

# Chapter IX

## A Systematic Implementation of Project Management

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### ABSTRACT

*In contrast to ongoing, functional work, a project is a temporary endeavor undertaken to achieve or create a unique product or service(s). The project management knowledge and practices are best described as component processes—initiating, planning, executing, controlling, and closing. We have taken a closer look at project management by reviewing the types of methodologies and tools that exist in business today. We observed the major existing risk factors facing project management practices. We also evaluated the unique issues in delivering projects brought about by globalization. As we were extracting the information, it became apparent that there should be measures taken related to the project management process that could alleviate the some major risk factors in some way.*

### INTRODUCTION

A comprehensive management of employee, resources, analytics, customer relationship management (CRM), supply chain, and project management is of paramount importance for modern corporations. Businesses can plan, track, and analyze time and labor through applications for scheduling, time and attendance, leave, and labor. While companies can focus on a number of areas in their efforts to be-

come high performance organizations, this chapter discusses the role that effective project management practices play in this process.

Project management is the discipline of defining and achieving targets while optimizing (or just allocating) the use of resources—time, money, people, materials, energy, space, and so forth, over the course of a project (a set of activities of finite duration). In contrast to ongoing, functional work, a project is a temporary endeavor undertaken to

achieve or create a unique product or service(s). The project management knowledge and practices are best described as component processes—initiating, planning, executing, controlling, and closing (Westland, 2006; Jin, Koskela, & King, 2007).

We have taken a closer look at project management by reviewing the types of methodologies and tools that exist in business today. We observed the major existing risk factors facing project management practices. We also evaluated the unique issues in delivering projects brought about by globalization. As we were extracting the information, it became apparent that there should be measures taken related to the project management process that could alleviate the some major risk factors in some way. Our chapter illustrates a solution idea for the project management process, which may close the issue gap with regard to many globalization issues and other identified risks. The idea is to include a sub-process for project management as it applies to the project life cycle, that would benefit an organization internally for a parent organization, and also externally for their client's benefit.

### **BACKGROUND**

There are various methods of project management, which differ, based on the scope and the complexity of the project undertaken. The Gantt chart is a well known standard in project management. Henry Gantt (1861-1919) studied in great detail the order of operations in work. His studies of management focused on Navy ship construction during WWI (Mintzer, 2002). His charts, complete with task bars and milestone markers, outlined the sequence and duration of all tasks in a process. These chart diagrams proved to be a very powerful analytical tool for managers, that they remained virtually unchanged for nearly 100 years. The chart plots a number of tasks across a horizontal time scale. It is easy to understand and it allows all team members to maintain the status of their tasks against the projected progress.

Many new techniques have been developed, which emerged from two major network systems, the program evaluation and review technique (PERT) and critical path method (CPM) (Punmia & Khandelwal, 2005). PERT is the method of project scheduling and coordination based on an integrated logic network, first developed by the U.S. Navy in 1958 to plan and control the Polaris missile project (Burgher, 1964). PERT allows for randomness in activity completion times. PERT has the potential of reducing total project lead time as well as reducing the cost of the project. CPM was developed at about the same time, by Remington Rand and DuPont and is very similar differing only in the way in which they arrive at time estimates (Dalcher, 2004; Lechler & Ronen, 2005). In the history of management methods, it would be difficult to find any other techniques which have received as much widespread attention as that of these network methods for planning, scheduling, and controlling. These methods are still very widely used today to achieve the earliest possible completion time at the least possible cost.

CPM is a planning tool developed for more complex projects, as is PERT. CPM provides a graphical view of a project (Lechler & Ronen, 2005). CPM estimates the amount of time required to complete the project and shows which activities are critical to keeping to the projects schedule and which are not. CPM models the activities and events of a project as a network. The larger CPM network may be considered a series of linked conditional statements. Activities are depicted as nodes on the network and events that signify the beginning or ending of activities are depicted as arcs or lines between the nodes. The CPM model is able to discern which activities are dependent on each other. Determining the critical path is at the heart of the CPM model. The critical path is the longest duration through the project's full network. A delay in the critical path results in a delay in the project's total completion time. Opportunities may be to "crash" or accelerate a project's completion time by reducing the allotted time for one or more activities of

the project. CPM was developed for more complex projects but projects that are somewhat routine in nature with a minimal amount of uncertainty. A limitation of the CPM model is for projects with a high degree of uncertainty; this uncertainty limits the effectiveness of the deterministic CPM model (Dalcher, 2004). This model's inability to consider time variations may have a significant impact on accurately estimating a project's total completion.

An alternative to the CPM model of project management is PERT. Unlike the CPM model, PERT allows for randomness in activity completion times. PERT has the potential of reducing total project lead time as well as reducing the cost of the project. In a project, an activity is a task that must be performed and an event is a milestone marking the completion of one or more activities. Before an activity can begin, all of its predecessor activities must be completed. Project managers, now more than ever, need to possess knowledge, skill, and expertise in every aspect of project management methodology. Of the many certifications, *project management institute's* (PMI) project management professional (PMP) is the most widely recognized of any project management credential (Carbone & Gholston, 2004).

We have explored the existing methods of project management and their effects on overall implementations. It is evident that there may be a gap with the normal process that we believe is an important factor in successful implementations. Secondly, we would like to evaluate what the prevalent risk factors are related to project management in addition to the issues brought about by globalization, a need for process training. When change is needed, either within an organization, or within a client project, it should be addressed in a consistent, procedure driven way, so the company can reduce ambiguity, and learn from its past mistakes by amicably agreeing on what is a best. With our evaluation, we will assert a commonality with the various risks and propose an idea for improvement through change control. Finally, we touch upon a future trend which may per-

haps change the landscape of project management and the overall future role of the project manager.

### **Risk Associated with Project Management**

In today's environment, risk is associated with every aspect of life; there is healthy risk and unhealthy risk—resulting in numerous reasons for failure in project management (Peters, 1987). Failure continues to be viewed as an organizational taboo even though corporate values such as learning and active experimentation for growth and profitability are increasingly exposed in this modern economy.

However, the fear and intolerance of failure go against the tenets of organizational learning and continuous improvement (Thorne, 2000). If failure is ignored, denied, or repressed, the opportunity to learn from past mistakes is lost. So when failure is embraced as an integral part of learning and development, much deeper insights into success can be gained (Chua & Lam, 2005).

The main reasons for failures in project management are often thought to be over-cost, behind schedule, and not meeting the user's needs. It is evident that intervention is an integral part of project management and is important in the prevention of project failures. The complexity of projects should determine the types of monitoring and the frequency. It may require periodic checks. Early detection of a problem allows the project manager to escalate or de-escalate commitment to the project. In escalating, additional resources may be all that is needed to prevent a potentially catastrophic business failure. In reexamining the project, it allows an alternative course of action or the implementation of an exit strategy (Ivory & Aderman, 2005). Below are some types of risk leading to the failure of project management practices (Aiyer, Rajkumar, & Havelka, 2005):

- Problems are denied
- Denial in detection of problems

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- Lack of communication to stakeholders defining the nature and magnitude

Also, organizational issues may originate from selecting team members from different areas. This sometimes results in rigid points of view, lack of collaboration, lack of trust, usually because the project is short term, and on a temporary basis resulting in minimal cooperation from participants.

In addition to these, the project manager may have difficulty communicating upstream and downstream without having sufficient authority over either group (Kuhl, Schnelle, & Tillmann, 2005). Causes of technology failures, as originally stated by Perrow (1984) and confirmed by Ivory & Alderman (2005), are:

- Multiple interactions since an nonlinear behavior can be either positive or negative in a project context
- Internal contradictions
- Multiple sites of control and influence
- Some interactions occur deep within the system and are hidden
- Low quality service from suppliers resulted from the fact that the project would not result in a long-term stream of work for the suppliers
- Contradictory demands of safety and speed need to co-exist and as such, complex systems can never be entirely coherent. This was originally stated by Law (2000) and confirmed by Ivory & Alderman (2005)

As Augustine, Payne, Sencindiver, and Woodcock (2007) discovered, leading a team by establishing a guiding vision, nurturing small, dynamic teams, setting simple rules, championing open information, and managing with a light touch is extremely challenging

An example of this is with a complex system implementation. When there are many linked tasks to complete a milestone, the impact one task has on a group might overlook some important aspects

needed for a future task that depends on it. This could have downstream effects on the usability of the final product, causing a defect not foreseen by the original resource. This could add additional costs to debug or identify the cause of original failure. These risks are generic to most projects and we agree that they still exist today.

From our observation, most employees are reluctant to share ideas to help foster needed change, due to fear that they might lose their jobs to outsourcing or outside consultants. Most improvements via technology usually result in staff reduction; as a result, many employees and some managers are very reluctant to share ideas that will eliminate their jobs and return profit to the company at their expense. On the other hand, the opposite of staff reduction sometimes could happen under certain circumstances.

Large ongoing projects may lead to failure simply because the length of time required for project development and anchoring. This increases the project's exposure to potential risk events (Miller & Hobbs, 2005). In most cases, by the time the project is completed, most of the software used is outdated or the resources are drained, or in some cases, the original vendors could be taken over by larger software house. This can result in loss of relationships between the company and their consultants; the new organization might be difficult to conduct business with or simply not supportive the old business strategy. There might be claims and counterclaims about broken promises, leading to additional cost factors with litigation and claims, and so forth.

## **Change Management and Project Success**

“We are experiencing an acceleration of change in our generation. Project management has to be... able to change the architecture of an organization,” according to Semler. “Project management has to be more strategic; it has to be able to change the architecture of an organization” (2006). Change is

imminent and change is constant, especially with the technological advances happening today. The way which employees deal with change in project driven organizations is often with great hesitation or even avoidance. We believe that this could lead to inconsistencies lacking repetitiveness, lead to lost revenue, and ultimate project failure. We hope to demonstrate how change management affects the project success framework by starting with detailing the project management process, issues, and flaws.

While we can infer that standardization is important for consistency with operational project management. We can see by the issues observed that project management process steps need a closer look to help identify where the process is broken, to see if missing steps or oversight helped to generate or promote any of these risks.

Project success has many challenges. What determines success? Do we limit the definition of success to the implementation phase? Do we need to gain consensus from the stakeholders to determine success? This topic is important because it has bearings on the future direction of project management in the strategic context (Jugdev & Müller, 2005). With that said, one option is to integrate an application process flow, a change management process (strategically, for infrastructure), and then operationally (for clients), based upon the need to repress ambiguity in the organization, and to contain scope creep. We prefer to include a “change management process” as a subset of the overall project management process, regardless of what type of methodology is suited and chosen. Change management is a planned approach to deal with change in an institution. This will ensure maximized benefits for all stakeholders involved, employees, and clients alike. This will minimize the risk of project failure.

Organizations often experience difficulty when taking on new projects, especially when important work needs to be coordinated across different geographical locations. Managers can take practical steps to identify critical commitments within the organization and should locate, diagnose, and

intervene to fix them. Managing by commitment increases flexibility because managers and employees can exercise in selecting the best people to work with and negotiate terms tailored to the task. Employees see a promise as personal security and they work harder to honor that commitment (Sull & Spinoza, 2005). Organizations should establish procedures to manage these criticalities or risk events in a repetitive fashion. The organization, especially global entities, should consider becoming a *learning organization* to disseminate those procedures to all affected functional personnel, by recording and teaching the new process steps of project management. This will solidify the internal tasks necessary to bring about the required change. Commitment to instill learning/teaching to introduce the new process is key.

Project management is the result of managing people, not managing work. Up until now, it was commonly thought that valued project managers stayed within the iron triangle (cost, time, and scope) optimizing these efficiencies, eluding the function to an operational role. As Jugdev and Müller (2005) emphasized that, in fact, the project management function is really more strategic in nature. Organizations need to realize that they must adjust their infrastructure to deliver projects through the best practice tools within their organizations. Whether it be by adding dashboard reviews, risk, action item, or gap metrics reporting, stakeholder or status meetings, project managers must draw attention toward heightened awareness of the importance of presenting input from and to the customer and effectively feed back results with the clients input into the equation. The strategy and mission statement of an organization should include functionality that embraces *change* for all stakeholders, clients, and employees. Definitely, in addition to people, resources, equipment, working capital, and so forth, are also important entities of project management.

In Dewett's research, the main benefits that IT affords organizations have been considered and then applied to the requirements for creative

production, the stages of the individual creative process, the process of organizational learning as related to creativity, and the creative process within large-scale project-based work. In keeping with Bromberg (2005), Thomas Edison held 1,093 patents. He guaranteed productivity by giving himself and his assistants idea quotas. In a study of 2,036 scientists throughout history, Dean Keith Simonton of the University of California at Davis found that the most respected scientists produced not only great works, but also many “bad” projects. They were not afraid to fail, or to produce mediocre in order to arrive at excellence.

In the case study of the British Library, Harris (2006) suggests that the bureaucratic context offers a more propitious environment for innovation than has been suggested by managerialist accounts of the “post-bureaucratic organization” in project management. Recently, Hodgson and Cicmil (2007) take as the focus of their analysis, a specific management model which has a significant and growing impact on many sectors of contemporary industry, that of project management. Their discovery shows that the suppression of creativity, innovation in organizations may come from the standardization of contemporary management knowledge.

Groupthink, a term coined by psychologist Irving Janis in 1972, is another barrier for a successful project management. Groupthink is a situation where people think alike and new ideas are not tolerated. Therefore, creativity, innovation, and/or individual responsibility are discouraged and critical thinking is suspended during the decision making process.

Creativity and innovation are vital to organizational success. Project management and knowledge management have increasingly become a major influence on organizational efficiency and effectiveness. We should begin to fill this gap by exploring the ways that project management might influence creativity and innovation in organizations. This is very important for organizational studies, given that knowledge and information are among the most important ingredients for creativity and innovation.

## **Globalization**

In today’s working environments, new developments often require cross-functional team members living and working on separate continents, to communicate accurately and effectively. Different languages, cultures, and time zones added complexity to the already difficult task of managing project team members with different perspectives and backgrounds (Barczak, McDonough, & Athanassiou, 2006).

In the current environment, companies have to globalize in order to achieve success in the business. Most large corporations deal with international companies directly or indirectly. No American corporation is immune from the impact of globalization. The fact is corporations must cope with diverse cross-cultural employees, customers, suppliers, competitors, and creditors if they are to become and/or remain successful. People are often not aware of the tremendous impact different cultures have on their vision and interpretation of the world.

Team members cannot fulfill their roles and responsibilities if they do not have necessary information about the project. The project leaders need to share relevant project information with all team members, even if they are not directly affected. By sharing important information with all team members, the project manager also keeps them motivated and committed to the project. This type of sharing is more important in some countries than others, because in some countries employees feel an obligatory sense of responsibility that necessitates a closer relationship with their managers.

Project management strategies are the key elements for corporations when dealing domestically or globally. The best business models and associated processes were those that were fully documented and incorporated within the company’s total quality management (TQM) systems. “Good leaders do inspire confidence in themselves, but a truly great leader inspires confidence within the people they lead to exceed their normal performance

level” (Prabhakar, 2005). Idealized influence is an important leadership quality that has an impact on a successful project anywhere in the world. With these combinations of global integration practices, success is imminent and measurable.

### FUTURE TRENDS

Much research has been done on the methods of project management, but it is evident that more attention is needed on best practice standard methods, namely, the delivery of change control in client projects (operationally) and in project management infrastructure procedures alike. Ambiguity caused by change is probably the single-most derailing element that leads to project failure today. As Bresnen, Goussevskaia, and Swan (2005) observed, “There is a lack of research that explores the micro-processes of organizational change and their effects on the development and emergence of organizational routines.”

If the organization had the vision to implement a robust change control process for all client and infrastructural work, it could tackle this ambiguity and turn it into a welcomed positive aspect for the organization and clients. The client will consider this process as a highly organized component to the business, eliminating questions, controlling scope creep, and adding overall value to new service or product offerings in the future, thus improving client and employee relationships. A change control process would not only manage ad-hoc requests by clients, but also to deal with systems and process changes within the infrastructure of the organization.

It is apparent that organizations are examining the nature and dynamics of organizational routines and their relationship to change processes today. We believe it will increase knowledge and learning across all functional teams, but not without capturing this and other processes in some type of learning vehicle, such as learning management systems (LMS). The capturing, storing, training, and then re-evaluating the best practices procedures

are key factors to project management and overall success.

There is much resistance to change and less willingness with sharing knowledge for fear of having one’s position eliminated. If a procedure or uniform planning mechanism were established across all projects, there would be accountability and acceptability on all fronts. Today there exists *business practice management* (BPM) software that is an example of such a learning vehicle for intercontinental organizations willing to optimize processes. What we foresee is the software to incorporate a process evaluation for us. While this may prove to be a daunting invention, we see this as a very real possibility. BPM is different from conventional approaches in that it hinges on *continuous process improvement* (CPI) as their core competency and philosophy (Miers, 2006).

We see a future trend as similar learning software as having the capability to detect or “alert” organizations when breakthrough developments emerge, which are closely related to the current organizational process or technological application(s). The implications of an “alerting” system would be vast and great if it could be applied. Of course, our opinion is that the use of subject matter experts would still be required to evaluate how the alerts were applied. This alerting system could revolutionize project management process in that a proactive approach could be taken by applying new and better methods. This would ultimately change the role of the project manager to a less administrative role, task pusher, risk mitigator, to the people manager, with less emphasis paid to issues and risks related to “missing” steps, or overlooking the quality of a task performed. Certainly, system designers, systems analysts, administrators, and managers have a big role to play in the future.

### CONCLUSION

Project management is the application of knowledge, skills, tools, and techniques to a broad range of

activities in order to meet the requirements of the particular project. The methods of project management must be evaluated on a company basis to decide which method is best for its organization to implement its projects. If possible, an analysis should precede it to find what processes need improvement, if any. The new proposal of incorporating change management procedures overall, would also be useful with any project management method. Whether utilizing a Gantt chart, PERT chart, CPM network, dashboard reporting, overall team procedures with meeting schedules, and pertinent project information needs to be disseminated to all functional team members and stakeholders alike.

With the risks today, all organizations must realize the value of our mistakes. With all projects, success needs to be defined, and overall project lessons learned must be admitted and documented. Mistakes or risks in projects should be raised as soon as they are found, and in conjunction with the client involvement. This will alleviate catastrophic failure. Failure in any way should be embraced, not punished or looked upon as negative. With global knowledge database incorporation, organizations could capture these lessons and improve upon their processes to correct any future actions. This emphasis on risk identification, process documentation, and overall communication, must be emphasized from the top stakeholder down to the last functional team members, especially important with global team members. This will ensure a vehicle for organizations to always keep up with the ever-changing organization strategy and vision.

Then change management is an additional sub-process step, which might be a consideration for the project management process overall to help capture the ever-present change requests, whether it be out of scope (scope creep) items or in scope (overlooked) items needed for any client projects, or actual organizational process steps. Any of these items cause additional work and may be a root cause for not having tasks completed on time. With globalization, having people work on projects in functional roles across continents is an added constraint. To break

down restrictions with borders, it is important for organizations to relay all necessary information about a project to these global constituents, including the methods of project management and the steps necessary to complete the project. Communication and learning is the key.

The top stakeholder must make a commitment to put forth this strategy, because this will unite all team members together and motivate them to commit to the project's success. Globalization and outsourcing is an ever-increasing reality today and attention must be paid to process steps and knowledge storage. This is why it is important to have organizations seriously consider using a training tool for all team members in all areas of the world. Here is where we should document all functional procedures, including project management procedures.

We can always fix technical failures, however, it is more challenging to understand the cause of the problems and how people factors are impacted in the ultimate success of a system implementation in an organization. A careful and continuous analysis of risks, gaps, and issues will minimize problems in the future. System analysis and design managers, practitioners, researchers, instructors, and so forth, should be knowledgeable about project management.

## **REFERENCES**

- Aiyer, J., Rajkumar, M. T., & Havelka, D. (2005). A staged framework for the recovery and rehabilitation of troubled IS development projects. *Project Management Journal*, 36(4), 32-44.
- Augustine, S., Payne, B., Sencindiver, F., & Woodcock, S. (2005). Agile project management: steering from the edges. *Communications of the ACM*, 48(12), 85-89. Online <http://agileprojectmgt.org/docs/augustine2.pdf>
- Barczak, G., McDonough, E. F., & Athanassiou, N. (2006). So you want to be a global project leader? *Research Technology Management*, 49(3), 28-38.

- Bresnen, M., Goussevskaia, A., & Swan, J. (2005). Organizational routines, situated learning and processes of change in project-based organizations. *Project Management Journal*, 36(3), 27-41.
- Bromberg, P.A. (2005). *Developer productivity as science and art*. Retrieved on Aug. 25, 2007, from <http://www.eggheadcafe.com/articles/20051218.asp>
- Burgher, P. H. (1964). PERT and the auditor. *Accounting Review*, 39(1), 103-104.
- Carbone, T., & Gholston, S. (2004). Project manager skill development: A survey of programs and practitioners. *Engineering Management Journal*, 16(3), 10-16.
- Chua, A., & Lam, W. (2005). Why KM projects fail: a multi-case analysis. *Journal of Knowledge Management*, 9(3), 6-17.
- Dalcher, D. (2004). Methods—project management. *Project Management Journal*, 35(2), 51.
- Dewett, T. (2003). Understanding the relationship between information technology and creativity in organizations. *Creativity Research Journal*, 15(2&3), 167-182.
- Harris, M. (2006). Technology, innovation and post-bureaucracy: the case of the British Library. *Journal of Organizational Change Management*, 19(1), 80-92.
- Hodgson, D., & Cicmil, S. (2007). The politics of standards in modern management: Making 'the project' a reality. *Journal of Management Studies*, 44(3), 431-450.
- Ivory, C., & Alderman, N. (2005). Can project management learn anything from studies of failure in complex systems? *Project Management Journal*, 36(3), 5-17.
- Jin, X. M., Koskela, L., & King, T. M. (2007). Towards an integrated enterprise model: combining product life cycle support with project management. *International Journal of Product Lifecycle Management (IJPLM)*, 2(1), 50-63.
- Jugdev, K., & Müller, R. (2005). A retrospective look at our evolving understanding of project success. *Project Management Journal*, 36(4), 1-19.
- Kuhl, S., Schnelle, T., & Tillman, F. J. (2005). Lateral Leadership: An organizational approach to change. *Journal of Change Management*, 5(2), 177-190.
- Law, J. (2000). *Ladbroke Grove, or how to think about failing systems*. Lancaster University, Lancaster LA, UK: Centre for Science Studies. Retrieved Aug. 25, 2007, from <http://www.lancs.ac.uk/fss/sociology/papers/law-mol-local-entanglements-utopias-and-train-accidents.pdf>
- Lechler, T., & Ronen, B. (2005). Critical chain: A new project management paradigm or old wine in new bottles? *Engineering Management Journal*, 17(4), 45-59.
- Miers, D. (2006). Best practice (BPM). *ACM Queue*, 4(2), 40-49.
- Miller, R., & Hobbs, B. (2005). Governance regimes for large complex projects. *Project Management Journal*, 36(3), 42-51.
- Mintzer, R. (2002). *The everything project management book*. Avon, Mass: Adams Media Corporation.
- Perrow, C. (1984). *Normal accidents: Living with high risk technologies*. New York: Basic Books.
- Peters, T. (1987). *Thriving on chaos: Handbook for management revolution*. New York: Harper-Collins.
- Prabhakar, G. P. (2005). An empirical study reflecting the importance of transformational leadership on project success across twenty-eight nations. *Project Management Journal*, 36(4), 53-60.
- Punmia, B. C., & Khandelwal, K. (2005). *Project planning and control PERT and CPM*. New Delhi, India: Laxmi Publications.

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Semler, R. F. (2006). International project management day. *PMI Today Project Management Institute*, 1(1), 1-10.

Sull, D. N., & Spinosa, C. (2005, Fall). Using commitments to manage across units. *MIT Sloan Management Review*, 47(1), 73-82.

Thorne, M. L. (2000). Interpreting corporate transformation through failure. *Management Decision*, 38(5), 305-314.

Westland, J. (2006). *The project management life cycle: A complete step-by-step methodology for initiating, planning, executing & closing a project successfully*. Philadelphia: Kogan Page.

### **KEY TERMS**

**Business Process Management (BPM):** An approach or technique that is applied to work flow models. It refers to a set of activities, which organizations can perform to either optimize their business processes or adapt them to new organizational needs. As software tools usually aid these activities, the term BPM is synonymously used to refer to the software tools themselves.

**Change Control:** A formal process used to ensure a product, service, or process is only modified in line with the identified necessary change. It is particularly related to development as during the early development of this engineering process it was found that many changes were introduced to software that had no obvious requirement other than the whim of the software writer. Quite often these unnecessary changes introduced faults (bugs) necessitating further change.

**Critical Path Method (CPM):** One of the techniques used in project planning. It is ideal for projects that are made up of numerous individual activities, some of which require other activities to finish before they can start. The activities are linked to show task relationship predecessors and successors, which then reveals a variety of paths, including the longest path, the “critical” one (hence the name!).

**Learning Management Systems (LMS):** Allows anyone with a personal computer and Internet access to enroll in Web-based courses and performs interim progress tracking and submits to the learning management system server for permanent storage. IBM first invented this system for the use of domestic and global learning when training was necessary for specific types of projects (i.e., privacy issues).

**Program Evaluation and Review Techniques (PERT):** A project management technique for determining how much time a project needs before it is completed. Each activity is assigned a best, worst, and most probable completion time estimate. These estimates are used to determine the average completion time. The average times are used to figure the critical path and the standard deviation of completion times for the entire project.

**Scope Creep:** It is the slow and continuous expansion of the scope of a project, such as data type or routine, resulting in a broad, unfocused, and unmanageable scope and usually leads to cost-overruns, missed deadlines, and loss of original goals.

**Total Quality Management (TQM):** The process that a company uses to achieve quality, where the goal is elimination of all defects. It is also a management strategy to increase awareness of quality in all organizational processes.