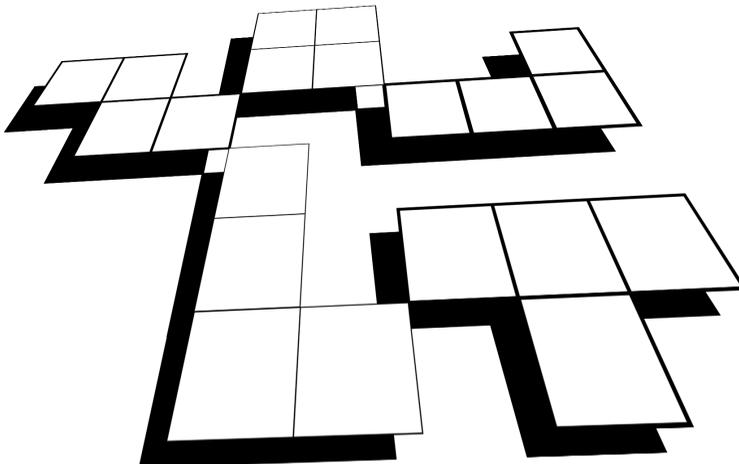

INTRODUCTION TO **PROJECT** MANAGEMENT

IN THIS CHAPTER WE WILL:

- Define project management in an automation setting
- Give examples of projects versus non-projects
- List the five phases of project management
- Define project scope
- Define project goals and objectives for automation project management
- List the duties of a project manager in an automation setting
- Discuss the responsibilities of the project manager



In covering these points, we will also:

- List projects that use project management techniques.
- Define the characteristics of the professional worker.
- Compare professional workers to non-professional workers.
- Compare the needs of professional workers with those of non-professional workers.
- Discuss the team approach to project management.

BACKGROUND AND DEFINITIONS

The techniques used in project management have been around since the 1950s. A number of fields—software development, construction, engineering, business, and manufacturing, for example—have used project management principles to complete large and small projects. A few examples of highly visible projects that have employed project management techniques include NASA's Space Shuttle project, nuclear submarine construction, Boeing 787 jet airplane manufacturing, and the construction of the new Indianapolis International Airport. Project management techniques can be used to carry out large projects that may take years or small projects that reach completion in a few days or weeks. One application for project management techniques, presented in this book, is in the field of automation. An automation manager can apply project management principles to complete a process-control system project that involves designing, building, retrofitting, calibration, and maintenance. We will use a number of examples from the automation field throughout this book to illustrate the principles and techniques of project management.

What Is a Project?

A project is a temporary activity whose purpose is to create a product or service. Temporary projects have a defined beginning and end. Projects usually involve a sequence of tasks with definite starting and ending points. These points are bounded by time, resources, and end results. A project consists of sev-

eral tasks or activities that have the following distinguishing characteristics:

- They have specific starting and ending dates.
- They use resources, such as equipment, people, money, and time that have been specifically assigned to the project.
- They have well-defined goals and objectives.
- They involve teams of people working together to achieve the goals and objectives.
- They have specific requirements for performance and quality.

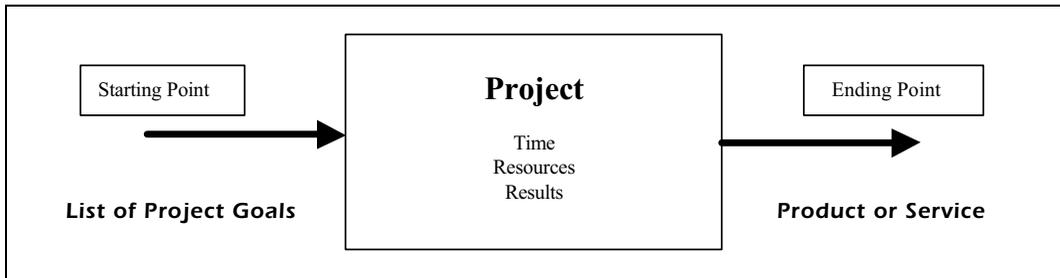


Figure 1.1 - Projects

A project is differentiated from normal work tasks that are accomplished each and every day. Normal work tasks are those that are completed by workers with little thought of planning or organization.

Table 1.1 - How Projects Differ from Normal Work — Some Examples

Normal work	Projects
Calibrating a temperature transmitter	Integrating PLCs into an existing process
Drafting a memo to your employees	Programming an operator interface
Attending a trade show	Designing a new process loop
Purchasing a new control valve	Implementing a new company intranet
Installing a new ink cartridge in your printer	Writing a new control standard

What Is Project Management?

Project management is the managing and directing of company resources to meet the defined objectives of a unique and temporary project. It involves the managing and directing of people, time, resources, and costs for a predefined time period to achieve the project goals and objectives. Project management is usually completed in five phases, as shown in Figure 1.2.

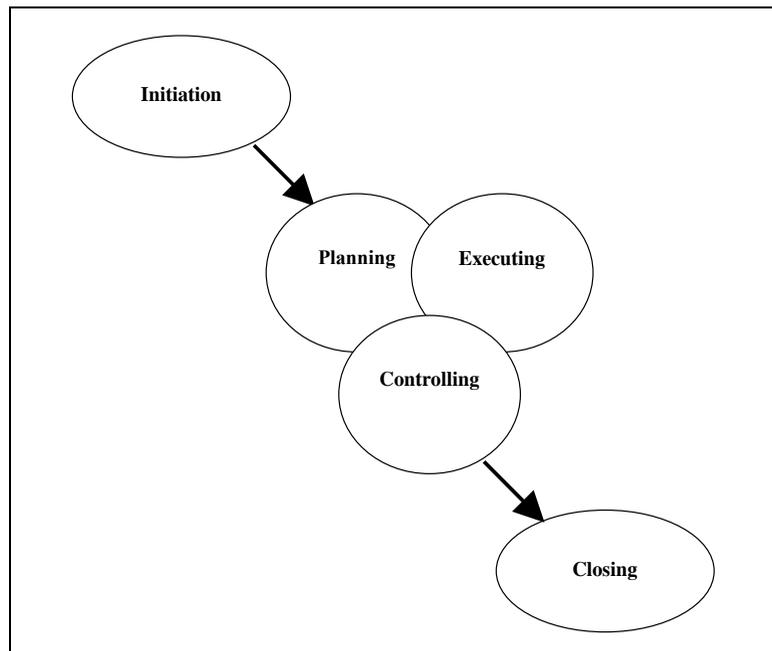


Figure 1.2 - The five phases of project management (2001 Project Management Institute, Inc. All rights reserved. See bibliography #11.)

PROJECT LIFE CYCLE

Collectively, project phases are usually referred to as the project *life cycle*. Each project phase provides a *deliverable* upon completion. Deliverables are tangible, verifiable work products such as detailed plans, prototypes, or a finished product.

Phase 1: Initiation — this phase of the project is the pre-planning phase; it usually results in a defined list of objectives and goals for the project. A feasibility study may be carried out to determine the expected return from the project, what the accomplishments should be, customer expectations, and a general definition of the project scope. From Figure 1.2, it is appar-

ent that the initiation phase is the entry point to the project management process. Although project managers may be involved in the initiation phase, it is more likely that the project manager will become active in the planning, control, and execution phases of a project.

Phase 2: Planning — project planning defines the individual project activities and required resources. Schedules, including goals and deliverables, are devised and a budget is developed during this phase of the project. Planning also includes the identification of objectives to be met by project team members during the course of the project. A number of tools are available for this phase, including the various charting schemes used to graph the project plan. The Gantt chart, PERT chart (Program Evaluation and Review Technique), and CPM (Critical Path Method) are some of the tools project planners have at their disposal. These tools will be discussed in Chapter 2.

Phase 3: Execution — the execution phase of any project involves the coordination of project resources in order to complete each task outlined in the planning phase. The project manager must provide leadership for the project team, guiding the team, and making sure that all tasks are completed within the prescribed criteria for time, budget, and quality.

Phase 4: Control — this phase involves managerial oversight of all aspects of the project. The project manager must monitor progress toward the objectives and take corrective action if any deviation from the plan occurs. The project manager is responsible for monitoring resources, time, people, costs, and technology.

Phase 5: Closing — every project must eventually come to an end. The final phase of the project involves the steps required to finish or close out the project. Tasks that could not be finished during the project because of time or resource constraints are dealt with during the closing phase. A project review is usually undertaken to measure and compare the project outcomes with the objectives outlined in the project plan. A final project report outlining all phases of the project may be required. Delivery to the customer of the product or service, as well as post-project support to the customer, may also be in

order. It is now time for the team to disband and go on to other projects and activities.

PROJECT MANAGEMENT GOALS AND OBJECTIVES

The process of project management follows a prescribed flow of steps, as outlined earlier. These steps begin at the initiation phase and end with the closing phase. What occurs between these two points is the basis for project completion. In order to complete the five phases of a project, a clearly defined picture of what needs to be done and how it will be accomplished must be developed. To develop this picture, some very important project statements must be designed and approved by all of the project stakeholders. These statements begin with the company mission statement. Everything that a company accomplishes must be in support of this mission statement. With an approved mission statement, the project-development process can begin. This process usually begins with the development of a number of objectives for the project, which in turn lead to the setting of project goals. With a list of valid goals in hand, the various strategies can be developed to meet those goals. This process is illustrated in Figure 1.3.

Scope

Every project must have a set of boundaries that specify what will and will not be done. Sometimes in automation engineering, this is referred to as the statement of work. In this book, we will refer to this set of boundaries as the *scope*. Scope can take the form of a document of understanding, project request form, or initiation document. It is important to remember that scope can change over the life of the project. *Scope creep* means a change or modification of the original plan. Changes in technology, manufacturing processes, personnel, and market conditions can result in scope creep. The job of the project manager is to determine how to respond to and accommodate these changes.

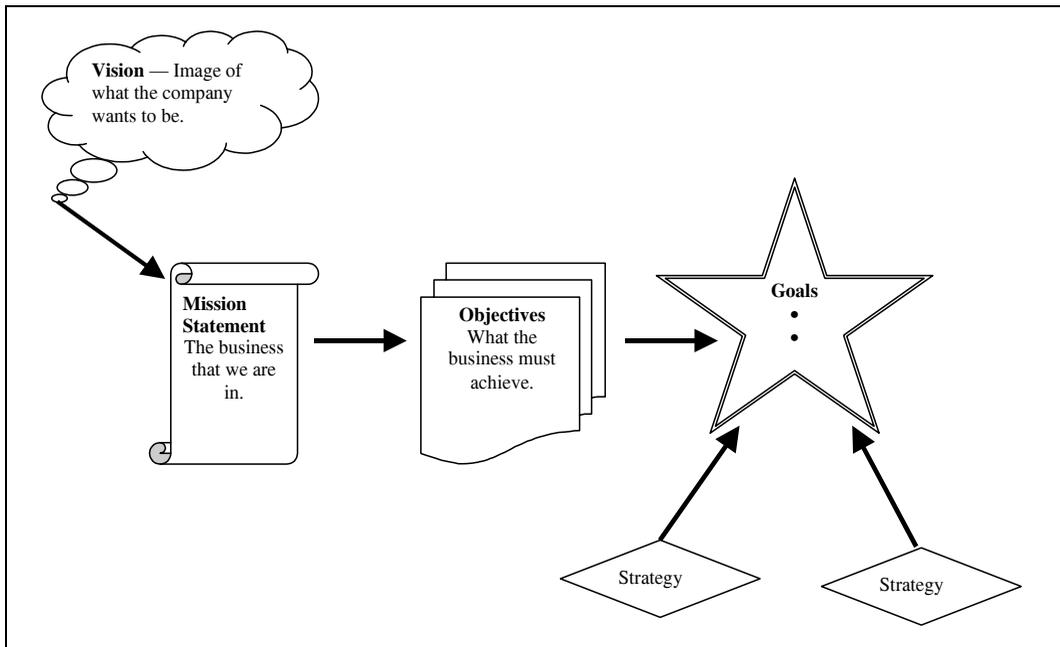


Figure 1.3 - Project Planning Process

Mission Statement

Most companies today have developed a mission statement that essentially states what business it is in or what it is trying to accomplish. The mission statement is a broad declaration of the strategic purpose for the company's existence. All organizational resources will be committed and directed toward that mission. Examples of mission statements include the following:

- To be the number-one process-control software company in the world in terms of marketing, quality, reliability, profitability, and growth.
- Our mission is to develop, design, market, sell, and distribute a line of high-quality control valves to the process industry at competitive prices.

Objectives

Organizational objectives focus on what the company must achieve in order to satisfy the mission statement. Objectives are stated in quantitative or qualitative terms. Examples of organizational objectives include the following:

- Provide customers with a complete line of programmable logic controllers that exhibit characteristics of high quality and reliability.
- Continue the innovative development of new state-of-the-art smart transmitters for fieldbus applications.

Goals

Goals are milestones on the way to meeting organizational objectives. There are six criteria for good project goals.

- They must be specific.
- They must be realistic.
- They must include set end dates.
- They must be measurable.
- They must reflect agreement among stakeholders.
- There must be an identified party responsible for achieving each goal.

The following are a few examples of goal statements.

- Install a new 4–20 mA analog control loop to achieve less than 2% error.
- Tune the temperature control loop to achieve minimum response to a process upset.
- Complete ladder logic programming for the new PLC installation in two weeks.

Tasks

Tasks are the specific work units that must be completed in order to meet the goals and objectives of a given project. Each task is composed of work activities that can be tracked by project managers. The ability to track activities is vital to the project manager for controlling and monitoring phases of the project. For a project to be successfully completed, the work items that make up its tasks must be completed on schedule, within cost parameters, and at the desired quality level.

Project tasks are developed from the lists of project goals, objectives, and strategies. They are usually formulated by breaking down the project goals and objectives into a specific list of all the work that must be done to complete the project. A diagram that documents all of the work to be completed on a project is called a Work Breakdown Structure (WBS). The WBS forms the basis for all cost, schedule, and work-assignment processes on a project. The WBS is discussed in detail in Chapter 2. Figure 1.4 is a simple example of a WBS.

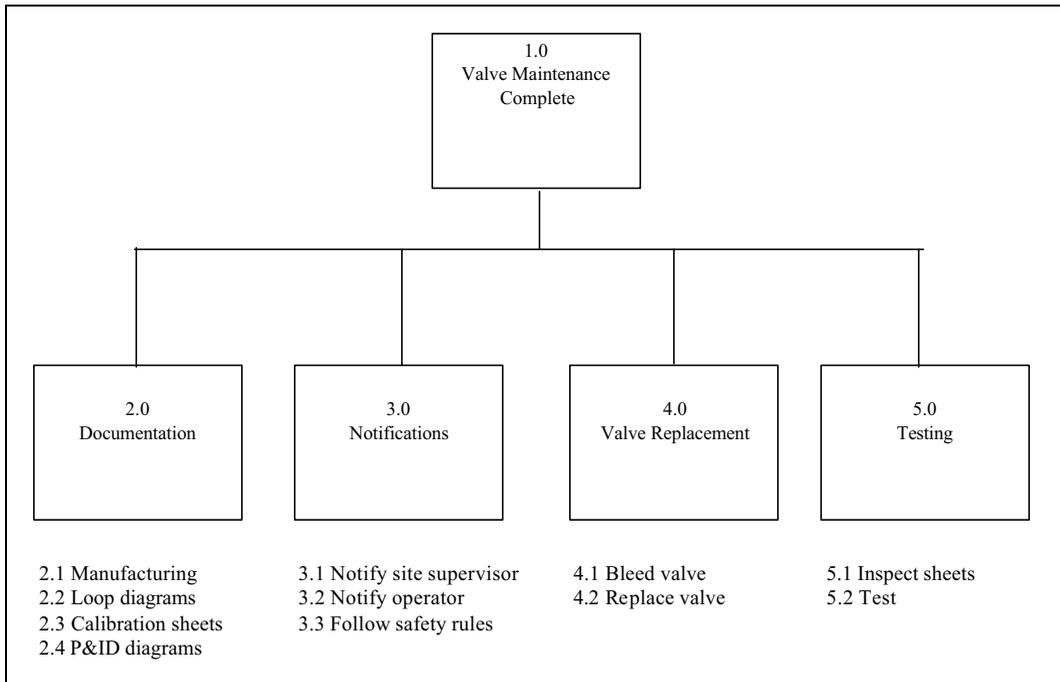


Figure 1.4 - A Work Breakdown Structure for a Valve Replacement Project

As shown in the sample WBS, each work unit is listed under a project milestone or subproject goal. The overall project objective is to perform maintenance on one or more control valves. This is indicated at the top of the hierarchical chart as “1.0 Valve Maintenance Complete.” Listed below this objective are the milestones that must be completed in logical order in order to consider the project complete. Subproject 2.0 begins the process by requiring the acquisition of all documentation materials, including manufacturing data sheets and loop diagrams. Milestone 3.0 includes the required notifications that must be made to supervisors and operators. Items 4.0 and 5.0 include the replacement and testing of the control valve.

The WBS provides the project planner with a standard method for organizing tasks. In addition, the WBS is useful for the following:

- Assigning project task responsibilities
- Developing the budget
- Developing the project schedule
- Developing the time schedule

Strategies

Strategies are the driving force behind reaching project goals. The reaching of project goals allows the project to achieve its objectives, which in turn support the mission statement of a company. The following list includes activities and processes that are typically involved in the development and execution of strategies:

- Project plans
- Project policies and guidelines
- Organizational designs
- Resource-allocation policies
- Leadership guidelines
- Motivational techniques
- Evaluation systems
- Control procedures
- Team dynamics

In the planning phase, the project manager works with others in the company to make sure the strategies for a given project are in line with the overall strategy of the company.

THE PROJECT MANAGER

The Job of the Project Manager

One of the most critical elements in a project—one that can determine its success or failure—is the project manager. Without effective leadership, projects often fail. The causes of failure may vary, but can include the following:

- Budget overruns
- Not meeting quality objectives
- Not completing the project on time
- Ineffective team performance
- Failure to allocate sufficient resources

The job of project manager includes a number of both simple and complex responsibilities related to the project. Although these responsibilities may begin with the initiation phase and end at the closing phase of a project, they usually begin at the planning phase. Thus, the project manager is the central factor in the planning, execution, and control phases of typical projects. Project managers must develop a number of traits that can equip them to succeed. Some of these traits are:

- Leadership ability
- Honesty and integrity
- Technical knowledge appropriate to the project
- Communication ability
- Dependability
- Negotiation skills
- Organization skills
- Decision-making ability
- Business-management experience
- Supervisory ability
- High energy and enthusiasm

In addition to these traits, an effective project manager should be oriented to the customer. The customer is, after all, the ultimate stakeholder in the project.

Some of the responsibilities that a project manager may face during a project include:

- Developing a project plan
- Staffing a project team, including hiring new employees for the project
- Dealing effectively with project team members, including:
 - Solving team disputes
 - Motivating team members
 - Communicating with team members
 - Meeting team members' needs
- Communicating with project stakeholders
- Coordinating resources
- Creating work schedules
- Monitoring project progress
- Developing contingency plans
- Monitoring time and cost details
- Making adjustments to the project plan if needed
- Monitoring quality

In most companies, the position of project manager is considered a middle-management position. Figure 1.5 shows where the project manager fits in a typical organization.

The project managers in the example both report to the General Manager/Plant Manager of the company. Each project manager has a number of specialized people reporting to him or her. These workers make up the project team. The project team consists of experts and skilled workers brought together to work on and complete the tasks included in the project plan.

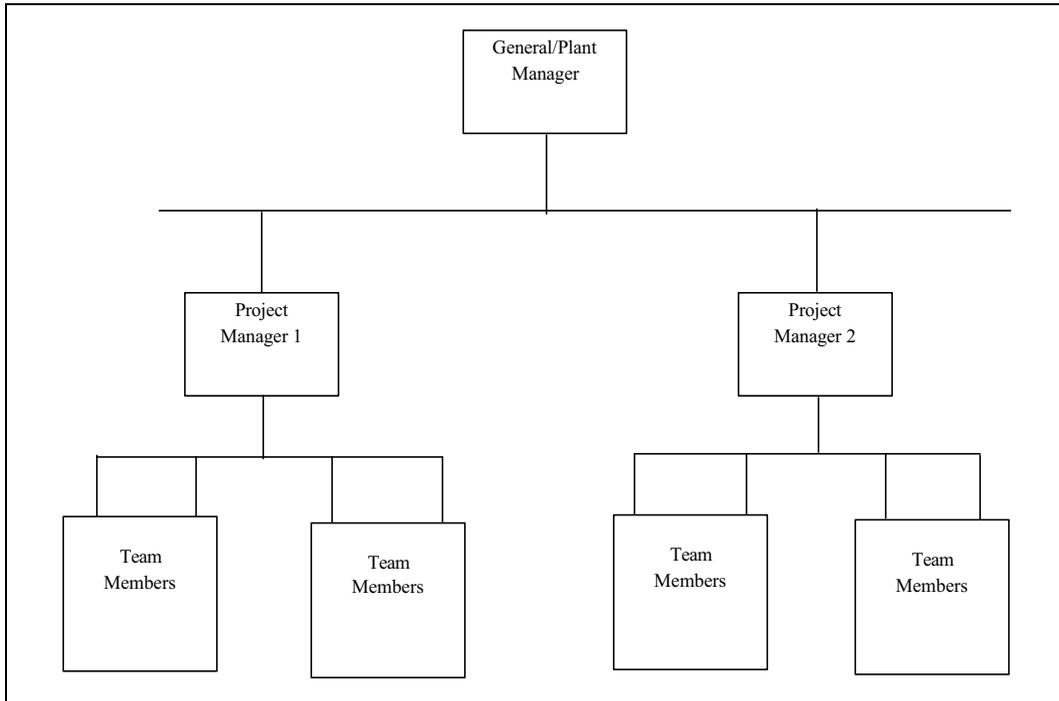


Figure 1.5 - Typical Project Organization Chart for Measurement-and-Control Industries

PROFESSIONALS VS. NON-PROFESSIONALS

This book concentrates on the concepts and techniques used by automation professionals to complete projects in a specific setting. To this end, it is appropriate to define what a “professional” is—and is not—and what he or she does in the workplace.

Professional Workers

The designation of a “professional” has come to mean one who receives payment for doing a job or occupation. It is common to refer to sports figures outside schools and colleges as professionals, while a person engaged in amateur sports is termed “amateur” and “non-professional.” In the workplace, however, a professional is a person who has completed some specialized education and who practices a specialty with an expected degree of excellence and integrity. Merriam-Webster’s Collegiate Dictionary defines “professional” as “characterized by or conforming to the technical or ethical standards of a profession.”

In corporate America, professional positions carry with them high expectations of accomplishment and conduct. Especially in businesses involving technology, most employees are considered professionals even if they lack advanced academic degrees or extensive professional experience. Often the distinction between professionals and non-professionals is one of payment method: Professionals are salaried, while non-professionals are paid by the hour. This distinction, however, is blurring as more companies use outside contractors to accomplish all kinds of work, from engineering to programming to documentation.

For the automation field, the professional is a person with certain academic preparation who possesses skills in a specialty. Their job usually requires the application of technical expertise acquired through academic preparation and experience in the specialty. Professionals are usually part of a professional organization such as ISA (International Society of Automation). Thus, they are expected to follow certain professional guidelines approved and published by the association, and often referred to as ethics. Following these professional ethics is one of the standards for a profession. Figure 1.6 shows the ISA Code of Ethics.

Being active in a professional organization is also a mark of professionalism. Professional organization activities can include the following:

- Attending association meetings and workshops
- Holding leadership positions within the association
- Facilitating or conducting a technical presentation
- Serving on committees

A professional's active support of the association is very important not only to the individual but also to the association that represents the profession. Without this active support, the association, as well as the profession, could be doomed to possible future elimination.

Non-professional Workers

Besides the professionals, any business needs the work of many non-professionals, from lower-level technicians to admin-

ISA CODE OF ETHICS**PREAMBLE**

As engineers, scientists, educators, technicians, sales representatives, and executives in an important and learned profession and in order to safeguard public welfare; and to establish and maintain a high standard of integrity and practice; and as members of ISA, we hold to these Articles:

ARTICLE I

Members shall hold paramount the safety, health and welfare of the public in the performance of their duties, and shall notify their employer or client and such other authority as may be appropriate where such obligations are abused.

Members shall hold in confidence facts, data and information obtained in a professional capacity, unless the release thereof is authorized by their employer or client, and shall not engage in fraudulent or dishonest business or professional practices.

ARTICLE II

Members shall perform services only in areas in which they are qualified by education or experience, and shall endeavor to maintain their professional skills at the state of the art. Members shall practice their profession in a manner which will uphold public appreciation of the services they render.

ARTICLE III

Members shall issue public statements only in an objective and truthful manner, and shall include all pertinent and relevant information in professional reports, statements and testimony. Members shall be honest and realistic in making estimates or in stating claims based on available data. Members shall offer honest criticism of work, and shall properly credit the contributions of others.

ARTICLE IV

Members shall act in professional matters for each employer or client as faithful agents or trustees, and shall not participate in any business association, interest or circumstances which influence, or appear to influence, their judgment or the quality of their services. Members shall accept compensation, financial or otherwise, from only one party for services on or pertaining to the same work, unless otherwise agreed to by all parties; and shall not give or accept, directly or indirectly, any gift, payment or service of more than nominal value to or from those having business relationships with their employees or clients.

ARTICLE V

Members shall use only proper solicitation of employments, and shall represent their abilities, qualifications, education, technical associations and professional registrations without exaggeration and in accordance with the laws of the locations in which they practice.

ARTICLE VI

Members shall pledge themselves to live and work according to the laws of man and to the highest standards of professional conduct, using their knowledge and skills to the benefit of all mankind.

(Adopted by the ISA Executive Board, October 17, 1986;
reaffirmed October 17, 2006)

Figure 1.6 - ISA Code of Ethics

istrative personnel. Non-professional workers are usually defined as those who do not possess advanced education or training. The project management team is likely to include some members whose purpose is to support the activities of the professionals on the team. While it is often assumed that these support workers are not as important as the professionals, it is sometimes the case that projects succeed or fail based on the dedication and motivation—or lack thereof—of these “non-professional” team members.

Thus, issues of motivation apply to both professional and nonprofessional workers.

MEETING WORKERS' NEEDS

Worker Motivation

The job of project manager is a highly complex undertaking. He or she must balance technical skills and knowledge with managerial competence. Since a number of project managers are promoted into the position from the technical ranks, the technical problems encountered are apt to be familiar and relatively easy to deal with. On the other hand, the management skills required for the position may be less familiar to the project manager. An important aspect of personnel management for project managers is motivating project team members. Motivation is an essential component of implementing project plans. Performance of project team workers is influenced by two factors.

Ability is the first of these factors. Any worker must have the skills and abilities to perform the job in a competent manner. The second factor is the worker's motivation level. If two people have the same level of ability, the worker who is more highly motivated usually performs at a higher level because he or she is willing to put forth more effort. One of the project manager's most important skills is an ability to motivate the members of the project team. In order to motivate workers, the manager must meet their needs. To meet worker needs, the project manager must understand worker performance in terms of human behavior. D. McGregor, in *The Human Side of Enterprise* (New York: McGraw-Hill, 1960), discusses worker per-

formance in the context of two different approaches to motivation, which he names Theory X and Theory Y.

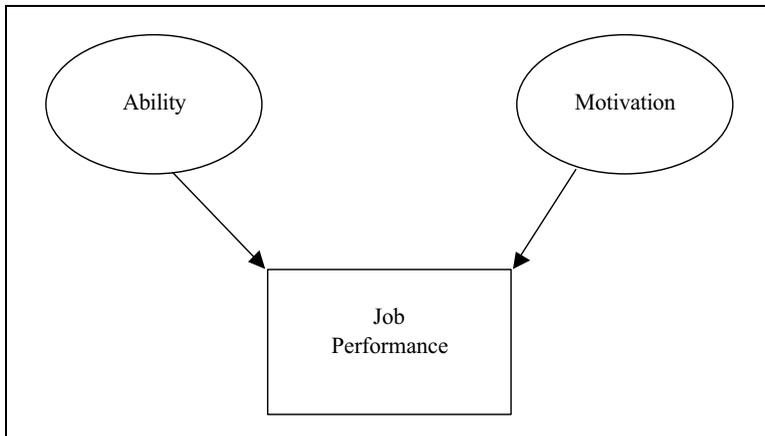


Figure 1.7 - Ability and Motivation in Job Performance

THEORY X

According to Theory X, workers are assumed to be uninterested and unmotivated to perform their work. Management must motivate these workers through external factors, including close and constant supervision. The Theory X worker often needs to be prodded to perform his or her job.

THEORY Y

Under Theory Y, workers are assumed to be naturally interested and motivated to perform their work. Motivation for Theory Y workers comes from factors within the workers themselves, including self-control and self-direction. This type of worker finds the job challenging, rewarding, and fulfilling, and needs little or no external pressure to perform.

Meeting Worker Needs

It is fair to assume that professional workers usually fall into the Theory Y category because of their major investment in academic preparation and professional experience. However, a project manager must be able to motivate a team according to both Theory X and Theory Y because both types of workers exist in any organization. It is apparent from both theories that the basic needs of workers are different. It becomes necessary for the project manager to be able to identify worker needs and

to attempt to meet these needs. Workers who have had their needs met are better motivated to complete all of the tasks necessary for reaching project goals. The needs of all project team members must be considered in the project-planning phase.

In 1954, psychologist Abraham Maslow presented his *Hierarchy of Needs Motivation and Personality* (New York: Harper & Brothers, 1954) to describe the factors that motivate people. Figure 1.8 shows the Maslow hierarchy, which includes five distinct levels of need.

As shown in Figure 1.8, Maslow's hierarchy starts at the base—most basic—and moves upward, each new level built upon the ones underneath it. The levels are defined as follows:

- Physiological Needs are the basic requirements for life, including food, water, shelter, and clothing.
- Safety Needs are the requirements for security, stability, and freedom from harm.

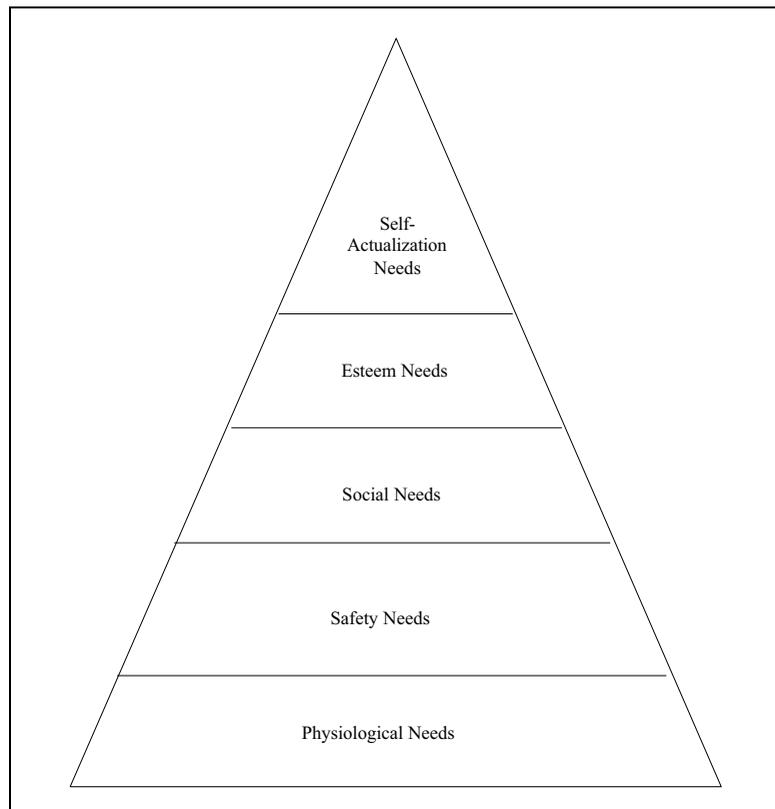


Figure 1.8 - Maslow's Hierarchy of Needs

- Social Needs are our need for friends, affection, love, and association.
- Esteem Needs are our need for respect, accomplishment, recognition, attention, and appreciation.
- Self-Actualization Needs are the need for self-fulfillment and self-improvement.

Each level of need must be met before progressing to the next level. For example, only when a person has satisfied all their physiological needs can he or she begin to think about safety needs. Similarly, a person who feels secure physically can begin to express social needs. The person who progresses to the top level of the hierarchy is approaching true self-actualization in his or her life, and may have reached a point where feelings of self-fulfillment—and deep happiness—prevail. Workers fortunate enough to be at the top level of Maslow's hierarchy pursue opportunities for professional growth and ways to improve work performance, for the pleasure of achievement. Most workers, however, are located in the middle levels of the motivational hierarchy and have needs at the social and esteem levels.

The project manager must learn how to identify worker needs and be able to meet them. Some motivational needs of all workers include the following:

- A fair salary
- Safe and positive working conditions
- Appropriate and consistent supervision
- Interesting and challenging work
- Recognition
- Increasing responsibility
- Opportunities for professional growth

A project team whose members are highly motivated will move naturally toward attainment of all project goals. To develop motivated workers, their needs must be met. The project manager can help in meeting these worker needs. Each individual employee's needs must be identified; and no two employees are the same in their needs. Professional workers

may have needs that are different from those of non-professional workers. With the workers' needs identified, a plan can be formulated to make sure that these needs are met.

PROJECT TEAMS

A very important aspect of project management is the methods used to accomplish the goals and objectives put forth in the project plan. The project plan provides a roadmap for where the project is to go and how to get there. The way these goals are reached depends on the breakdown of tasks and milestones outlined in the work breakdown structure. To complete the tasks in the project plan, the workers are the foundation of the process.

As a project manager, the way you organize the workers to complete project tasks is critical. One method that has proven effective in recent years is *team management*. On this method, projects are undertaken by teams comprised of individual workers. Therefore, project managers must know how to deal with people both as members of a team and as individuals. The project team is defined as a small number of workers with complementary skills who are committed to a common purpose and performance goal. These people come together to work with a common approach, and with mutual accountability, to achieve the goals and objectives outlined in the project plan.

A common team organization used in project management is the centralized structure, whereby the project manager is also the team leader. Figure 1.9 is a diagram of the centralized team structure.

In this organizational model, team members report to the project manager at the center of the structure. The project manager provides leadership to help guide the team toward its goals and objectives. The project team can be a powerful tool in project success, just as the athletic team that wins a championship competition achieves success. Team dynamics and development are discussed in more detail in Chapter 5.

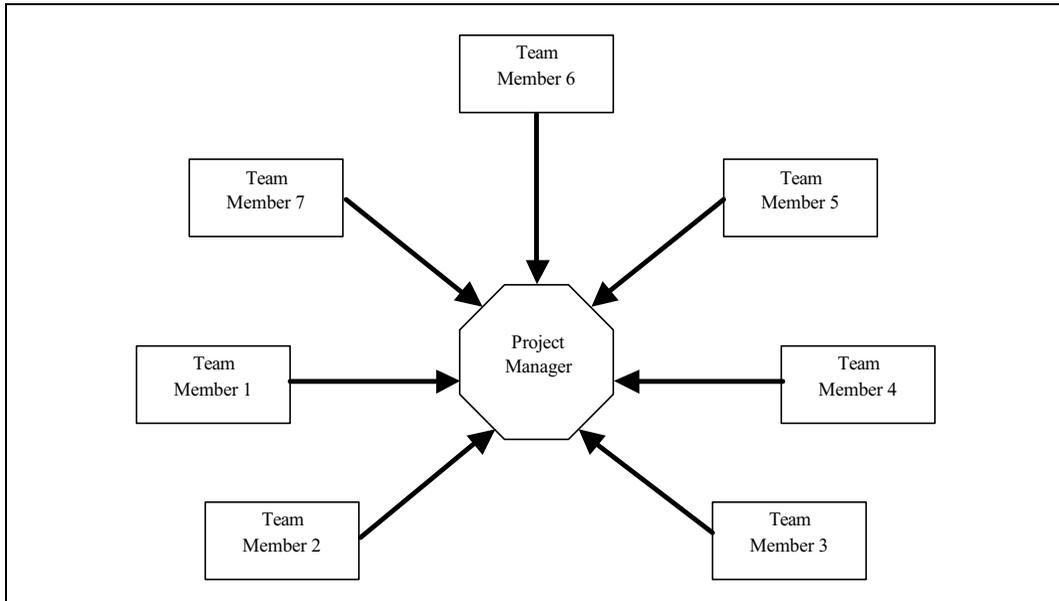
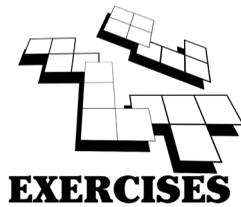


Figure 1.9 - Centralized Team Structure

SUMMARY

Project management includes a number of tools to be used to complete activities in business and industrial settings. It is composed of a number of methods and concepts that can be used to bring about success in the completion of projects. We define success as completion of the project on time, within budget, and at the desired levels of technology and quality. In subsequent chapters of this book, we will discuss the various tools available to the project manager to make the process run in an effective and efficient manner. This book is meant to be a guide for the practicing project manager or a learning aid for the future project manager.



1. Write a definition of a project.
2. Explain scope creep and its effect on the project plan.
3. List and explain the five phases of a project.
4. Define project management.
5. List the responsibilities of a project manager.
6. Name some common projects that you are familiar with in your local area. Identify the characteristics that indicate each is a project.
7. Name some common projects that are apt to be encountered in an automation environment.
8. List some of the typical duties of the project manager in the automation industry.
9. Develop a work breakdown structure (WBS) for one of the projects listed in 6 or 7 above.
10. Compare professional workers with non-professional workers.
11. Discuss some advantages in using the team approach in projects.

PHASES OF PROJECT MANAGEMENT

IN THIS CHAPTER WE WILL:

- Review the five phases of a project
- Define goals, objectives, tasks, and activities typical of automation projects
- Show the phases and categories of a risk assessment
- List sample sources of project ideas
- Show sample mission statements
- Show sample goals for automation projects
- Show sample objectives for automation projects
- Show sample tasks and activities for automation projects
- Develop task lists for automation related projects
- Develop a WBS for sample projects
- Define PERT, CPM, and GANTT charts
- Develop planning charts for projects using PERT, CPM, and GANTT methods
- Explain the monitoring and control function of the project life cycle
- Show sample leadership qualities of a project manager
- Explain the project-closing process

