The Application of Project Management

Mohammad Bagher Abdollahi[1], Hamed Ghezelbash[2], Mehdi Eskandari[3]

[1]Industrial Engineering Department, Islamic Azad University of Firozkoh, Tehran, Iran
[2]Mechanical Engineering Department, Islamic Azad University of Takestan, Qazvin, Iran
[3] Mechanical Engineering Department, Islamic Azad University of Takestan, Qazvin, Iran
([1]m_abdolahi_1387@yahoo.com, [2]hamedghezelbash@gmail.com, [3]mehdy.skandary@gmail.com)

Abstract- Project management is a carefully planned and organized effort to accomplish a successful project. A project is a one-time effort that produces a specific result, for example, a building or a major new computer system. This is in contrast to a program, which is 1) an ongoing process, such as a quality control program, or 2) an activity to manage a series of multiple projects together. In some countries, the term "program" refers to a software tool.

Project management includes developing a project plan, which includes defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved, quantifying the resources needed, and determining budgets and timelines for completion. It also includes managing the implementation of the project plan, along with operating regular 'controls' to ensure that there is accurate and objective information on 'performance' relative to the plan, and the mechanisms to implement recovery actions where necessary.

Keywords- *Project management, CPM, WBS, VA, KPI.*

I. INTRODUCTION

Project management has been practiced since early civilization. Until 1900 civil engineering projects were generally managed by creative architects and engineers themselves, among those for example Vitruvius (1st century BC), Christopher Wren (1632–1723) , Thomas Telford (1757–1834) and Isambard Kingdom Brunel (1806–1859). It was in the 1950s that organizations started to systematically apply project management tools and techniques to complex engineering projects.

As a discipline, Project Management developed from several fields of application including civil construction, engineering, and heavy defense activity Two forefathers of project management are Henry Gantt, called the father of planning and control techniques, who is famous for his use of the Gantt chart as a project management tool; and Henri Fayol for his creation of the 5 management functions which form the foundation of the body of knowledge associated with project and program management. Both Gantt and Fayol were students of Frederick Winslow Taylor's theories of scientific management. His work is the forerunner to modern project management tools including work breakdown structure (WBS) and resource allocation.

The 1950s marked the beginning of the modern Project Management era where core engineering fields come together working as one. Project management became recognized as a distinct discipline arising from the management discipline with engineering model. In the United States, prior to the 1950s, projects were managed on an ad hoc basis using mostly Gantt Charts, and informal techniques and tools. At that time, two mathematical project-scheduling models were developed. The "Critical Path Method" (CPM) was developed as a joint venture between DuPont Corporation and Remington Rand Corporation for managing plant maintenance projects. And the "Program Evaluation and Review Technique" or PERT, was developed by Booz Allen Hamilton as part of the United States Navy's (in conjunction with the Lockheed Corporation) Polaris missile submarine program; These mathematical techniques quickly spread into many private enterprises.[1]
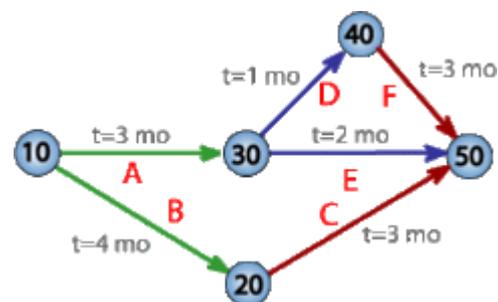
Fig. 1

At the same time, as project-scheduling models were being developed, technology for project cost estimating, cost management, and engineering economics was evolving, with pioneering work by Hans Lang and others. In 1956, the American Association of Cost Engineers (now AACE International; the Association for the Advancement of Cost Engineering) was formed by early practitioners of project management and the associated specialties of planning and scheduling, cost estimating, and cost/schedule control (project control). AACE continued its pioneering work and in 2006

released the first integrated process for portfolio, program and project management (Total Cost Management Framework).

The International Project Management Association (IPMA) was founded in Europe in 1967, as a federation of several national project management associations. IPMA maintains its federal structure today and now includes member associations on every continent except Antarctica. IPMA offers a Four Level Certification program based on the IPMA Competence Baseline (ICB). The ICB covers technical competences, contextual competences, and behavioral competences.

In 1969, the Project Management Institute (PMI) was formed in the USA. PMI publishes A Guide to the Project Management Body of Knowledge, which describes project management practices that are common to "most projects, most of the time." PMI also offers multiple certifications.[2]

Project management is the science (and art) of organizing the components of a project, whether the project is development of a new product, the launch of a new service, a marketing campaign, or a wedding. A project isn't something that's part of normal business operations. It's typically created once, it's temporary, and it's specific. As one expert notes, "It has a beginning and an end." A project consumes resources (whether people, cash, materials, or time), and it has funding limits. The purpose of the present paper is to summarize and review the prior studies, so that their results can be synthesized into an integrated framework. This process reveals a more general class of cases than those previously considered; to derive some propositions dealing with project manager, and to suggest some directions for future research in this general area.

II. DEFINITION THE PROJECT

In this stage the project manager defines what the project is and what the users hope to achieve by undertaking the project. This phase also includes a list of project deliverables, the outcome of a specific set of activities. The project manager works with the business sponsor or manager who wants to have the project implemented and other stakeholders - those who have a vested interest in the outcome of the project.

While project management skills are obviously important for project managers, interestingly the methods and tools that project managers use can be helpful for everyone.

A 'task' does not necessarily have to be called a 'project' in order for project management methods to be very useful in its planning and implementation. Even the smallest task can benefit from the use of a well-chosen project management technique or tool, especially in the planning stage. [3]

Any task that requires some preparation to achieve a successful outcome will probably be done better by using a few project management methods somewhere in the process. Project management methods can help in the planning and managing of all sorts of tasks, especially complex activities.

Project management is chiefly associated with planning and managing change in an organization, but a project can also be something unrelated to business - even a domestic situation, such as moving house, or planning a wedding. Project management methods and tools can therefore be useful far more widely than people assume.

Project management techniques and project planning tools are useful for any tasks in which different outcomes are possible - where risks of problems and failures exist - and so require planning and assessing options, and organizing activities and resources to deliver a successful result.

Projects can be various shapes and sizes, from the small and straightforward to extremely large and highly complex. In organizations and businesses, project management can be concerned with anything, particularly introducing or changing things, in any area or function, for example:

- People, staffing and management
- Products and services
- Materials, manufacturing and production
- IT and communications
- Plant, vehicles, equipment
- Storage, distribution, logistics
- Buildings and premises
- Finance, administration, acquisition and divestment
- Purchasing
- Sales, selling, marketing
- Human resources development and training
- Customer service and relations
- Quality, health and safety,
- Legal and professional
- Technical, scientific, research and development
- New business development

and anything else which needs planning and managing within organizations. Successful project management, for projects large or small, tends to follow the process outlined below. The same principles, used selectively and appropriately, also apply to smaller tasks. Project management techniques are not just for project managers - they are available for anyone to use.

III. What is the project management?

There are many definitions of what constitutes a project such as 'a unique set of co-ordinate activities, with definite starting and finishing points, undertaken by an individual or team to meet specific objectives within defined time, cost and performance parameters' (Office of Government Commerce).

We are all aware that our organizations undertake projects and, rather than debate the merits of different definitions, it is perhaps more helpful to look at a few of the characteristics that make projects different from other work. Projects are usually characterized by being:

- Instruments of change
- Non-routine
- Unique
- Composed of inter-dependent activities
- Carried out by people who don't normally work together
- Temporary with defined start and end dates
- Intended to achieve a specific outcome
- Frequently risky and involving uncertainties[4]

There is no magic formula for ensuring that a project is successful, but there are well proven techniques available to help plan and manage projects. No one need feel daunted at taking on their first project - project management is not a 'black art', nor does it need to be a minefield of jargon and bureaucracy. Most of project management is plain, common sense and a lot of what we describe is simply a structured approach to what you would do instinctively. Project management gives you a framework - at certain points it prompts you to take a step back and think 'have I done this?', 'have I considered that?', 'do I understand this fully?', 'what will we do should "x" happen?', 'how should I deal with this?'

There are many formal project management methodologies that combine a framework or approach with a set of project tools and guidelines. Some are 'proprietary' approaches developed by consulting firms and software houses whilst others are in the public domain. They vary in scale and complexity but all are based around a small core of common sense principles.

A methodology that is commonly used in the public sector and forms the basis of this info Kit is PRINCE2 (Projects IN Controlled Environments). PRINCE2 is a very comprehensive methodology that can be applied to projects no matter how large and complex. The JISC info Net method pares down PRINCE2 to the bare bones of a framework suitable for managing any project. We have tried to ensure that the method is scalable and hence we highlight areas where you may go into greater or lesser amounts of detail. The important thing is to make the methodology work for you. Properly applied it should be a user-friendly framework that matches the size, risk level and complexity of your project.

Another key difference about the JISC info Net approach is the emphasis on people and behavior. One thing that stands out in the analysis of all projects, whether successful or otherwise, is that projects are about people. Few information systems projects fail for technical reasons. They fail because of people's perceptions of what to expect from technology or

because of their belief that technology can somehow adapt to their way of doing things without the need for associated business process change. We aim to give due emphasis on the skills required to manage the people aspects and the organizational change that any project will inevitably bring about.

The diagram below shows the main components of the JISC info Net project management methodology. Some elements, namely Project Start-up and Project Closure, occur only once. The remaining elements, Planning, Managing Phases and Controlling, form an iterative cycle that may repeat many times before the project is complete.
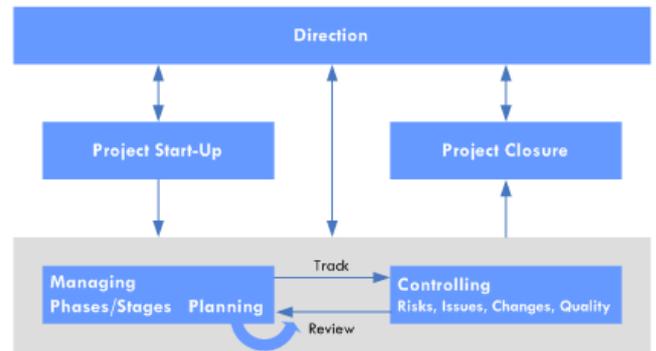
Fig. 2

It must be stressed that the methodology is a framework and nothing more. It is a tried and tested, structured approach that will give you a sound basis for running a successful project. It is not, however, a substitute for creativity. Projects are always unique; they necessarily involve uncertainty and risk and they will require all your flexibility and ingenuity if they are to succeed. That's what's exciting about managing a project![5]

IV. PLANNING THE PROJECT

Define all project activities. In this stage, the project manager lists all activities or tasks, how the tasks are related, how long each task will take, and how each tasks is tied to a specific deadline. This phase also allows the project manager to define relationships between tasks, so that, for example, if one task is x number of days late, the project tasks related to it will also reflect a comparable delay. Likewise, the project manager can set milestones, dates by which important aspects of the project need to be met.

Define requirements for completing the project. In this stage, the project manager identifies how many people (often referred to as "resources") and how much expense ("cost") is involved in the project, as well as any other requirements that are necessary for completing the project. The project manager

will also need to manage assumptions and risks related to the project. The project manager will also want to identify project constraints. Constraints typically relate to schedule, resources, budget, and scope. A change in one constraint will typically affect the other constraints. For example, a budget constraint may affect the number of people who can work on the project, thereby imposing a resource constraint. Likewise, if additional features are added as part of project scope, that could affect scheduling, resources, and budget.

Plan the various stages and activities of the project. Where possible (and certainly where necessary) involve your team in the planning. A useful tip is to work backwards from the end aim, identifying all the things that need to be put in place and done, in reverse order. Additionally, from the bare beginnings of the project, use brainstorming (noting ideas and points at random - typically with a project team), to help gather points and issues and to explore innovations and ideas. Fishbone diagrams are also useful for brainstorming and identifying causal factors which might otherwise be forgotten. For complex projects, or when you lack experience of the issues, involve others in the brainstorming process. Thereafter it's a question of putting the issues in the right order, and establishing relationships and links between each issue. Complex projects will have a number of activities running in parallel. Some parts of the project will need other parts of the project to be completed before they can begin or progress. Such 'interdependent' parts of a project need particularly careful consideration and planning. Some projects will require a feasibility stage before the completion of a detailed plan. Gantt Charts and Critical Path Analysis Flow Diagrams are two commonly used tools for detailed project management planning, enabling scheduling, costing and budgeting and other financials, and project management and reporting.

Fig.3

After the initiation stage, the project is planned to an appropriate level of detail. The main purpose is to plan time, cost and resources adequately to estimate the work needed and to effectively manage risk during project execution. As with the Initiation process group, a failure to adequately plan greatly reduces the project's chances of successfully accomplishing its goals.[6]

Project planning generally consists of:

- determining how to plan (e.g. by level of detail or rolling wave);
- developing the scope statement;
- selecting the planning team;
- identifying deliverables and creating the work breakdown structure;
- identifying the activities needed to complete those deliverables and networking the activities in their logical sequence;
- estimating the resource requirements for the activities;
- estimating time and cost for activities;
- developing the schedule;
- developing the budget;
- risk planning;
- Gaining formal approval to begin work.

Additional processes, such as planning for communications and for scope management, identifying roles and responsibilities, determining what to purchase for the project and holding a kick-off meeting are also generally advisable.

For new product development projects, conceptual design of the operation of the final product may be performed concurrent with the project planning activities, and may help to inform the planning team when identifying deliverables and planning activities.

V. CONTROLLING THE PROJECT

The project manager is in charge of updating the project plans to reflect actual time elapsed for each task. By keeping up with the details of progress, the project manager is able to understand how well the project is progressing overall. A product such as Microsoft Project facilitates the administrative aspects of project management.[7]

VI. PROJECT MANAGEMENT PROCESS

- Agree precise specification for the project - 'Terms of Reference'
- Plan the project - time, team, activities, resources, and financials - using suitable project management tools.
- Communicate the project plan to your project team - and to any other interested people and groups.
- Agree and delegate project actions.
- Manage and motivate - inform, encourage, enable the project team.
- Check, measure, monitor, review project progress - adjust project plans, and inform the project team and others.

- Complete project - review and report on project performance; give praise and thanks to the project team.
- Project follow-up - train, support, measure and report results and benefits.

VII. MONITORING AND CONTROLLING

Monitoring and controlling consists of those processes performed to observe project execution so that potential problems can be identified in a timely manner and corrective action can be taken, when necessary, to control the execution of the project. The key benefit is that project performance is observed and measured regularly to identify variances from the project management plan.
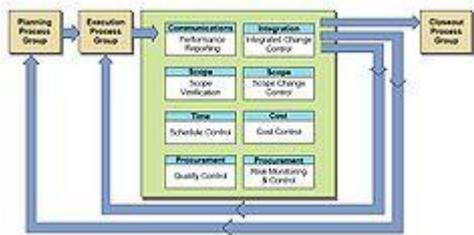
Fig.4

Monitoring and Controlling includes:

- Measuring the ongoing project activities ('where we are');
- Monitoring the project variables (cost, effort, scope, etc.) against the project management plan and the project performance baseline (where we should be);
- Identify corrective actions to address issues and risks properly (How can we get on track again);
- Influencing the factors that could circumvent integrated change control so only approved changes are implemented

In multi-phase projects, the monitoring and control process also provides feedback between project phases, in order to implement corrective or preventive actions to bring the project into compliance with the project management plan.
Project Maintenance is an ongoing process, and it includes:

- Continuing support of end users
- Correction of errors
- Updates of the software over time

In this stage, auditors should pay attention to how effectively and quickly user problems are resolved.[8]

Fig.5

Over the course of any construction project, the work scope may change. Change is a normal and expected part of the construction process. Changes can be the result of necessary design modifications, differing site conditions, material availability, contractor-requested changes, value engineering and impacts from third parties, to name a few. Beyond executing the change in the field, the change normally needs to be documented to show what was actually constructed. This is referred to as Change Management. Hence, the owner usually requires a final record to show all changes or, more specifically, any change that modifies the tangible portions of the finished work. The record is made on the contract documents – usually, but not necessarily limited to, the design drawings. The end product of this effort is what the industry terms as-built drawings, or more simply, "as built." The requirement for providing them is a norm in construction contracts.

When changes are introduced to the project, the viability of the project has to be re-assessed. It is important not to lose sight of the initial goals and targets of the projects. When the changes accumulate, the forecasted result may not justify the original proposed investment in the project.[9]

VIII. PROJECT MANAGEMENT TOOLS

Here are examples and explanations of four commonly used tools in project planning and project management, namely: Brainstorming, Fishbone Diagrams, Critical Path Analysis Flow Diagrams, and Gantt Charts. Additionally and separately see business process modeling and quality management, which contain related tools and methods aside from the main project management models shown below.

The tools here each have their strengths and particular purposes, summarized as a basic guide in the matrix below.[10]

Matrix key:

B = Brainstorming
F = Fishbone/Ishikawa Diagrams
C = Critical Path Analysis Flow Diagrams
G = Gantt Charts

	B	F	C	G
Project brainstorming and initial concepts, ideas, structures, aims, etc	***	**		
Gathering and identifying all elements, especially causal and hidden factors	*	***	**	
Scheduling and timescales			**	***
Identifying and sequencing parallel and interdependent activities and stages	*		***	*
Financials - costings, budgets, revenues, profits, variances, etc	*	*	**	***
Monitoring, forecasting, reporting		*	**	***
Troubleshooting, problem identification, diagnosis and solutions	**	***	**	*
'Snapshot' or 'map' overview - non-sequential, non-scheduled	**	***		
Format for communications, presentations, updates, progress reports, etc		*	*	***

PROJECT CONTROLLING AND PROJECT CONTROL SYSTEM

Project controlling should be established as an independent function in project management. It implements verification and controlling function during the processing of a project in order to reinforce the defined performance and formal goals. The tasks of project controlling are also:

- Creation of infrastructure for the supply of the right information and its update.
- Establishment of a way to communicate disparities of project parameters.

- Development of project information technology based on an intranet or the determination of a project key performance index system (KPI).
- Divergence analyses and generation of proposals for potential project regulations.
- The establishment of methods to accomplish an appropriate the project structure, project workflow organization, project control and governance.
- Creation of transparency among the project parameters.

Fulfillment and implementation of these tasks can be achieved by applying specific methods and instruments of project controlling. The following methods of project controlling can be applied:

- investment analysis
- cost-benefit analyses
- value benefit Analysis
- expert surveys
- simulation calculations
- risk profile analyses
- surcharge calculations
- milestone trend analysis
- cost trend analysis
- target/actual-comparison[11]

Project control is that element of a project that keeps it on-track, on-time and within budget. Project control begins early in the project with planning and ends late in the project with post-implementation review, having a thorough involvement of each step in the process. Each project should be assessed for the appropriate level of control needed: too much control is too time consuming, too little control is very risky. If project control is not implemented correctly, the cost to the business should be clarified in terms of errors, fixes, and additional audit fees.

Control systems are needed for cost, risk, quality, communication, time, change, procurement, and human resources. In addition, auditors should consider how important the projects are to the financial statements, how reliant the stakeholders are on controls, and how many controls existing. Auditors should review the development process and procedures for how they are implemented. The process of development and the quality of the final product may also be assessed if needed or requested. A business may want the auditing firm to be involved throughout the process to catch problems earlier on so that they can be fixed more easily. An auditor can serve as a controls consultant as part of the development team or as an independent auditor as part of an audit.

Businesses sometimes use formal systems development processes. These help assure that systems are developed

successfully. A formal process is more effective in creating strong controls, and auditors should review this process to confirm that it is well designed and is followed in practice. A good formal systems development plan outlines:[12]

- A strategy to align development with the organization's broader objectives
- Standards for new systems
- Project management policies for timing and budgeting
- Procedures describing the process
- Evaluation of quality of change

A- PROJECT MANAGEMENT TRIANGLE
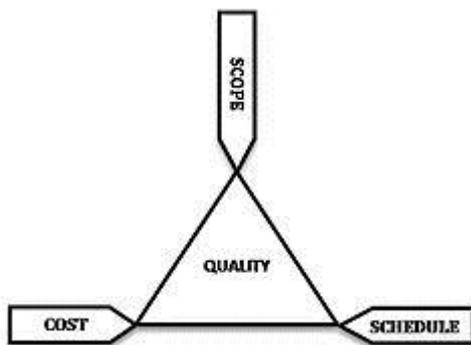
Fig.6

Like any human undertaking, projects need to be performed and delivered under certain constraints. Traditionally, these constraints have been listed as "scope," "time," and "cost". These are also referred to as the "project management triangle", where each side represents a constraint. One side of the triangle cannot be changed without affecting the others. A further refinement of the constraints separates product "quality" or "performance" from scope, and turns quality into a fourth constraint.

The time constraint refers to the amount of time available to complete a project. The cost constraint refers to the budgeted amount available for the project. The scope constraint refers to what must be done to produce the project's end result. These three constraints are often competing constraints: increased scope typically means increased time and increased cost, a tight time constraint could mean increased costs and reduced scope, and a tight budget could mean increased time and reduced scope.

The discipline of project management is about providing the tools and techniques that enable the project team (not just the project manager) to organize their work to meet these constraints.[13]

X. Project Management Framework
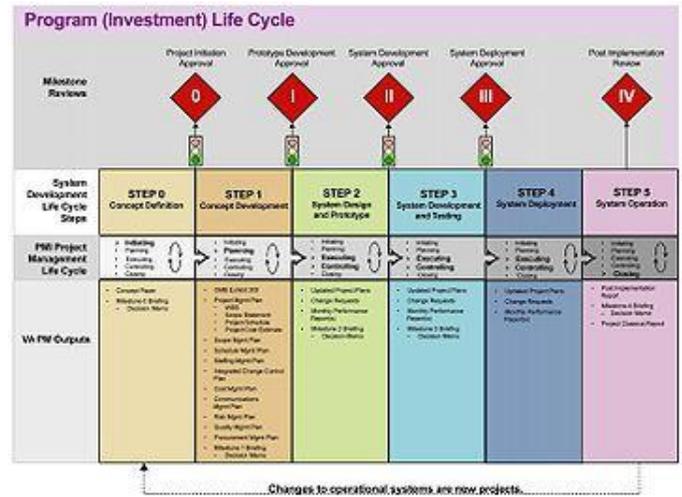
Fig. 7

The Program (Investment) Life Cycle integrates the project management and system development life cycles with the activities directly associated with system deployment and operation. By design, system operation management and related activities occur after the project is complete and are not documented within this guide.

For example, see figure, in the US United States Department of Veterans Affairs (VA) the program management life cycle is depicted and describe in the overall VA IT Project Management Framework to address the integration of OMB Exhibit 300 project (investment) management activities and the overall project budgeting process. The VA IT Project Management Framework diagram illustrates Milestone 4 which occurs following the deployment of a system and the closing of the project. The project closing phase activities at the VA continues through system deployment and into system operation for the purpose of illustrating and describing the system activities the VA considers part of the project. The figure illustrates the actions and associated artifacts of the VA IT Project and Program Management process.[14]

XI. Conclusion

An increasing number of organizations are using, what is referred to as, project portfolio management (PPM) as a means of selecting the right projects and then using project management techniques as the means for delivering the outcomes in the form of benefits to the performing private or not-for-profit organization. Recent trends in project management include project portfolio management (PPM). PPM is a move by organizations to get control over numerous projects by evaluating how well each project aligns with strategic goals and quantifying its value. An organization will typically be working on multiple projects, each resulting in potentially differing amounts of return or value. The company or agency may decide to eliminate those projects with a lower return in order to dedicate greater resources to the remaining

projects or in order to preserve the projects with the highest return or value.

REFERENCES

[1] Morgen Witzel (2003). Fifty key figures in management. Routledge, 2003. ISBN 0-415-36977-0. p. 96-101.

[2] David I. Cleland, Roland Gareis (2006). Global project management handbook. McGraw-Hill Professional, 2006. ISBN 0-07-146045-4. p.1-4 states: "It was in the 1950s when project management was formally recognized as a distinct contribution arising from the management discipline..

[3] F. L. Harrison, Dennis Lock (2004). Advanced project management: a structured approach. Gower Publishing, Ltd., 2004. ISBN 0-566-07822-8. p.34.

[4] PMI (2010). A Guide to the Project Management Body of Knowledge p.27-35.

[5] Harold Kerzner (2003). Project Management: A Systems Approach to Planning, Scheduling, and Controlling (8th Ed. ed.). Wiley. ISBN 0-471-22577-0.

[6] Young-Hoon Kwak (2005). "A brief history of Project Management". In: The story of managing projects. Elias G. Carayannis et al. (9 eds), Greenwood Publishing Group, 2005. ISBN 1-56720-506-2

[7] Dennis Lock (2007) Project management (9e ed.) Gower Publishing, Ltd., 2007. ISBN 0-566-08772-3

[8] The Definitive Guide to Project Management. Nokes, Sebastian. 2nd Ed.n. London (Financial Times / Prentice Hall): 2007. ISBN 978 0 273 71097 4.

[9] Lewis R. Ireland (2006) Project Management. McGraw-Hill Professional, 2006. ISBN 0-07-147160-X. p.110.

[10] VA Office of Information and Technology (2003) Project Management Guide US DEPARTMENT OF VETERANS AFFAIRS. March 3, 2005.

[11] Martin Stevens (2002). Project Management Pathways. Association for Project Management. APM Publishing Limited, 2002 ISBN 1-903494-01-X p.xxii.

[12] Bjarne Kousholt (2007). Project Management –. Theory and practice.. Nyt Teknisk Forlag. ISBN 87-571-2603-8. p.59.

[13] http://www.ipma.ch/publication/Pages/ICB IPMACompetenceBaseline.aspx

[14] Stellman, Andrew; Greene, Jennifer (2005). Applied Software Project Management. O'Reilly Media. ISBN 978-0-596-00948-9 http://www.stellman-greene.com/aspm/.