillip Dick provides a bleak view of the world where massive

Do we travel forward to a world envisaged by Stephen Spielberg in ‘A.I.’ where failed projects in artificial intelligence have changed the landscape of society and blurred the meaning of life and death.
projects have allowed those who can afford it to leave planet Earth to live in style and safety, with those who can’t inheriting the legacy of a failed social project of multiculturalism where non-human replicants are hunted down by blade runners? Or do we travel forward to a world envisaged by Stephen Spielberg in ‘A.I.’ where failed projects in artificial intelligence have altered the landscape of society and blurred the meaning of life and death.

What message is there for future project managers in such art forms? Authors of such stories will incorporate sound research into their premise, although artistic licence tends to exaggerate time lines and story outcomes tend to spin out of control for the sake of drama (http://www.msnbc.msn.com/id/5058474/ns/ us-news-environment/). However, key messages remain. The conflict between the rapid and inequitable consumption of finite resources and societal expectations of increasing standards of living will be a key challenge for projects in the near and distant future. Ethical and moral views on sustainability will place demands on the socioeconomic dimensions of future projects, requiring difficult choices and decisions to be made in terms of project evaluation. What is desirable? And what is acceptable, as standards of living inevitably fall where technology does not find ways to compensate for the diminishing availability of physical resources?

Where will future project managers come from?

Project managers will inevitably be caught in this ethical and social crossfire. Who will be the project managers of the future? Will project managers increasingly emerge from industry on a ‘learn as you go’ basis, or will the responsibility for the development of future project managers be placed with the tertiary education institutions? Will society demand a new breed of project managers with competence at levels expected of historically recognised professions such as medicine and law? Will society continue to tolerate the extent of project failure that is seen to be commonplace (Pinto & Mantel, 1996)? As educators, do we have a strategy for development of our would-be profession? I contend that at present, we don’t. We have a strategy for development of our ‘would-be profession’.

Project management as a future profession

The rights of project managers to regard themselves as part of a profession have been explored by numerous authors (Barber, 2001, p. 952; Curling, 1998; Mitra, 1999; Zweerman, 2000). Project management has often been called the ‘accidental profession’ (Stratton, 1994) and the ‘latest baby’ (Kipnis, 1991). Project management has historically moved from the status of an aspiring profession. Recognition of professional mastery has historically moved from early stages of basic awareness and sharing of ideas. Through such teaching and learning practices, consensus has been achieved in language, terminology, practices, values, and cultures which have become embedded in discrete disciplines and programs of study. ‘Second’-generation professions of architecture, engineering, nursing, account- ing, etc. have tried to model themselves on first-generation professions. Industry-based practices have evolved into theoretical frameworks through research and have now become the domain of universities and recognised undergraduate disciplines of study. There are valid reasons for university involvement in the development of professions, including objectivity, development of evidence-based practice (Tüysüz & Kahraman, 2006), and problem solving in situations of ethical dilemmas. Established and recent entrants to project management have attempted to jump over that stage and bolt on professional ‘wings’ that allow them to fly with the minimum of training and formal education. Jon Whitty has used a metaphor of project managers as non-human replicants are hunted down by blade runners. (Whitty, 2011) and this may be an apt example of its application – project managers who provide a colourful and noisy ‘flying’ show but with little real ability to fly.

An analysis of higher education for medicine reveals a comprehensive pattern of learning, moving from early stages of basic education (Booth, 1995). In project management, we have a fragmentation of training and education. Non-registered training organisations have carved out a space in the system for their professional education (CPE) courses. Registered training organisations (RTOs) and the Technical and Further Education (TAFE) sectors offer programs in project management. The Australian Qualifications Framework (AQF) (http://www.aqf.edu.au/standardsforprojectmanagement/standardsforprojectmanagement.aspx) and earns considerable revenue from the providers of training. The AQF has no alignment with any qualifications framework (such as the AQF). In the case of both APM and PMI, certification is unrelated to any requirement for membership of that body, which is a significant anomaly.

The future of project management education

There is limited control of providers of education and training in spite of national quality control authorities in both sectors. There is little consistency across the training programs employed by registered training organisations (RTOs), and there is inconsistency and duplication across the university sector in development of project management programs. The new Australian Qualifications Framework (Australian Qualifications Framework Advisory Board, 2011) will not eliminate through disciplining the requirements of graduate (and postgraduate) qualifications and the lack of guidelines on exemptions for work experience as credits into tertiary study.

Competencies that will be the key to future successful projects relate more to generic attributes and ‘softer’ skills, as these are essential in the articulation of project outcomes to meet the needs of disparate stakeholders. Such project managers will not depend on high levels of skill in the use of traditional tools— they will depend on a significant amount of time in the workplace. This is offset to some extent by the increasing adoption of ‘work integrated learning’ (WIL) (Origel, 2004) in university programs, and this should be expanded significantly to capture workplace experience.

Similar industries are concluding that an undergraduate degree is a clear indicator of an aspiring profession. The Financial Planning Association has recently committed to a minimum entry requirement for professional recognition as a Personal Financial Planner of an appropriate Bachelor’s degree (http://www.fpa.asn.au/default.asp?action=article&ID=21638). Educators in the area of project management must put aside their competitive tendencies and share practices and resources to ensure that future graduates meet the expectations of all stakeholders. Where is the ‘International Project Management Education Council’ or its equivalent? It does not exist yet but it should. At this stage, the profession of project management has multiple competency frameworks developed by multiple organisations. The APM developed the Australian National Competency Standards for Project Management (NCSPM) (http://www.apm.com.au/html/pcspm.cfm) in the 1990s and these have been revised over the years. The PMI has published the Project...
Project managers of the future will find it increasingly more difficult to access education and training due to workplace constraints. The need will be for more flexible learning opportunities but what is ‘flexible’ in pedagogical terms (Laurillard & Margetson, 1997; Moran & Mathews, 2008). Synergies are largely untapped in terms of the multiple cohorts of project management students across the world, who could undertake learning activities in team-based environments to cater for the needs of our future project managers.

Unfortunately, there is considerable waste and duplication in the development of learning resources, most of which already utilise a common industry framework such as the Guide to the Project Management Body of Knowledge (PMBOK) (Project Management Institute, 2008). Synergies are largely untapped in terms of the multiple cohorts of project management students across the world, who could undertake learning activities in team-based environments to cater for the needs of our future project managers.

List of references


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Dr Jonathan Whitty?feature=sub_widget_1

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Conclusion

This paper commenced with a reflective view of the evolution of project management – the drivers, the practitioners, the stakeholders and the outcomes, with projects progressively contributing to a cumulative body of knowledge. This platform provided the basis for development of project management practices and processes that have become formalised in contemporary methodologies. A view over the horizon has highlighted the changing nature of projects resulting from social and economic pressures and rapid technological advancement. These changes will impact on the profile of future project managers who will come from different backgrounds, have different attributes, demand more extensive education and training, and require different professional skill sets to manage the complexity and scope of future projects. Social and professional expectations will place greater demands on higher education to provide appropriate teaching and learning environments to cater for the needs of our future project managers.
A Universal Management Mode for Permanent Organizations Based on Management by Projects

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Based on the assumption of regarding “goals, tasks and resources” as three core elements of organizational management and the perspective of “Management by Projects (MBP)”, a universal management mode for permanent organizations based on MBP (MBP-mode) is presented through case study and empirical study. This paper establishes a conceptual model for the MBP-mode with project orientation and the highlight of sufficient utilization of management resources and external resources. In accordance with that, a structure of the management system based on MBP for permanent organizations and its basic construction elements is developed by using four-quadrant chart. A compound organizational structure based upon the improved matrix is further developed in this paper. In order to support the implementation of the management system based on MBP, this paper proposes five key mechanisms which focus on dealing with relations among goals, tasks and resources.

Introduction
A project is a temporary organization (Turner, 2006). In project practice, we are aware of the fact that project management usually can not achieve favourable results merely by the temporary organization itself. It calls for a broader management and supporting platform provided by the strategic level or the level of permanent organizations. What’s more, tasks (Maylor, 2006) in permanent organizations become projectized to deal with the rapid changing macro and micro environment characterized by diversity and uncertainty. However there is a lack of a project-oriented management system which can dynamically integrate organizational resources to better achieve project goals in permanent organizations so that they can thrive in the uncertain external environment. The MBP-mode presented in this paper is hereby to cope with the questions above mentioned.

A2: The major tasks of organizational management are to obtain and maintain favourable relationships between strategies and tasks, between strategies and resources, as well as between tasks and resources.

A3: There are two types of tasks in a permanent organization: projects and operations. The former is the key of organization development, characterized by a growing proportion of projects in it.

A4: There are two kinds of resources utilized in permanent organizations: internal resources and external resources, and external resources utilization now act as a growing important mean for expanding rapidly, coping with changes and reducing risk. Organizational resources can be separated into two parts: technology resources and management resources, and management resources have become a significant component of the organizational core competitiveness.

Research methodology
The MBP-mode is presented as a universal management application system framework in this paper. Experimental Research is applied into the research of such a model which stands upon the methodology “coming from the practice and tested by the practice”. The research process lasts for nine years by following certain methodological route (Figure 1).

This study intends to build up a universal management mode for permanent organizations from the perspective of MBP (MBP-mode). And thus we firstly categorize permanent organizations from the light of tasks into three types: operation-based (not accounted in this study, since projects have been well acknowledged as an essential part in organizations), hybrid tasks-based and project-based, in order to analyze the commonality among all types of organizations. And then this study conducted several case studies on different type of organizations to answer the two questions: what permanent organizations need to do to support the application of project management methods, and how to establish a comprehensive and efficient management system for project-based organizations. This research then conducted literature study incorporating operation management, organizational project management, PBOs, PMOs, change management, programme management and portfolio management etc to discover the common features of permanent organizations and the theoretical and practical system frame of the MBP-mode. This research further conducted expert interviews with more than 800 business management and project management professionals to receive more professional suggestions to improve the MBP-mode. Empirical study of several R&D institutes and public sectors were then conducted to testify the validity and applicability of the MBP-mode.

Conceptual model
Assumptions are the logic starting point, independent perspective or the fundamental theoretical premises on which some certain theory or method framework is built. Based on the definition of “management” and common characteristics of organizational management, some researchers talked about the effectiveness of programme management and portfolio management in organizational project management (Payne, 1998; Lycett, 2004). Some other researches focus on the role of project management capability in organizational project management (Crawford, 2005; Igeley, 2007). Above all, it’s not hard to observe that researches abovementioned are basically conducted from certain facet of organizational project management or specific field of organizations such as PMOs, PBOs etc, while they don’t give out a whole picture to deal with organizational project management. Therefore, this paper intends to develop a systematic management framework (the MBP-mode) for all kinds of permanent organizations.

B1: Goals, tasks and resources are the three core elements of organizational management.

B2: The major tasks of organizational management are to obtain and maintain favourable relationships between strategies and tasks, between strategies and resources, as well as between tasks and resources.

B3: There are two kinds of tasks in a permanent organization: projects and operations.

B4: There are two kinds of resources utilized in permanent organizations: internal resources and external resources, and external resources utilization now act as a growing important mean for expanding rapidly, coping with changes and reducing risk. Organizational resources can be separated into two parts: technology resources and management resources, and management resources have become a significant component of the organizational core competitiveness.

Figure 1. Methodological route for the research of the MBP-mode

Classification research for permanent organizations
Research on how to apply project management methods to single project in mixed-tasks organization
Research on how to establish the management system based on MBP for project-based organizations
Development of the universal management mode based on MBP
Application of the universal management mode based on MBP
Expert interviews

Figure 2. Relationships among three core elements of organizational management

Goals
Tasks
Resources
K1: Because of the diversity of tasks in permanent organizations, the organizational structure based on the improved matrix is developed. Such management system incorporates four sub-systems, the basic construction elements of each of which briefly explained on the following:

1. Single project management sub-system - Projects with similar characteristics of management can be put into one category, for each of which the corresponding management system is developed. According to the unique characteristics of the specific project, the applicable project management plan can be further formed through refinement of the corresponding management system.

2. Multi-projects management sub-system - The multi-projects management system can be used within organizations in which two or more projects simultaneously exist. Such management system concerns about the relationship among projects and how to build up the body of project management capability improvement from the perspective of supporting all projects inside the organization.

3. Partnership management sub-system - Partnership management sub-system is defined as the one which deals with the issues from stakeholders outside.

K2: A project is defined as a temporary organization and the thought of MBP acts as the dominant role in permanent organizations.

K3: Strategic goals are realized by the implementation of projects, and the management system of permanent organizations is project-centered or project-oriented.

K4: Temporary organization units such as project organizations are of great importance to enhance organization flexibility. Permanent organization units and temporary organization units bring out the best in each other.

K5: Management and project management, which are merging together, act as the backbones of organizational management in the model. Project management, programme management, and portfolio management are the core methods of organizational management.

Management systems
A good management system is the guarantee to achieve organizational goals. Based upon the assumptions of three core elements and the thought of MBP by introducing the form of BCG Matrix which depicts “task” as the vertical axis and “resource” as the horizontal axis, this paper presents the structure of management system based on MBP. Management system is developed by understanding the basic characteristics of organizational management elements and the growing concern of strategy mechanisms. The conceptual model contains 5 key points (K) as follow:

- K1: the management system based on MBP comprises management thoughts, management organizations, management methods, management mechanisms, and management processes.
- K2: a project is defined as a temporary organization, and the thought of MBP acts as the dominant role in permanent organizations.
- K3: strategic goals are realized by the implementation of projects, and the management system of permanent organizations is project-centered or project-oriented.
- K4: temporary organization units such as project organizations are of great importance to enhance organization flexibility. Permanent organization units and temporary organization units bring out the best in each other.
- K5: management and project management, which are merging together, act as the backbones of organizational management in the model. Project management, programme management, and portfolio management are the core methods of organizational management.

A management model can be viewed as a system which consists of management thoughts, management organizations, management methods, management tools. In accordance with the assumptions abovementioned, this paper constructs a conceptual model (see figure 3) of the MBP-mode by understanding the basic characteristics of organizational management elements and the growing concern of strategy mechanisms. The conceptual model contains 5 key points (K) as follow:

- K1: the management system based on MBP comprises management thoughts, management organizations, management methods, management mechanisms, and management processes.
- K2: a project is defined as a temporary organization, and the thought of MBP acts as the dominant role in permanent organizations.
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Such management system incorporates four sub-systems, the basic construction elements of each of which briefly explained on the following:

1. Single project management sub-system - Projects with similar characteristics of management can be put into one category, for each of which the corresponding management system is developed. According to the unique characteristics of the specific project, the applicable project management plan can be further formed through refinement of the corresponding management system.

2. Multi-projects management sub-system - The multi-projects management system can be used within organizations in which two or more projects simultaneously exist. Such management system concerns about the relationship among projects and how to build up the body of project management capability improvement from the perspective of supporting all projects inside the organization.

3. Partnership management sub-system - Partnership management sub-system is defined as the one which deals with the issues from stakeholders outside.

Concerns how to establish the external resources network in light of strategies, how to maintain a favourable relationship among partners, and how to select appropriate partners and effectively manage the cooperation.

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requirements of strategy development by constructing reliable external resources networks for organizations and integrating internal and external resources to attain the projects goals. Primarily pointed at developing the strategic planning system for organizational resources, the internal resources allocation mechanism and the external resources integration mechanism.

M3: Communication and Knowledge Accumulation Mechanism aims at creating an open, convenient as well as effective environment for information flow and consolidating knowledge accumulation in order to successfully address the relationship between the temporary nature of projects and the requirement over knowledge asset from permanent organizations, primarily pointed at developing the communication mechanism among stakeholders, management information system and knowledge accumulation mechanisms.

M4: Performance Appraisal and Motivated Mechanism aims at guiding organizational and individual behaviours and correctly inducing their working motivation through appraisals to sustain or correct their behaviour so that the requirements or strategic goals of both organizations and individuals can be realized. It mainly centres on establishing the corresponding appraisal system and motivation measures to support the implementation of the “MBP” thought.

M5: Project Management Capability Continual Improvement Mechanism focuses on constantly strengthening Project Management Capability, the core competitiveness of permanent organizations that see the MBP as their leading idea, which mainly aims at developing the Project Management Capability evaluation system and activation mechanism for capability improvement. The MBP-mode presented in this paper also serves as a reliable reference paradigm for the five mechanisms abovementioned.

Conclusions

On the basis of the assumption of three core elements in organizational management and the perspective of Management by Projects, the MBP-mode is developed through case study and empirical study. It has been attested by practices to be a valuable guideline to build up the management system based on MBP for permanent organizations (particularly project-based organizations and project-oriented organizations) in rapid changing environment. This paper provides project management with a new study perspective which starts on an organizational level. And by introducing the MBP-mode, it brings about a new clue for the study of organizational management.

References


Sustainable Beauty – achieving sustainability goals by fulfilling materialistic aspirations

Project production involves creation of original goods ranging from engineer-to-order ships and buildings to bespoke clothes and furniture. These goods fulfill the most sophisticated materialistic aspirations for unique goods that make personal statements about their owners. Established perspectives on project production can be found in, for example, International Project Management Journal (e.g. Yang, 2012) and the International Journal of Managing Projects in Business (e.g. Fox, et al., 2009). This paper introduces new perspectives on the environmental and economic potential of project production. These perspectives are possible because of innovative production technologies and new lifecycle strategies.

Challenges and opportunities in project production

Production challenges

Currently, project production of goods is carried out through the application of craft skills and engineering practices. In particular, smaller goods, such as clothing and jewellery, are created for individual customers by bespoke businesses, which use craft practices. Larger goods, such as homes and yachts, are created for individual customers by engineer-to-order (EtO) enterprises involving, for example, building architects or naval architects. In either case, the starting point is the incomplete and imprecise images envisaged by the individual customer in the mind’s eye. A project produced good is first seen in the mind’s eye of the individual who imagines its form and function. The good is not seen then as a complete and precise picture. Rather, it is seen as incomplete and imprecise mental images. Thus, when individual speaks of the goods that they envisage— they speak of their dreams. For example, individuals speak of their dream houses, and other goods, which they would have made for themselves if they had enough money. Typically, the individual customer’s requirements are elicited through multiple iterations of dialogues, measurements, sketches, models, etc., which lead to the definition of design information. These multiple iterations lead to a description of an original good that is uniquely meaningful for the individual customer. This is because the design information brings completeness and precision to what the individual customer has previously envisaged as an incomplete and imprecise conceptualization in the mind’s eye. As the design information is manufactured a physical good, through multiple iterations of shaping, fitting, and fixing, the individual customer experiences the tangible form of what is ‘first seen in the mind’s eye. Thus, bespoke businesses and EtO enterprises do not offer goods. Rather, they offer production services that enable individual customers to realize their personal dreams as original goods, which for them are especially beautiful.

By contrast, companies operating mass production or its derivative, mass customization, pre-design the sub-assemblies of the goods that they offer, and they pre-define all the possible configurations of those sub-assemblies. This pre-design and pre-definition of goods is aligned with what the marketing departments of mass companies define as the common attributes of millions of consumers. Then, mass companies communicate the range of their goods’ forms and functions to consumers through in-store displays, online configurators, etc.

Mass companies reduce the time and cost of creating goods by reducing reliance on human-to-human interactions and human skills. They achieve this through deployment of technologies that depend upon the pre-design of sub-assemblies and the pre-definition of their potential configurations; for example, shaping presses and assembly robotics. The high costs of these mass production technologies are then spread across mass sales. Consider, for example, the locate-to-order practices of mass car production. These involve automotive companies smoothing demand by making common types of family cars to forecast, and then storing those cars until orders are received for them. Subsequently, when a consumer is persuaded to buy one of the stored vehicles, it is located-to-order. Hence, while many cars were painted black at the beginning of the 20th Century, many cars are painted silver at the beginning of the 21st Century, and given other features which mass companies define to be the common denominators among masses of consumers (Agrawal et al., 2002).

By contrast, bespoke businesses and EtO enterprises rely on human skills and human interactions for the multiple iterations of dialogues, measurements, sketches, models, etc., that lead to definition of individual customer’s requirements. For example, an individual customer interacting with one or more skilled industrial designers; and then industrial designers interacting with one or more skilled production crafts persons. Subsequently, all of the costs of design and manufacture have to be borne by the price of the one original good that is created. Accordingly, technological innovations are needed that reduce the time and cost of creating goods, but that do not depend upon pre-design of sub-assemblies and the pre-definition of their potential configurations.

Sustainability opportunities

As summarized in Table 1, the differences between project produced goods and mass produced goods are not limited to their design and manufacture. They also include status and longevity. In particular, mass production drives throwaway consumerism by “instilling in the buyer the desire to own something a little newer, a little better, a little sooner than is necessary” (Stevens, 1954).

Throwaway consumerism is driven by mass companies through planned obsolescence: in particular, obsolescence of desirability and obsolescence of function. Obsolescence of desirability is imposed by mass marketing. This tells consumers over and over again that the goods they recently bought are no longer in fashion. Thus, if they want to have self-esteem and social standing, they must replace those goods with new goods. Hence, these throwaway goods have only extrinsic value for their owners. Obsolescence of function is imposed by introducing alternative types of goods, rather than offering parts, servicing, etc. to improve the functionality of existing goods. Living under the threat of obsolescence, billions of consumers are locked into an unsustainable cycle of buy – throwaway – buy again – throwaway again – and again and again and again.

This throwaway cycle is unsustainable because of the massive quantities of raw materials that are consumed in producing new goods. It is unsustainable because of the millions of tons of greenhouse gas emissions are pumped into the Earth’s atmosphere through endless cycles of extracting, transporting, and processing. It is unsustainable because of the vast quantities of throw-away goods that are pushed into landfill, piled onto scrapheaps, and dumped off-shore.

Unlike mass companies, bespoke businesses and engineer-to-order enterprises do not make goods that they intend to be thrown away as soon as possible. Rather, they create treasured possessions that their owners can value for decades. They can even become family heirlooms, and be valued by their owners’ subsequent generations. The goods are treasured because they are uniquely meaningful for their owners. This is because beauty is in the eye of the beholder; and their owners treasured because they are in their own minds’ eye. Then, they had input into every stage of their design and production. Hence, these goods have strong intrinsic value for their owners.

Importantly, project produced goods are a materialistic aspiration for many. This is be-

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Project produced goods</th>
<th>Mass produced goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td>Mind’s eye of individual customer</td>
<td>Brand holder’s marketing department</td>
</tr>
<tr>
<td>Design</td>
<td>Multiple iterations of dialogues, measurements, sketches, models</td>
<td>Pre-definition of components and pre-definition of their potential configurations</td>
</tr>
<tr>
<td>Manufacture</td>
<td>Unique shapings, fittings and fixings</td>
<td>Made-to-forecast and locate-to-order</td>
</tr>
<tr>
<td>Status</td>
<td>Treasured possession with intrinsic value</td>
<td>Throwaway good with extrinsic value</td>
</tr>
<tr>
<td>Longevity</td>
<td>Life of owner; even future generations</td>
<td>Planned obsolescence</td>
</tr>
</tbody>
</table>

Table 1. Project produced goods compared to mass produced goods
cause many consumers aspire to the lifestyles of the rich and famous as presented in celebrity magazines, etc (Robins, 2010). Yet, the rich and famous are not presented with mass consumer goods. Rather, their wealth enables them to have their own uniquely beautiful treasured possessions. These goods range from original jewelry, clothing and furniture to original boats and buildings, which are created through project production.

Project produced goods that are treasured for decades can make an important contribution to sustainability, because they can make an important contribution to reducing the materials consumption, greenhouse gases, and waste arising from throwaway consumerism. Until recently, however, the time consuming and labour intense processes involved in the design and manufacture of project produced goods has put them beyond the financial reach of many people. As described in the following paragraphs, this situation is now changing through the introduction of innovative technologies for project production.

Innovative project production technologies

Technological innovations are needed that reduce the time and cost of creating goods, but that do not depend on pre-design of sub-assemblies and the pre-definition of their potential configurations. Three such innovations are digital data capture technologies, generative computation, and digitally-driven manufacturing equipment.

Digital data capture technologies

Digital data capture technologies include digital pens. These enable rough sketches drawn on paper to be rapidly converted into digital computer models. Other digital data capture technologies include digital photograph cameras and digital video cameras. The data captured with these can be converted into digital computer models through photogrammetry. Alternatively, digital data capture technology is low cost scanners. These can be hand-held or table-mounted, and like digital cameras, enable ordinary people to make digital descriptions of physical objects as computer models. Together, these technologies enable ordinary people to make digital approximations of what they behold in the mind’s eye, for example, as roughly drawn adaptations of existing physical goods (Song et al., 2009).

Generative computation

Generative computation can then be applied to the digital computer models that represent rough approximations of what is in the mind’s eye. Generative computation can emulate what human designers/engineers do when they draw, erase, modify and/or move shapes such as lines and curves. Generative computation is already widely used in the design of unique buildings. Rough approximations of the form envisaged in the mind’s eye, such as physical models shaped from clay, etc., are scanned and converted into digital computer models. Generative computation then automates the evolution of an infinite variety of designs from the initial form. The individual customer chooses the particular design that provides the most complete and precise representation of what is been envisaged in the mind’s eye. The Bird’s Nest Stadium, created in Beijing for the 2008 Summer Olympics, is a notable example of the application of generative computation to an initial approximate representation of design intent. As well as generating unique aesthetic, generative computation yielded a design for the Bird’s Nest Stadium that met exacting criteria for production. The setting of criteria for generative computations, such as minimum material usage, can filter the number of design to be viewed by the individual customer to a practical number (Krish, 2011).

Importantly, generative computations can be carried out without the financial cost. For example, generative computation has been applied to the aesthetics of famous building architects, such as Frank Lloyd Wright, and famous product brands, such as Harley Davidson (Fox, 2011).

Digitally-driven manufacturing equipment

Generative design computations can be related to optimal combinations of manufacturing machinery and materials (Fox, 2011). This is because the generative computation creates an infinite variety of potential configurations. Three such innovations are digital data capture technologies, generative computation, and digitally-driven manufacturing equipment.

Three-dimensional (3D) data measuring devices, for example, replace manual measuring practices that employ tape measures, vernier gauges, etc. These traditional measuring practices often involve multiple iterations of fitting – finishing – fitting. This can be very time consuming. In contrast, the use of 3D data measuring devices can enable improved functionality and reduced human-to-human interactions. Goods can have removable components to enable improved functionality and reduced human-to-human interactions.

Combining technological innovations

As summarized in Table 2, together, digital data capture technologies, generative computation, and digitally-driven manufacturing equipment can radically reduce reliance on human-to-human interactions and human skills in the creation of goods that are first envisaged in the mind’s eye of their owners. In doing so, these technologies can enable a fundamental shift from mass production to mass imagining, and the scaling up of project production businesses.

Inexpensive digital data capture technologies, for example, replace manual measuring practices that employ tape measures, vernier gauges, etc. These traditional measuring practices often involve multiple iterations of fitting – finishing – fitting. This is inevitable because it is very time consuming. In contrast, the use of 3D data measuring devices can enable improved functionality and reduced human-to-human interactions. Goods can have removable components to enable improved functionality and reduced human-to-human interactions.

New lifecycle strategies for project production

Project production goods that are treasured for decades can make an important contribution to sustainability, because they can make an important contribution to reducing the materials consumption, greenhouse gases, and waste arising from throwaway consumerism. As described in the following paragraphs, sustainability can be further increased by the project production of goods involving the augmenting of standard assemblies and the upcycling of existing goods.

Augmenting standard assemblies

The lifecycle of mass manufactured goods can be extended by augmenting them with uniquely beautiful casings, housings, etc. The company, Bespoke Innovations, for example, makes uniquely beautiful casings, which calls fairs, for standard prosthetics (http://www.bespokeinnovations.com). These fairs are

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mass produced good</th>
<th>Project produced good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desirability</td>
<td>Obscurity of desirability is imposed mass marketing</td>
<td>Goods have intrinsic value because they originated in owner’s mind’s eye</td>
</tr>
<tr>
<td>Function</td>
<td>Obscurity function is imposed by continual introduction of whole new goods</td>
<td>Goods have removable components to enable improved functionality</td>
</tr>
</tbody>
</table>

Table 3. Addressing the planned obscurity of throwaway consumerism
Beauty

Goods are thrown away less often because they have intrinsic value and components that can be easily upgraded.

Table 4: Sustainable beauty from project-produced goods

<table>
<thead>
<tr>
<th>Innovation</th>
<th>Production technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable capture and realization of what is seen as beautiful in the mind’s eye of the individual customer</td>
<td></td>
</tr>
<tr>
<td>New lifestyle strategies</td>
<td></td>
</tr>
<tr>
<td>The augmenting and/or upcycling of assemblages / products enables each good to have its own original beauty</td>
<td></td>
</tr>
<tr>
<td>Augmenting and upcycling reduces the consumption of raw materials; generation of pollution; and volume of waste.</td>
<td></td>
</tr>
</tbody>
</table>

References


Dr Stephen Fox

Dr Stephen Fox is a Senior Scientist at VTT, the Technical Research Centre of Finland. He has 25 years’ experience in industry, and has published work in a range of scientific and professional periodicals including: APM Yearbook: International Journal of Managing Projects in Business; Journal of Manufacturing Technology Management.
Uncertainty Management in Projects - A New Perspective

This paper focuses on a Norwegian research project, called “Practical uncertainty management in a project owner’s perspective” – in short, the PUS-project. The PUS-project had 6 major industrial partners – from public and private sectors. Both qualitative and quantitative methods were associated with this collaborative project work. This paper describes some of the major results produced by the PUS-project. In this regard, this paper touches upon approaches, methods and practices related to managing uncertainty in projects. The PUS-project emphasised on the role of project owner and giving adequate consideration on opportunities, when it comes to managing uncertainty. This emphasis, which is not common in the project world, is discussed in this paper with relevant theories and practical examples. This paper also presents examples from the industry to highlight some of the benefits that the involved organisations obtained in collaboration with the PUS-project – a research project’s contribution to create value in the industry.

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Introduction

This paper focuses on a research project called “Practical uncertainty management in a project owner’s perspective” – in short, the PUS-project. The purpose of this paper is to describe some major contributions of this research project to create value in the industry and academia. In order to materialise this purpose, this paper has the following structure: The paper starts with a short description of the PUS-project. A brief description of methodology follows it. Then, some contributions of the PUS-project are described. Firstly, the topic of dealing with opportunities in uncertainty management in projects is discussed. This is one of the significant focus-areas of the PUS-project. And then, examples from the industries are presented to point out some concrete benefits that the involved organisations achieved in collaboration with the PUS-project. Contribution to academia is then briefly described. Finally, concluding remarks wind up the whole discussion.

The PUS-project

The PUS-project (2006–2010) had an ambition of focusing on leadership and culture connected to practical management of uncertainty in major public and private projects. Lot of work was done on the issue of uncertainty analysis both in Norway and abroad, and much of this kind of work was carried out in the early phase (“front loading”) of projects. But, there was less research on the issue of how to manage opportunities and threats in a project’s life cycle in a practical manner. Furthermore, there was not much research on what the project owner’s role should be with respect to management of uncertainty. PUS had an ambition to shed light on the owner’s role in uncertainty management throughout the project life cycle. The project had a keen interest in influencing large organisations’ thinking patterns and actions associated with identification and management of uncertainty elements in projects. The PUS-project collaborated with the Research Council of Norway and the Norwegian Centre of Project Management (NSP). The main industrial partners (both from public and private sectors) of the project were:

1. Statoil (an international energy company with operations in 34 countries, headquartered in Norway).
3. Telenor (one of the world’s largest mobile operators with 332 million employees worldwide, headquartered in Norway).
4. Norwegian Armed Forces.
6. Norwegian National Rail Administration.

Apart from these main industrial partners, other Norwegian organisations were also involved in the PUS-project. The project’s cost frame was approximately 4 million euro. This frame included spin-off projects and own efforts.

Methodology

Methodology that we mention here is a mode of cooperation that the PUS-project had with its industrial partners. During the cooperation, the PUS-project used both qualitative and quantitative research methods: (1) Questionnaire studies (2) Interviews (3) Document analysis (4) Action research.

During the project, two focus-seminars per year were conducted with the intention of anchoring plans, developing new models, procedures, routines, and transferring experiences between project managers and project owners in the involved organisations.

Focus on opportunities

When it comes to managing uncertainty in projects, there has been more focus on dealing with threats than with opportunities (Ward & Chapman, 2003). We believe that it is relevant and important to look at opportunities - the positive outcome of uncertainty management, because it can generate new benefits to projects / organisations.

A project can be seen as a system. The system is basically unstable and flexible at the start of the project, and it tries to achieve stability and order by the help of establishing objectives, sub-objectives and plans. This will reduce uncertainty of the system. And, the system becomes gradually more stable and controllable. Though the system becomes more controllable when it goes from the early phase to the execution phase, it becomes more rigid, and the flexibility with respect to changes and adopting new opportunities in later phases of the project therefore tends to diminish.

However, new opportunities can emerge at any time in a dynamic work environment. There can be new internal conditions (such as, higher level of competence, effective resources / work methods) and new external conditions (such as cooperation with new projects in the nearby area, which can lead the project to save money by, for instance, common procurement; new products in the market, which can lead the project to simplify its technical solutions) that the project did not consider when objectives and plans were established. If these conditions are exploited effectively, then the project can deliver the product / service with the predetermined quality at a lower cost, or quicker than previously expected. Active involvement, knowledge and authority are required from the management in order to materialize the benefits of opportunities.

Here are two examples that can illustrate that opportunities can appear / create during the course of projects:

- Project El1 Østfold – a road construction project – was assessed by quality assurance procedure (QA) and given a cost estimation of approximately 16.3 million euro. When the initial contracts came in, a new analysis showed that the project, with a low probability, would manage to keep itself within the predetermined frame of cost. The analysis showed that the cost forecast was approximately 176 million euro. The project carried out a process with the focus on finding potential opportunities that could reduce cost. In the course of a four-hour time, opportunities were found and they were used to reduce the cost more than approximately 20 million euro.

- Project R6 – Construction of 3 government buildings – was at the phase of developing keys and lock-systems that could deliver safe and secure solutions. This process originally included among other things, design / project engineering, purchase and installation. But, the project participants found out that there was another project that was going on primarily in connection with key and lock-systems in government buildings. Then, the project participants studied this project, and it was found that the other project took advantage of new lock-systems that were developed in the course of R6. The project participants then decided to cooperate with the other project, and in the course of it, they were able to save costs by using the new lock-systems that were developed in the other project. This saved approximately 300,000 euro.

Norwegian Public Roads Administration

Figure 1. Major industrial partners of the PUS-project

Statoil
PUS
Telenor
Norwegian Armed Forces
Norwegian Directorate of Public Construction and Property Management
Norwegian National Rail Administration
Norwegian Directorate of Public Construction and Property Management
Norwegian Directorate of Public Construction and Property Management

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Opportunities – 1st, 2nd and 3rd order consequences

Opportunities can be looked at with respect to different levels of consequences (see Figure 2). Opportunities can produce effects and benefits for stakeholders of a project. How an opportunity is viewed is dependent on the stakeholders; for example, a consequence of a project can be seen as positive by a stakeholder, while another stakeholder views the consequence negatively.

First order consequences emerge within the framework of the execution of a project and deliverance of the project’s result-objective. (Result-objective focuses on time, cost and quality). Opportunities are in this respect connected to achieving project’s result-objective: Opportunities in terms of cost: The project can deliver more at the cost that was previously determined, or with the predetermined quality at a lower cost.

- Opportunities in terms of time: The project can deliver a predetermined product/service quicker than planned, without increasing the cost and with the predetermined quality.
- Opportunities in terms of quality: The project can deliver a concept that is better than the one which was originally agreed upon, within the same frame of time and cost. Operational solutions can also be considered here; for example, a project can deliver a product/service according to the predetermined frame of time and cost, and the delivery is more flexible to operate.

The second order consequences are the effects that emerge after the project is completed. These effects include benefits to the organisations that have been involved in the project, i.e., access to new markets and technology, development of new knowledge and competence within the respective organisations.

The third order consequences are broader effects of the project on the society. Opportunities in this regard encompass establishing new organisations and services as the result of the completion of the project. An example in this regard is a construction project called Snowflake in the Finnmark region, Norway. When the construction project was completed and operations were begun, then the surrounding environment started to benefit from it; for instance, there were new work opportunities for the local people, day care facilities for children, and schools.

Table 1 shows examples of first, second and third order consequences.

Table 1. Examples of consequences

<table>
<thead>
<tr>
<th>Project</th>
<th>First order consequences (Result-objective)</th>
<th>Second order consequences (Effect-objective)</th>
<th>Third order consequences (Society-objective)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Opera house, Oslo</td>
<td>A modern building where opera shows can be arranged.</td>
<td>Having the possibility to apply the experience that the involved organisations gain in future projects.</td>
<td>- Tourism in Oslo / Norway</td>
</tr>
<tr>
<td>Constructing the highway E16, Døstfold</td>
<td>New, modern road</td>
<td>- Less accidents</td>
<td>- Town-development (Bjørnå)</td>
</tr>
</tbody>
</table>

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Table 1 shows examples of first, second and third order consequences.

Now, we shall use the description of the 3 orders of consequences (the 3 different objectives that are associated with projects) to illustrate the role of the project owner in handling opportunities in projects.

Cooperation between project managers and project owners

It is beneficial to have a broader perspective in managing projects. The broader perspective can be developed by establishing a good cooperation between project managers and project owners – with a strong involvement from project owners.

A project owner has rights to and is responsible for the project. Olsson, Johansen, Langlo, & Torp (2007) say:

“The beauty behind the concept of a project owner lies in the fact that a project owner has incentives for weighing costs against benefits for a project. Project owners are therefore expected to strive for project governance aimed at maximising the value from the project.”

The project manager focuses on achieving the result-objective of the project in accordance with the predefined time, cost and quality (1st order consequences), whereas the project owner focuses on ensuring the effect-objective as well as the society objective (2nd and 3rd order consequences).

Project managers and project owners traditionally deal with two types of information; project managers with detailed information (mainly projects’ internal conditions – operational), and project owners with general / high level information (mainly projects’ external conditions – tactical and strategic). Establishment of a common understanding by combining and studying these two types of information can lead the involved parties to identify / create opportunities effectively in projects.

However, cooperation between the project owner and the project manager is not always a problem-free affair. The project owner and the project manager can have varying understanding of opportunities: what opportunities are and how one can use them in order to improve result-objective, effect-objective and society-objective.

Though there are challenges with respect to communication and attitudes, companies take certain measures in order to tackle the challenges. A study in the Norwegian telecommunications sector (conducted by the PUS-project) points out that there are training programs in which project owners and project managers learn about their roles, responsibilities and what they expect from each other. After the training programs, project managers seem to notice improvement in project owners’ behaviour and in the collaboration. These training programs can be seen as arenas for reflecting on action and making sense of various situations.

Creative thinking

We see that there is a clear connection between creativity / innovation and the topic of opportunities in projects. It can be said that creative and innovative thinking can promote identifying and creating opportunities in projects. In this
Identifying and creating opportunities, materializing them and harvesting the benefits of them can also encourage innovative and creative thinking in organisations.

Brainstorming, scenario thinking and creation of artificial crises are some of the methods that can be used to promote creative thinking to identify and create opportunities in projects. These methods were applied by the organisations that have been involved in our research study on the topic of uncertainty in organisations. Identifying and creating opportunities, materializing them and harvesting the benefits of them can also encourage innovative and creative thinking in organisations (Ekambaram, Johansen, Jermstad, & Ólendal, 2010). We believe that the topic of opportunity in projects can influence creating opportunities, not as a condition that exclusively can be seen as a potential source of generating innovations and creativity; uncertainty can thus be transferred / transformed in order to make positive effects on wider organisational settings.

In the beginning of 2011, the SUS-project won Statsbygg’s innovation prize. A description that accompanied the prize says that the project has provided documentation of both threats and opportunities over time in projects, including effects and efforts related to them, and that the overview of uncertainty, provided by the documentation, give both project managers and project owners more confidence in executing their roles in managing uncertainty in projects.

Another industrial example is Telenor (from the private sector). Telenor developed a tool called “Health check” in collaboration with the PUS-project. The tool has 20 questions that can be used to check how project participants experience their work situations. The questions can be used in different phases of a project – as a kind of an early warning system. The tool is now available at the website of the Norwegian Centre of Project Management (http://www.nsp.ntnu.no/) to its members. Telenor indicated its willingness to continue the work, which had been started with the PUS-project, through its “risk forum” (PUS-project, 2011).

Contribution to academia

The PUS-project contributed to academia too. In this regard, 17 master degree theses and 11 student project theses were produced at the Norwegian University of Science and Technology (NTNU), Trondheim, Norway. Two doctoral theses were also connected to the PUS-project. Eleven journal articles and 22 conference articles were published during the 4-year period. The academic contribution was in collaboration with the industry.

Concluding remarks

In this paper, we have described some major contributions that the PUS-project made to the industry and academia in Norway. The PUS-project managed to create a positive culture that can promote effective and efficient uncertainty management in projects.
The rolling wave scheduling problem solved by the real options approach

This paper presents a methodology for the rolling wave scheduling. The methodology aims to manage the cost and risk of delay of the project by identifying the best schedule using the available information. The literature shows the absence of specific quantitative algorithms for the rolling wave scheduling problem since most of the approaches are merely qualitative. Therefore it is necessary to define and test a new methodology to evaluate the overall alternatives. This new approach first lists all the possible schedules than evaluate each schedule with a real option based optimization model. The methodology described has been implemented in Matlab, in order to perform the related sensitivity analysis. The results show how this approach is able to reduce both the expected cost and the variance respect to a not real option approach.

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Introduction
This paper presents a model for project re-planning using real options as a tool to value the information available to the Project Manager (PM). Traditional scheduling methods do not consider the possibility to include on the problem the information about uncertain events. This paper aims to fill this gap providing, describing and implementing a model able to consider the risks and the costs to hedge them. The application area of the model is the Rolling Wave Scheduling (RWS). For example, the project work is a for-profit project and the manager’s objective is to maximize profits in each time period. At each period, the manager decides whether to continue or stop the project at that time. The manager then has the option to continue the project with the goal of increasing the value of the project and reducing the risks associated with it. The model aims to determine the best schedule based on the available information at the time of evaluation. The model’s goal is to determine the risk of delay through the possible rescheduling of Work Package (WP) and “exercises of options” available for the PM. The model manages the execution risk on the project when it is quantifiable and when actions to reduce the risk considered are available.

Literature review
Even if most of the projects deal with RWS only few authors provides quantitative algorithms. The main contributions presented in this paper relays mainly on the following contributions:

(Russell, 2003) identifies the re-planning as a sequence of steps based on measuring actual cost and schedule and compare them with the budget values. The correlation between progress and costs is considered at single WP level. (Ipsilandis, 2007) is focused on the scope of project management developing the concept of timeboxes. He analyzes the scheduling of repetitive project with a linear programming model. The author proposes an optimization model to minimize an objective function which takes into consideration cost elements regarding the project’s duration, the idle time of resources, and the delivery time of the project’s units. The interesting aspect is the use of the algorithm in timeboxes and mathematical formulation of the problem of linear optimization. (Georgiannos, Mavridis, Ipsilandis, & Stamelos, 2008) propose, starting from the timeboxes, a scheduling algorithm using interactive real options approach. They identify the problem as a problem of scheduling multi-projects, in which the PM has two options: (1) to stop the project, (2) to continue the project. Real options derive from financial options, that is, they have a very strong theoretical development since the papers of (Black & Scholes, 1973) and (Merton, 1973). Such papers detail the theory of options, hedging instruments whose value depends on a certain underlying asset. Options are tools that give the right, not an obligation to perform or not an action (e.g. an investment like building a temporary roof, change a supplier, work on two shifts etc...) at a pre-determined price (strike price). There are several types of options; those used in this model are defined as call options which give their holder the right to buy the underlying security at a specified price.

Among the call options, the specific type of real options used in this model is the “deferred option”, i.e. it is expected that the PM has the ability to make an investment that can eliminate the negative event considered. The ability to exercise the option is held until the last possible moment, consistent with the theory of vanilla (European) call options. In that moment, if the value of this option is greater than the cost of its exercise, the option is exercised (hedging the risk), otherwise the PM take risk of the event.

It is hypothesized that there are means (i.e. options) to avoid the risk and the relative cost. For example, in case of risk of bad weather, it is assumed that it is possible to arrange a temporary roof and its cost. If the risk is a stroke it is possible to cover the risk with a wage reserve. There are three main clusters of algorithm to evaluate real options (Dixit & Pindyck, 1994): Black & Scholes Model, Simulation and Binomial Model. The model used in this work is the binomial.

Model description
The “time windows” is the interval of time (same days, or few weeks) of the project analyzed with the related risks/options to exercise in order to increase the value of the project.

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General overview
Figure 1 summarizes the method presented in this section.

Identification of WP
This phase lists the WPs included in the time window considered.

Identification of Feasible Schedules
The method (Matlab based) creates all the possible schedules. From a computation point of view this is the most time-consuming step. Since the method creates and evaluates all the possible schedules it could be defined as an “optimal enumerative algorithm”.

Identification of Feasible Schedules
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Parameters updating
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Compute the value of each option
Compute the value of the option respect to its cost
Project re-planning
Application of kernel algorithm
WP with feasible schedules
WP with infeasible schedules
Figure 1. Method

Start

Identification of WP included

First, the WP to be solved is analyzed. The WP is at risk of a problem described by probability and magnitude. Each WP and its related risks are inserted in the database. The WP is then inserted in the database.

Next, the WP is selected and the feasible schedules are generated. The feasible schedules are then evaluated using the evaluation algorithm.

Once the feasible schedules are evaluated, the optimal schedule is selected and the project is planned.

Finally, the project is planned and the selected optimal schedule is returned to the user.

The rolling wave scheduling problem solved by the real options approach

This paper presents a methodology for the rolling wave scheduling. The methodology aims to manage the cost and risk of delay of the project by identifying the best schedule using the available information. The literature shows the absence of specific quantitative algorithms for the rolling wave scheduling problem since most of the approaches are merely qualitative. Therefore it is necessary to define and test a new methodology to evaluate the overall alternatives. This new approach first lists all the possible schedules than evaluate each schedule with a real option based optimization model. The methodology described has been implemented in Matlab, in order to perform the related sensitivity analysis. The results show how this approach is able to reduce both the expected cost and the variance respect to a not real option approach.

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Introduction
This paper presents a model for project re-planning using real options as a tool to value the information available to the Project Manager (PM). Traditional scheduling methods do not consider the possibility to include on the problem the information about uncertain events. This paper aims to fill this gap providing, describing and implementing a model able to consider the risks and the costs to hedge them. The application area of the model is the Rolling Wave Scheduling (RWS). For example, the project work is a for-profit project and the manager’s objective is to maximize profits in each time period. At each period, the manager decides whether to continue or stop the project at that time. The manager then has the option to continue the project with the goal of increasing the value of the project and reducing the risks associated with it. The model aims to determine the best schedule based on the available information at the time of evaluation. The model’s goal is to determine the risk of delay through the possible rescheduling of Work Package (WP) and “exercises of options” available for the PM. The model manages the execution risk on the project when it is quantifiable and when actions to reduce the risk considered are available.

Literature review
Even if most of the projects deal with RWS only few authors provides quantitative algorithms. The main contributions presented in this paper relays mainly on the following contributions:

(Russell, 2003) identifies the re-planning as a sequence of steps based on measuring actual cost and schedule and compare them with the budget values. The correlation between progress and costs is considered at single WP level. (Ipsilandis, 2007) is focused on the scope of project management developing the concept of timeboxes. He analyzes the scheduling of repetitive project with a linear programming model multi-objective. The author proposes an optimization model to minimize an objective function which takes into consideration cost elements regarding the project’s duration, the idle time of resources, and the delivery time of the project’s units. The interesting aspect is the use of the algorithm in timeboxes and mathematical formulation of the problem of linear optimization. (Georgiannos, Mavridis, Ipsilandis, & Stamelos, 2008) propose, starting from the timeboxes, a scheduling algorithm using interactive real options approach. They identify the problem as a problem of scheduling multi-projects, in which the PM has two options: (1) to stop the project, (2) to continue the project. Real options derive from financial options, that is, they have a very strong theoretical development since the papers of (Black & Scholes, 1973) and (Merton, 1973). Such papers detail the theory of options, hedging instruments whose value depends on a certain underlying asset. Options are tools that give the right, not an obligation to perform or not an action (e.g. an investment like building a temporary roof, change a supplier, work on two shifts etc...) at a pre-determined price (strike price). There are several types of options; those used in this model are defined as call options which give their holder the right to buy the underlying security at a specified price.

Among the call options, the specific type of real options used in this model is the “deferred option”, i.e. it is expected that the PM has the ability to make an investment that can eliminate the negative event considered. The ability to exercise the option is held until the last possible moment, consistent with the theory of vanilla (European) call options. In that moment, if the value of this option is greater than the cost of its exercise, the option is exercised (hedging the risk), otherwise the PM take risk of the event.

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Compute the value of the option respect to its cost
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Once the feasible schedules are evaluated, the optimal schedule is selected and the project is planned.

Finally, the project is planned and the selected optimal schedule is returned to the user.
Risk A

The Kernel Algorithm

The options embedded in a project are considered as “European call options” since can be executed in each moment but has the maximum value at maturity. To use the real option algorithms it is necessary to “translate” the PM parameters in real option parameters:
- The Option underlying (S), is the evolution of the delivery date under different scenarios
- The strike price (X) is the delivery date at the time now.

The method provides the new schedule with the list of options to exercise

The Kernel Algorithm

The evaluation of each option is divided in two risks:
- Which option to exercise
- The new schedule of each WP

The time bucket is one day (or the units of measure used in the project). The underlying tree is defined starting from the $S_0$ (expected delivery date) at the time now. There are two possible evolutions:
1. A single branch if there are not risks or the risks are neutralized. Without risk the duration is deterministic.
2. A ramification of two branches if the risk can occur or not

As a consequence the underlying tree shows the delivery date (underlying ($S_i$)) according to the different paths. It is worth to exercise the option if it provides a positive effect. If building a temporary roof avoids the risk from the bad weather the positive effect is the number of days saved. This value can be easily computed by subtracting in the final value for each scenario (considering the risk) by the value of a scenario “without risk”. The remaining nodes are calculated with a back-forward approach using as strike price ($X$) the delivery date at the time now.

The Kernel algorithm uses three parameters
1. WP state: This indicator considers the “WP float” i.e. compares the duration of work remaining (standard value, risk free) respect to the same value plus the WP float (computed with the CPM, early start). Larger the WP float less valuable is the option since a delay does not increases the duration. A float equal to zero (or negative) implies that each delay will increase the fee to pay.
2. Project state: This indicator considers the “project float” i.e. the float between the duration of the project computed with the CPM, early start and the contractual delivery date.
3. Global state: This indicator merges the two previous indicators and it is used to compute the indicator used in the option valuation. Since the algorithm is executed at different time it is necessary to update them to perform each evaluation.

Application of Kernel Algorithm

For each feasible schedule identified in the previous steps the Kernel Algorithm (presented in the next section) evaluate the total cost. This cost, called “Rolling Wave Scheduling Cost (RWSC)”, represents the main attribute of each schedule. The schedule with the minimum RWSC is the best schedule.

Project Replanning

The method provides the new schedule with the list of options to exercise

The Kernel Algorithm

This steps analysis each WP to assess if it is jeopardized and if there are options available to hedge the risk.

STEP 1: analysis of each WP and the related risks/options

This steps analysis each WP to assess if it is jeopardized and if there are options available to hedge the risk.

STEP 2: compute the value of each option

The method used to evaluate the option is the binomial tree. The method implies the evaluation of both underlying value and options value according to positive and negative probabilities i.e. it performs an evaluation for each scenario assessing what happen if the risk occurs or not.

STEP 3: parameters updating

The Kernel algorithm uses three parameters:
1. WP state: This indicator considers the “WP float” i.e. compares the duration of work remaining (standard value, risk free) respect to the same value plus the WP float (computed with the CPM, early start). Larger the WP float less valuable is the option since a delay does not increases the duration. A float equal to zero (or negative) implies that each delay will increase the fee to pay.
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3. Global state: This indicator merges the two previous indicators and it is used to compute the indicator used in the option valuation. Since the algorithm is executed at different time it is necessary to update them to perform each evaluation.

STEP 4: Compare the value of the option respect to its cost

The first step is to convert the value embedded in the option in monetary terms with the formula:

$$\alpha = \text{option payoff} \times \text{delay} \times \text{Global state}$$

This value is compared with the cost of exercise the option

$$\beta = \alpha - \text{exercise cost}$$

If $\beta > 0$ it is worth to exercise the option

$a = \frac{0}{0}$ It is not worth to exercise the option

Now the method can provide the new schedule with the following information:
- The new schedule of each WP
- Which option to exercise

The application: results and risk management

This paragraph shows how the algorithm presented in section 4 deals with risk management. The algorithm, developed to minimize the "expected total cost" can even reduce the variability of the delivery date and therefore is a useful Risk management tool. For example, let’s consider the project in figure 2 jeopardized by two risks:

1. Risk A:
   - Impacts on activity A
   - Can occur the day 1 (70% probability) and the day 2 (40% probability)
   - Strike price of option A to cover the Risk A: 20,000Euro

2. Risk G:
   - Impacts on activity G
   - Can occur the day 2 (80% probability) and the day 3 (20% probability)
   - Strike price of option B to cover the Risk B: 5,000 Euro

Without any countermeasure this project has:
- An earliest delivery date the day 15 (32% probability)
- Mean expected delivery date the day 26 (39% probability)
- Latest delivery date the day 17 (29% probability)
- The standard deviation is 17 days (results obtained with the CIM - Controlled Interval and Memory - or Monte Carlo approach).

The model can now perform the analysis:
- There are 32 feasible schedules
- Among these 32 schedules 12 of them minimize the total rolling wave cost, i.e. have the same minimum cost. The model chooses the early start schedule from the optimal solution.
- The best solution implies exercising the option A and to delay the activity G without exercise its option. The risk on WP G cannot occur since the WP has been delayed.

### Table 1. Time required to solve the problem

<table>
<thead>
<tr>
<th># WP</th>
<th>Float value</th>
<th>Number of configurations</th>
<th>Number of feasible schedules</th>
<th>Number of optimal schedules</th>
<th>Resolution time [minutes]</th>
<th>Evaluation of optimal schedules [minutes]</th>
<th>Total time [minutes]</th>
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<td>986.632</td>
<td>924.85</td>
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</tbody>
</table>

Figure 2. Initial Early Start schedule

Figure 3. Final Early Start schedule

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Conclusions
This paper presented a model for the project’s rolling wave planning using real options as a tool to exploit the information and the degrees of freedom owned by a PM. Each day a PM faces many risks and there are options to overcome them. Some options could be free of charge, such as rescheduling some non-critical activities, others are costly (as building a temporary roof). Therefore a tool is required to identify the optimal schedule with the relative options to exercise. The method presented in this paper aims to support the PM in managing the risk in the RWS. The literature review showed as the real options have the characteristics to become a valuable tool in project re-planning, however it is necessary to shape them according to the specific PM field.

The main assumptions of the model are:
- The underlying was identified in the delivery date of the project, and consequently it was assumed that the PM owns one or more options on its evolution.
- The financial reference option has been identified as a European call option without dividends, in particular a deferred (real) option.
- The scheduling algorithm is associated to an optimization model with an appropriate objective function that has to be minimized: the decision variables are measured in monetary terms: cost of option, resources and risk assumed. The model presented allows an efficient and effective risk reduction.

Reference

1 - A European option may be exercised only at the expiry date of the option, i.e. at a single pre-defined point in time. An American option may be exercised at any time before the expiry date. Even if the options are American the algorithm treats the option as European. Let’s consider the stroke risk. Until the last moment it is not necessary to give the pay raise since the treat of stroke can be a bluff or can be avoided with other cheaper solution.

Giorgio Locatelli, PhD
Giorgio Locatelli is a lecturer at the Lincoln University (UK). He obtained is Master of Science in mechanical engineering (2006) and PhD in industrial engineering from the Politecnico di Milano (Italy). In March 2011 he defended his dissertation on economics and strategic aspect of Small Medium nuclear Reactors (SMR). His main research topics are related to the economic/competitiveness evaluation of power plants, advanced techniques of Project Management with particular focus on large projects and sustainability issues. He is author of more than 50 international publications in Project Management and Energy Economics.

Mauro Mancini, PhD
Mauro Mancini is Dean of executive Master in Nuclear Plant Construction Management, Professor of Project Management at the Master in Strategic Project Management European Programme and Professor of Project Management at the Politecnico di Milano (Italy). Involved in several national and international research projects about project risk management, project cost and time estimation and operation management, his main areas of interest regard large project with particular focus on nuclear and military sectors. He is author of more than 80 international publications in Project Management, Operation Management and Total Productive Maintenance.

Jacopo Ascoli
Jacopo Ascoli got the bachelor Degree in Management Engineering at the University of Bologna and then, in 2010, the Master of Science in Management Engineering at the Politecnica di Milano. In 2011 he joined BNP Paribas Assurance Italy working as account operation manager on commercial partner in order to improve the customer relationship and internal integration.
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