

Project management

Project management is the process of leading the work of a team to achieve all project goals within the given constraints.^[1] This information is usually described in project documentation, created at the beginning of the development process. The primary constraints are scope, time, and budget.^[2] The secondary challenge is to optimize the allocation of necessary inputs and apply them to meet pre-defined objectives.

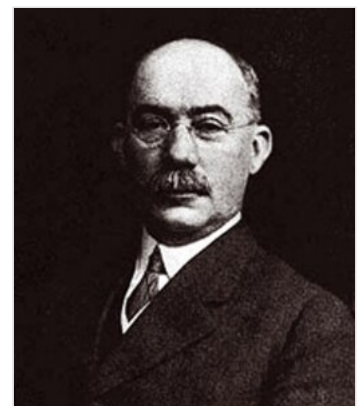
The objective of project management is to produce a complete project which complies with the client's objectives. In many cases, the objective of project management is also to shape or reform the client's brief to feasibly address the client's objectives. Once the client's objectives are clearly established, they should influence all decisions made by other people involved in the project – for example, project managers, designers, contractors, and subcontractors. Ill-defined or too tightly prescribed project management objectives are detrimental to decision-making.

A project is a temporary and unique endeavor designed to produce a product, service, or result with a defined beginning and end (usually time-constrained, and often constrained by funding or staffing) undertaken to meet unique goals and objectives, typically to bring about beneficial change or added value.^{[3][4]} The temporary nature of projects stands in contrast with business as usual (or operations),^[5] which are repetitive, permanent, or semi-permanent functional activities to produce products or services. In practice, the management of such distinct production approaches requires the development of distinct technical skills and management strategies.^[6]

History

Until 1900, civil engineering projects were generally managed by creative architects, engineers, and master builders themselves, for example, Vitruvius (first century BC), Christopher Wren (1632–1723), Thomas Telford (1757–1834), and Isambard Kingdom Brunel (1806–1859).^[7] In the 1950s, organizations started to apply project-management tools and techniques more systematically to complex engineering projects.^[8]

As a discipline, project management developed from several fields of application including civil construction, engineering, and heavy defense activity.^[9] Two forefathers of project management are Henry Gantt, called the father of planning and control techniques,^[10] who is famous for his use of the Gantt chart as a project management tool (alternatively *Harmonogram* first proposed by Karol Adamiecki);^[11] and Henri Fayol for his creation of the five management functions that form the foundation of the body of knowledge associated with project and program management.^[12] 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.



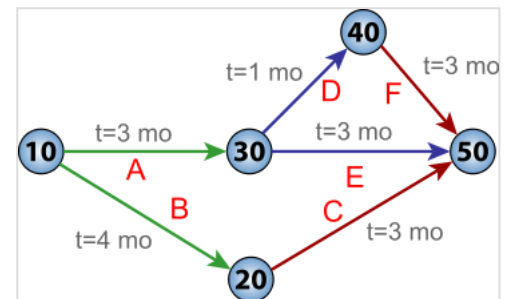
Henry Gantt (1861–1919),
the father of planning and
control techniques

The 1950s marked the beginning of the modern project management era, where core engineering fields came together to work as one. Project management became recognized as a distinct discipline arising from the management discipline with the engineering model.^[13] 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. The program evaluation and review technique (PERT), was developed by the U.S. Navy Special Projects Office in conjunction with the Lockheed Corporation and Booz Allen Hamilton as part of the Polaris missile submarine program.^[14]

PERT and CPM are very similar in their approach but still present some differences. CPM is used for projects that assume deterministic activity times; the times at which each activity will be carried out are known. PERT, on the other hand, allows for stochastic activity times; the times at which each activity will be carried out are uncertain or varied. Because of this core difference, CPM and PERT are used in different contexts. These mathematical techniques quickly spread into many private enterprises.

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 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).



PERT network chart for a seven-month project with five milestones

In 1969, the Project Management Institute (PMI) was formed in the USA.^[15] PMI publishes the original version of A Guide to the Project Management Body of Knowledge (PMBOK Guide) in 1996 with William Duncan as its primary author, which describes project management practices that are common to "most projects, most of the time."^[16]

Project management types

Project management methods can be applied to any project. It is often tailored to a specific type of project based on project size, nature, industry or sector. For example, the construction industry, which focuses on the delivery of things like buildings, roads, and bridges, has developed its own specialized form of project management that it refers to as *construction project management* and in which project managers can become trained and certified.^[17] The information technology industry has also evolved to develop its own form of project management that is referred to as *IT project management* and which specializes in the delivery of technical assets and services that are required to pass through various lifecycle phases such as planning, design, development, testing, and deployment. *Biotechnology project management* focuses on the intricacies of biotechnology research and development.^[18] *Localization project management* includes application of many standard project management practices to translation works even though many consider this type of management to be a very different discipline. For example, project managers have a key role in improving the translation even when they do not speak the language of the translation, because they know the study objectives well to make informed decisions.^[19] Similarly, *research study management* can also apply a project manage approach.^[20] There is public project management that covers all public works by the government, which can be carried out by the government agencies or contracted out to contractors. Another classification of project management is based on the hard (physical) or soft (non-physical) type.