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Managing New Product Development: A Project Management Manual

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MANAGING NEW PRODUCT DEVELOPMENT: A PROJECT MANAGEMENT MANUAL

Ronald A. Hoormann, B.S.

An Abstract Presented to the Faculty of the Graduate School of Lindenwood College in Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

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ABSTRACT

The purpose of this study is to develop a new product development project management manual for a typical firm. It will also investigate many of the problems companies have had managing the development of new products, as well how these companies have addressed the problems. The manual is intended to define a project management system by describing the goals of project management; the project management organization for the firm; job descriptions as they pertain to project management; the product development cycle; the project management process; and the procedures that will be used to plan, monitor, and control a project. It is not intended to be the ideal system for all firms, but one way to implement project management. For this reason, it will also outline a procedure to be used to customize the manual for a particular firm's needs.

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A Culminating Project Presented to the Faculty of the Graduate School of Lindenwood College in Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

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INTRODUCTION

Project Management

Today's marketplace requires that new products be developed quickly, and that they offer a sellable edge over the competition. Paul Waitkus, the Engineering Operations Manager for Digital Equipment Corporation, wrote, "The days when products could be designed in an almost leisurely way, with only marginal improvements in performance and reliability, are long gone." Project teams are being developed that include all areas of the corporation: engineering, manufacturing, product assurance, field service, marketing, quality control, and accounting (91-92). In order to accomplish these goals, project management techniques have emerged. In an article by Donna Dressler, titled "In Project Management, the Emphasis Should Be On 'Management'," she believes project management should,

> .... encompasses the planning, organizing, directing and controlling of company resources for a relatively short term to complete specific goals and objectives. Project management is designed to obtain more effec-

> tive and efficient use of resources such as staff power, money, information/technology, equipment, facilities and materials. (62)

The goals of project management are to "complete objectives within a specified budget, time, and specifications of technical merit" (U.S. Office of Personnel Management I-2).

According to Harold Kerzner's Project Management, A System Approach to Planning, Scheduling, and Controlling, a project can be defined as any series of activities or tasks that:

- Have a specific objective to be completed within certain specifications
- Have defined start and end dates
- Have funding limits (if applicable)
- Consume resources (i.e. money, people, equipment). (2)

John M. Nicholas, Ph.D., an associate professor of Management Science at Loyola University of Chicago, categorizes causes of successful project management into three categories: "participants's involvement in the project, communication and information sharing and exchange, and the project management system's development process" (25). The key participants in project management include top management, the Project Manager, the project team, and the client or user. All

of the participants must be strongly committed to maintaining and fulfilling project goals. They must also be committed to the project management process, the concept of project planning and controlling, and to putting the concept into practice. The participants must also be involved in the project. "They must have the opportunity and the desire to provide necessary inputs at key stages of the project life cycle" (25).

Top management's support is essential because it affects the degree of acceptance or resistance to the project. Examples of ways management can show its support are: 1) by backing the Project Manager in times of crisis, and 2) granting the Project Manager significant authority. Successful project managers are strongly committed to meeting project goals.

> They must be both people-oriented and results-oriented, diplomatic as well as hard-driving. These project managers have strong leadership styles which allow them to compensate for gaps between their authority and responsibility. (26)

The Project Manager must also be able to trust the skills of the project members and delegate work to them.

> In successful projects, the project team is committed both to the goals of the project

> and to the project management process. The team is involved in estimating, setting schedules and budgets, helping solve problems and making decisions. (26)

Successful project teams will identify the users before the project begins and clearly understand his needs. The user must be committed to the project goals and involved in the project management process. The following are some examples of ways the user can be involved: sharing in decision-making, authorizing changes, and helping select sub-contractors. The user must be involved in the planning and designing process. However, note that there situations where proprietary information may restrict the user's role.

The project management system can be broken into four parts: definition, planning, control, and implementation. During the definition phase, the project team must clearly and completely define the project's scope, objectives, and work to be accomplished. Project responsibilities and requirements must be clearly understood by every team member.

> Successful projects have a plan which relates time, money and performance goals. The plan makes adequate use of definitive cost estimates, scheduling and network techniques, milestones, scope and work definition, cash

> flow analysis, labor and equipment requirements, and risk analysis. (27)

A good project plan is one that all project participants can live with.

Project control is achieved through a system that provides monitoring and feedback at various stages of the project by comparing the schedules, budgets, and key performance with project goals. This system should anticipate problems and take the appropriate action to resolve them.

> In successful projects, minimum changes are allowed except when they are essential to safety or to facilitate the job. Changes are made on paper early in the job, not later. (28)

The implementation phase of a project should be clearly defined in the project plan. During this phase, there should be a strong liaison between the project team and the end user.

Types of Project Management Organizations

Firms can organize their projects in different fashions: functional organizations, matrix organizations, and/or project organizations. In a functional organization (Figure 1), projects are made part of one of the functional divisions of the company,

such as finance, marketing, manufacturing, or engineering. Projects are usually assigned to the functional group which has the most interest in ensuring the project's success. For example, if a project involves developing a new technology, it is most likely to be assigned to the engineering department, whereas if the project involved introducing a new production line, it most likely would be assigned to the manufacturing department. The primary advantage of a functional organization is the flexibility in the use of manpower, since the functional group's management has direct authority over both personnel and the project. The primary disadvantage of this type of organization is that the functional group's focus is not always on the project, since the functional group may have other priorities (Meredith 97-98).

In a project organization (Figure 2), each project has a complete staff in all aspects of the project. That is, the project will include finance, marketing, manufacturing, and engineering. In this type of organization, each Project Manager usually reports directly to the president of the company. The primary advantage of this type of organization is that the Project Manager has full-line authority over the

project. The primary disadvantage of this system is that each project must be fully staffed. This can lead to considerable duplication of efforts, thus increasing costs. This type of organization can also dilute the technical knowledge of the firm, in that, the project may not have the correct technical skills for all phases of the project (Meredith 99-101).

A matrix organization (Figure 3) is a combination of a functional and project organization. In a matrix organization, functional groups such as engineering, marketing, finance, and manufacturing retain their respective technical expertise. The functional groups will then loan resources to the respective project managers to accomplish a given task. Usually the project managers and functional managers will report to the same level. In the case of Figure 3, this would be the president of the company. The functional managers have direct authority over the people within their department, however, the project managers have indirect authority over the same people in that they are given responsibility for getting a project accomplished within its goals. This is sometimes referred to as dotted line authority. The primary advantage of matrix management is that it takes advantage of both

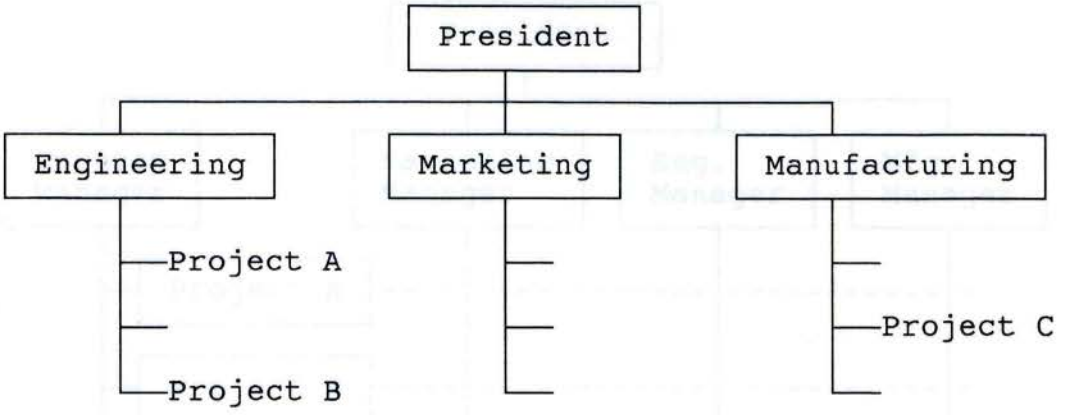
functional and project organizations. The Project Manager has the optimal resources and focus to accomplish the project's goals. The primary disadvantage of a matrix organization is that it violates the principle of unity of command, in that workers will have two bosses, their Functional Manager and Project Manager (Meredith 101-104).

Adolph Mueller, Vice-President of Controls and Fasteners Group of TRW, Inc., believes that matrix management can bring small company flexibility to large, complex organizations. One of the advantages of matrix management is that it:

> ... brings managers together; it compels them to talk to each other, and in the process, to challenge assumptions about how things are being done, to air any potential conflicts, and reach agreement on what actually needs to be done. (41)

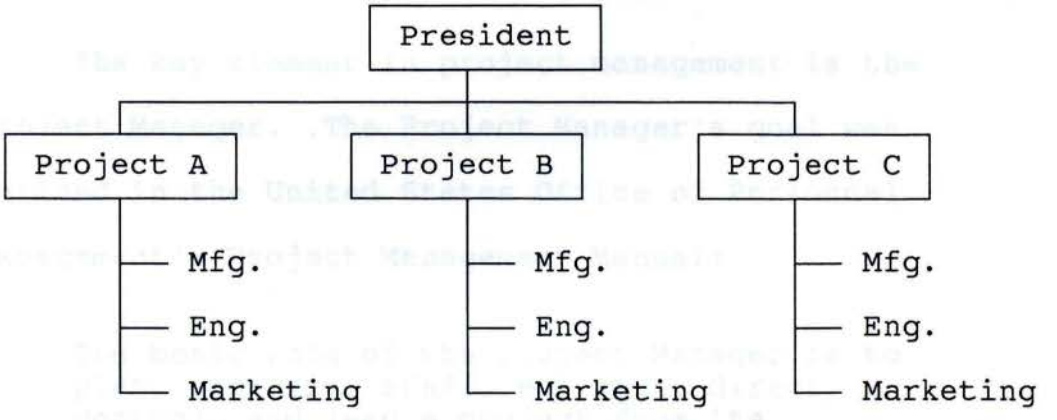
Matrix management also makes it easier to get team member commitments since the team members have had a part in making the decisions.

Figure 1
Functional Organization



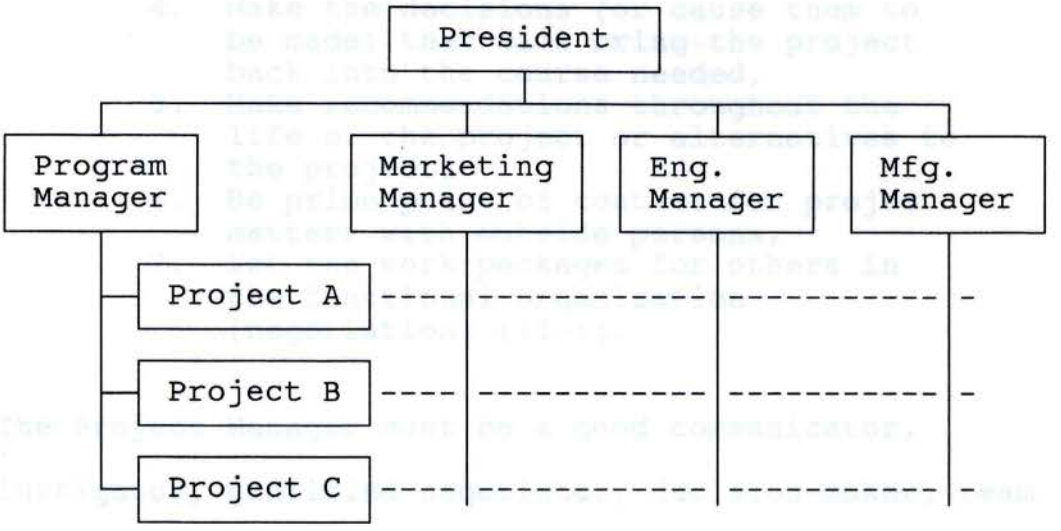
SOURCE: Project Management: A Managerial Approach, by Jack R. Meredith and Samuel J. Mantel, Jr. (1985): 96

Figure 2
Project Organization



SOURCE: Project Management: A Managerial Approach, by Jack R. Meredith and Samuel J. Mantel, Jr. (1985): 99

Figure 3
Matrix Organization



SOURCE: Project Management: A Managerial Approach, by Jack R. Meredith and Samuel J. Mantel, Jr. (1985): 102

The Project Manager

The key element in project management is the Project Manager. The Project Manager's goal was defined in the United States Office of Personnel Management's Project Management Manual:

> The basic role of the Project Manager is to plan, organize, staff, evaluate, direct, control, and lead a project from its inception to its completion. To perform these activities, the Project Manager has the responsibility to perform the following:
>
> 1. Us existing organizational resources, to produce the objectives within cost, technical, and time specifications,
> 2. Meet any profit objectives set for the project,

3. Alert higher management when it appears that cost, time, or technical specifications will not be met,
4. Make the decisions (or cause them to be made) that will bring the project back into the course needed,
5. Make recommendations throughout the life of the project or alternatives to the project,
6. Be prime point of contact for project matters with outside persons,
7. Set the work packages for others in the functional organization (negotiation) (II-1).

The Project Manager must be a good communicator, instigator, qualified negotiator, decision-maker, team leader and salesperson (Dressler 62). Harold Kerzner also added that a Project Manager must be a results oriented individual (In Search of Excellence... 37).

Project management is more than just developing a product. According to Michael Lackman, a consultant who specializes in project management, a project is an active process that consists of six major components:

- Development of a team
- Understanding and working with a client, customer, or marketplace
- Scheduling and planning
- Developing a product
- Management of resources - financial and equipment
- Project monitoring (8).

The Project Manager's most important activity in getting the project accomplished is to develop a team.

The first step is to identify the skills, traits and qualities of the positions that will be needed for the project. It is important to find the best possible people for the positions, capable of working together as a team. The team members must have a common vision of the goals and an understanding of their roles in achieving these goals. The Project Manager must also make sure that the team members have the necessary resources to get the job done (9-10).

Understanding and working with a client, customer or marketplace is one of the most misunderstood and abused activities. Lackman states:

> Often a customer does not understand what is truly needed. Only by understanding the customer's business, their problems, their goals, their constraints, weaknesses and strengths, can a project team hope to develop a product which the customer needs. A big gap can exist between what the customer asks for and what the customer actually needs. (10-11)

Developing the product is the best understood activity. This includes product specification, documentation, design, development, testing, introduction and implementation. The Project Manager's primary responsibility is to make sure the team understands the product that the customer needs, and

monitoring the team's activities so that the product does not drift away from the specifications (11).

Although planning and scheduling usually receives the most attention, it usually has the poorest results. The following are the three most common reasons for scheduling problems:

1. The schedule was never workable given the personnel and equipment resources available to the project.
2. Unexpected technical difficulties and complications. Always expect and have padding in the schedule for the unexpected.
3. Critical deliverables from other groups or companies, such as equipment, parts, software, documentation or specifications, were late. Monitoring of deliverables from other sources, risk analysis and contingency plans are the most effective way to reduce the potential impacts from external sources. (11)

The easiest way to avoid problems with scheduling and planning is to use teamwork. All members of the development team should work together and review proposed schedules and plans (11-12).

The Project Manager also needs to manage the project resources. This can include such things as staff, equipment, capital, time, and reputation/ credibility. It is important for the Project Manager to always be aware of the "cost" of each resource and

the relationship between resources. Lackman believes, "The most important resource is the reputation of the development team and your company." Project managers will sometimes spend their company's reputation by missing delivery dates or shipping low quality products. This should be avoided if at all possible (12).

Project monitoring is also an important activity for the Project Manager. The following are some activities the Project Manager can do to ensure effective project monitoring:

- Establish a reporting system so that if any resource becomes critical then quick action can be taken to correct the problem.
- Always be aware of the critical path and the cost of any decision which will affect the critical path.
- Always notify the customer immediately when problems arise which might impact the product, cost, or schedule.
- Create an environment which encourages involvement and commitment of the entire team in watching for and reporting potential problems. (12)

Product Development Process

An article written by Paul Waitkus titled, "Managing High-Tech Development," defined the product development process in four major steps: strategy and requirements, planning, implementation, and

qualification. With respect to strategic and requirements, the project team's marketing group should analyze the user's needs and prioritize them. They should also address such issues as: delivery, functionality, quality, ease of use, performance, compatibility, and serviceability. A marketing plan would be developed to address pricing, channels of distribution, and the sales approach. The team must also consider alternative approaches to meeting product requirements. Manufacturing must evaluate their requirements as far as their impacts on manpower, space, and cost factors. Field service will evaluate their requirements as far as their impacts on training, logistics, documentation, and manpower. Planning involves developing a functional specification for the product. The specification should translate the product requirements into a detailed working document that includes how the product will look, operate, and how its functions will be distributed among various components. The plan must also consider:

- Description of critical relationships among hardware and software components, as well as human factor considerations.
- Statement of engineering decisions on strategic matters such as system architecture, technology, and compatibility.
- Identification of applicable company and

external standards and regulations of how compliance is to be achieved.
- Explanation of how the product requirements determined in the first step will be met and, conversely, why certain requirements cannot be met by the proposed design.
- Specification of the commitments and cost of all groups that are necessary to achieve the project's objectives.
- Outline of the master plan's schedule, project resource plan, and organizational chart.
- List of all major responsibilities of each particular group, as well as the commitments required by international marketing considerations, including product certification by national agencies. (94)

Examples of some of the types of items that are covered in a project plan include:

1. A statement as to the type of technology being used, such as the product will be made out of plastic versus metal.
2. Resource requirements could be defined as the number and type of engineers, technicians, and support personnel, and for how long.
3. The product may be required to meet certain safety agency standards such as Underwriters Laboratories Inc. (UL) and/or Canadian Standards Association (CSA).

Implementation concerns the design, prototype, and testing of the product to verify product specification.

According to Waitkus, a product assurance group should not be part of the project team. Their task is to perform an independent evaluation of the product's design. This will begin with a paper design review early in the implementation step, and finish with a reliability qualification test. Evaluation by outside safety and regulatory agencies will be performed during this test.

During the qualification step, production units are built in a pilot run and qualified by testing specialists within and outside the company. Pilot production involves taking the design from engineering into the manufacturing facility. Waitkus believes:

> The results of the reliability, design verification, and field test are submitted to an independent review team consisting of quality control specialists in engineering, manufacturing, field engineering, product assurance, and the corporate reliability staff for approval. (96)

Product development is complete after the qualification step. Before the project team is disbanded, they will meet to perform a wrap-up review of lessons learned. At that time, the project team should be able to answer the following questions:

> How did we do in relation to our plans?
> What happened in regard to the matters that

did not turn out as planned?
What would we do different next time? (96)

For example, the project team may determine that the project met all of its performance goals, but was two months late and over budget. The team may then recommend some changes to the project management system to alleviate this problem in the future. The answer to these questions should be published widely throughout the company so that other people can learn from the experiences of this team.

Paul Bernard, a senior systems engineer with Litton Integrated System Technologies Industries, believes that a structured project methodology is needed to manage the product development process so that management can make informed business decisions. Bernard's plan includes:

1. Project teams
2. Establish project perimeters
3. Direction
4. Information gathering
5. Analysis
6. Alternatives
7. Costs
8. Schedule
9. Risk analysis
10. Conclusions
11. Recommendations
12. Sell management on the results. (52-57)

Project teams should understand how the business

operates and have the expertise necessary to perform the justification analysis. After the team is assembled, they will meet with the company's management to establish management's expectations for the project and to resolve any conflicting goals or objectives. Information gathered during the "direction" step should allow the team to formulate the project goals, objectives, constraints and qualifiers, and to make individual team assignments. An operating budget, which should cover travel, research and development, prototypes, contract personnel, and administrative expenses, is an example of one item that is developed during this step. During the "information gathering" step, the team will try to learn as much as possible about the technology to be used in this project. For example,

> ... product and process, evaluating existing equipment and personnel capabilities, identifying present operating costs and support requirements, and doing a partial or comprehensive business analysis and marketing study. (53)

The team will then analyze the effects of different business and technical issues on the company. Brainstorming is an example of one way to identify and prioritize areas to be analyzed. During the alterna-

tives step, the team must investigate different scenarios for the interactive effects of cost, quality, reliability, flexibility, demand, competition, governmental regulations, obsolescence, personnel, product redesign, process change, other capital and strategic projects, lead times, etc. It is important to identify which areas of cost are important to the decision making process. Typically, costs fall into four areas: product cost (material, labor, and overhead), capital cost (equipment, tooling, etc.), operating cost (space, utilities, perishables, etc.) and project cost (development man-hours, prototypes, etc). The team will then develop the project's schedule and action plan.

A risk analysis should also be performed on the project. Bernard believes,

> A complete justification must include an evaluation of all areas of risk associated with the project according to the probability of occurrence and the magnitude of the effect on the project. (56)

The following are examples of areas that may be evaluated during the risk analysis step: cost, performance, manufacturing, financial performance, reliability, personnel, obsolescence, and customer

satisfaction.

"When the project team reaches this point, some conclusion must be reached about the technology and project viability" (56). The next step is to enumerate all the various recommendations identified by the project team. "Each recommendation should be stated in enough detail so that some specific action can be taken" (56). The last step is to prepare a presentation for management to sell them on the results of the investigation. The following are examples of what might be included in this presentation: a description of the actual project methodology which was followed, any sources of data, calculations, simulations, or analysis.

Statement of Purpose

In summary, to accomplish the goals of a project, some form of project management techniques must be employed. Since matrix organizations offer the advantages of, and minimize the disadvantages of, both functional and project organizations, the remainder of this paper will focus on a matrix type of organization. The purpose of this paper is to develop a project management manual to be used in training new and

existing project managers on how to manage new product development projects. This manual will also define the project management techniques and procedures to be used within the firm.

Chapter II

LITERATURE REVIEW

Michael W. Hughes, in a article titled, "Why Projects Fail: The Effects of Ignoring the Obvious", concluded that projects fail because of:

- Improper focus of the project management system.
- Fixation on first estimate.
- Wrong level of detail.
- Too much, too soon.
- Too many people.
- Lack of communication of goals.
- Rewarding the wrong actions. (14-18)

Avots, in a similar article believes that project management systems fail because:

- The basis for a project is not sound.
- The wrong person is appointed Project Manager.
- Lack of organizational support.
- Poor definition of objectives.
- Poor techniques in planning, scheduling, and controlling.
- Lack of agreement of measurement of objectives.
- Lack of necessary information to control the project.
- Inflexibility to change.
- Interface problems.
- Project manager not given authority to meet responsibilities.
- Inability to make quick decisions. (3)

Both Hughes and Avots, share similar views and agree that inflexibility and poor project management techniques contribute to product failure. For example project inflexibility would be a requirement that a project maintain the original schedule, even though it was developed before the team had a good understanding of what it would take to do the project. Examples of poor project management techniques include:

- Spending more time managing the project than actually doing the project's work.
- A project where the staff has no overall picture of what is going on, and no sense of importance.

Another problem with project management is the way that most project managers are trained. According to a 1983 study of 110 project managers, most of the companies employ the "sink or swim" technique of project management training (Thornberry 60). For example, a firm may make an engineer a Project Manager without any training, then hold him/her accountable for less-than-successful projects.

According to Richard Plasket, senior associate with Bauer & Associates, Inc., a consulting firm which specializes in organizational systems, estimated that only three out of every ten projects are managed by

effective project management techniques. He believes that this lack of good project management techniques causes many projects to fail. Companies today are becoming more project oriented in an effort to be in better control of their resources. According to Plasket:

> ... the supply of trained and/or experienced project managers does not meet the demand. Untrained, inexperienced staff members are placed in charge of projects and are floundering in the area 'behind schedule and over budget.' (6)

Many people have tried to use project management software packages as a solution to this problem. What they don't realize is that the software cannot manage their project, but is only a tool to help collect, store, manipulate and display data and information. Plasket maintains that,

> In order for the new technology to enhance the old concept of project management, you first should have a general idea of what project management is, and define the project life cycle, and methodology to be followed. Once this is done, you can fit software packages to your scheme. (6)

One way project management software can be misused is if different project managers within the firm use different levels of detail and different formats for

reporting project statuses. This can cause confusion and make communication difficult.

To resolve the problem Plasket proposes a three phase methodology for project management: "getting ready, planning, and execution." The planning phase is the most important of the phases. The first step in planning a project is to develop a work breakdown structure. This is a top-down project chart with increasing levels of detail, similar to an organizational chart.

Some of the advantages of the work breakdown structure are:

1. Level of detail: Each level of the work breakdown structure represents a consistent multiple level of detail, with the first level being the most general and the bottom level being the more specific.
2. Communication: Because the work breakdown structure can be presented in a graphical format similar to an organizational chart, it is easy to communicate the task to be performed in a project.
3. Time estimation: The work breakdown structure allows for an easy way to estimate the project time in that the lowest level tasks (which are the easiest to estimate because of their size) can be estimated and then "rolled up" to develop an overall project time estimate. (7)

After the work breakdown structure is complete, project management software can be useful in planning a

project.

In a recent article on project management, Mary M. K. Fleming agrees with Plasket and states that many projects fail because of inadequate project management techniques. Moreover, many projects fail because of inadequate planning and controlling of time, cost, and quality. If project schedules and cost budgets are either not properly developed during the planning phase or not monitored, the project has little chance of meeting its goals. Fleming also points out that the Project Manager should allow for contingencies when preparing schedules and cost budgets. Quality is controlled by comparing it to specified objectives, for example, a specification or contract. If the project objectives are not properly defined the project may not meet the customers needs. She states,

> Time, cost and quality are interacting elements even though they are frequently monitored through separate control techniques. For example, an increase in quality is likely to cause an increase in cost and time. Consequently, a decrease in cost can lead to a corresponding decrease in time and quality. (58)

Another important aspect of project management that can lead to problems is project reviews and reporting. The most important aspect of reporting is

that it must be accurate. It cannot only tell "good" news or what the subordinates perceive their superiors want to hear. If reports are not accurate, management will not know about problems until it is too late.

Vilma Barr agrees that a good product development methodology is needed to make projects successful. In Barr's article titled, "Six Steps to Smoother Product Design," she points out that in the 1990s the product development cycle is being pushed shorter and shorter. Several things are causing this, such as a more competitive marketplace and government regulations. For example, when the federal government changed the regulations on carbon monoxide emissions. This caused a whole new market for CO measuring devices. She believed the following rules are crucial to the success of an accelerated product development project:

- Select a strong project leader.
- Make the writing of the new product specification a team effort.
- Emphasize that a strong team attitude is as important as individual expertise.
- Remember that quality need not be compromised when development time is compressed.
- Recognize that in an accelerated product development program, less testing may not be time efficient.
- Avoid technological leaps. (49)

She believes that the project leader's authority

over the project must exceed the authority of the functional head. If it doesn't, the project may turn into a design-by-committee, which could lengthen the design process and cause the project to not meet its goals.

Another important aspect that Barr pointed out was that the specification should be developed as a team. She states,

> When marketing and engineering do not sufficiently discuss the product specifications, the resulting product usually lacks the balance needed to make it salable. (50)

Although all aspects of project management are important, Dr. T. F. Gautachi, a professor and consultant at Bryant College in Smithfield, Rhode Island, believes communication is the most important and that the lack of communication is one reason why projects fail. He states,

> A project without good communication is really not a project at all; it is just a collection of people working in some uncoordinated fashion towards vague and poorly defined goals. (170)

Good communication is an essential part of a successful project. For example, if the project's

goals and objectives are not effectively communicated to the project team, they may develop a product that doesn't meet the customer's needs. Similarly, other problems can occur when support groups are not kept informed of the project's objectives, goals, status, and priorities. These types of problems are likely to cause projects to be late because the service groups may not have resources available when they are needed. The following outlines some of the things Gautachi believes the Project Manager can do to insure good communication in a project:

- Should view the entire project as a communications process.
- Must assure that all participants in the organization receive all the information required to support the project, in a form best suited for the recipient's action. For example, top management should receive brief summaries which highlight the progress and problems that they need to know about, otherwise the busy executive will never read them.
- Should ensure that all essential documentation is identified and is scheduled to be available when it is required.
- Should take steps to eliminate any paperwork that is not required.
- Should try to keep the number of meetings to a minimum and should ensure that all meetings are held in an efficient manner.
- Cannot assume that because he or she, and perhaps a few key members of the team, have knowledge about a particular event, problem, or decision, that all team members have a need to know that information.

- Must recognize that different people perceive the same information in different ways depending on their backgrounds, interests, biases and expectations.
- Should encourage a high level of interest, support and enthusiasm for the project.
- Should ensure that certain key technical analysis is not lost. (170)

Kliem and Doughty share a similar view. They believe that poor communication and poorly organized projects contribute to project failure. They think projects fail because management fails to:

> ... define the objectives of their projects, clarify responsibilities, determine which reports are necessary, establish effective communication channels, or follow any standard policies or procedures. The result is a seemingly disorganized mess that exhibits excessive duplicate efforts, massive cost overruns, and acute resource shortages. (17)

In order to avoid these problems they suggest that a firm develop a project management manual that includes policies, procedures, forms, charts, standards and guidelines on how to plan, organize, and control a project. To facilitate the planning function, the manual should specify how to define project goals and how these goals will be achieved. Examples of the types of items found in the organizing function section of the project management manual include information on how to develop project documentation, preparing time

and resource estimates for scheduling, and conducting meetings at various stages of the project.

The controlling section should contain information on monitoring and tracking projects. Its purpose is to help employees determine when a project is off course and what to do when the situation arises.

It is also important to maintain the project's management manual. One method of doing this is to conduct regularly scheduled reviews.

Communication and organization are important parts of project management. W. Alan Randolph and Barry Z. Posner pointed out in their article, "What Every Manager Needs to Know About Project Management," that the Project Manager has the primary responsibility for these issues. They believe the following principles would help the Project Manager organize a project and help prevent the project from failing:

Set a clear project goal.
Determine the project objectives.
Establish checkpoints, activities, relationships, and time estimates.
Draw a picture of the project schedule.
Direct people individually and as a project team.
Reinforce the commitments and excitement of the project team.
Keep everyone connected with the project informed.
Empower yourself and others on the project team.

Build agreements that vitalize team members. (66-72)

When setting project goals it is important to make the goal very specific and measurable. This process should involve a dialogue between the Project Manager, the project team, and the end users of the project. If the goals are not clear, the project team may waste time working on the wrong things. On the other hand, if the goals are not measurable, the Project Manager will not know where the project is and if it is in trouble.

The next step is to set project objectives. These objectives should be in more detail than the project goals and should be broken down for each functional group or person associated with the project. When setting objectives, it is important to work with the people who will be performing the tasks, so that they take ownership in the objectives. Without ownership it is more difficult to get team members to meet the objectives.

The Project Manager then needs to establish the project's checkpoints, activities, relationships, and time estimates. Checkpoints are points in the project used to measure the project's progress. The activities

that need to occur in order to accomplish the objectives and meet these checkpoints must be defined. The Project Manager must setup the relationships between the activities, for example, can activities be run in parallel, which activities have to occur before others, etc. Time estimates for each activity can then be added. It is important to work with the team members when developing these estimates. The next step is to draw a graphical representation of the project schedule. This is used to graphically communicate how the project will be executed. When managing projects, the Project Manager must understand the needs of the team members. This will require him to direct people individually and as a project team.

> Research has shown over and over again that project managers who are sensitive to why people do what they do are a step ahead of their colleagues when it comes to directing the efforts of a project team towards the finish line. (70)

Another important job of the Project Manager is to reinforce the commitment and excitement of the project team. The following are examples of ways to achieve this:

1. Get team members to volunteer to perform certain tasks.

2. Make sure team members have input into how the project is executed.
3. Reward achievements. This can be done by establishing awards such as "person of the month" or by simply thanking people for doing a good job.

It is also important to keep everyone connected with the project informed. Too often, project managers do not communicate as effectively as they should. During any project there will be conflicts and disagreements. Randolph and Posner state,

> The challenge is to use conflict so that it becomes a force for unleashing imagination and creativity. It is a process to be managed, not eliminated. You have to build agreements that vitalize the project team, and there are a variety of ways to do this. (71)

The following are some examples of ways to reach agreements:

1. Give into the other person if the issue is small.
2. Smooth over the disagreement by focusing on the goals.
3. Split the difference by finding a compromise.
4. Persuade the other person to see your point.
5. Find common ground for which to bargain and negotiate.

"All project members have to do to drive you (the Project Manager) crazy is exactly what you tell them to do, no more and no less" (72). In order to avoid this, the Project Manager must empower his team so they feel they have power and authority. When this is accomplished, productivity will improve. Project managers and team members should be encouraged to take risks and be creative. To accomplish this, project managers should allow time for thinking, experimenting, and creative behavior. They should also keep an open mind and reward successes.

Ralph L. Kliem agrees and in his article, "Why Project Managers Fail," states that having a good Project Manager is a critical part of a successful project. He believes that the Project Manager should be someone who is good at: "communicating, relating to others, interpreting, managing crises, and seeing the whole picture" (109). Kliem felt that the most common mistake in choosing a Project Manager is to promote an engineer because of his distinguished technical skills. A good engineer doesn't necessarily have the skills needed to be a good manager.

The Project Manager must be able to relate to others in order to foster teamwork. Kliem states,

> Without teamwork, a group will deteriorate into mere assemblage of bodies replete with duplication of effort, frustration, and an I-don't-care attitude. (110)

In order to foster teamwork the Project Manager must have a genuine interest in others and enjoy interacting with them. However, this can be taken too far. He must keep enough distance between himself and his staff members to be able to command effectively.

William J. Walsh, the director of engineering for the Eaton Controls Operation, also believes in teamwork, which he calls organizationally-driven product development. He states, "....something like nine out of ten new product developments end up as failures"(33). Walsh believes that organizationally-driven product development is built around the following four basic concepts:

1. A holistic philosophy of new product development. All functional departments are appropriately involved in the program from the up-front planning stage to final completion.
2. Date making and date keeping.
3. Individualized commitment based on education and training.
4. Program control by means of a New Product Integration Manager. (33)

New products cannot be successful if one or more functional departments "did its own thing" to the detriment of the overall program. In order to avoid this Walsh proposed implementing a "Quality Function Deployment" system and to form a cross-functional group that meets to discuss "boundary" type problems, such as:

- Identification of schedule slippages and corresponding actions to get a project back on track.
- Advance warning on the need for unplanned or additional manpower of equipment resources.
- Avoiding product design actions that adversely impact downstream departments.
- Maintaining "total" product cost goals.
- Keeping the entire organization up to date on changing customer or competitive requirements. (34)

Walsh also noted that a project that doesn't meet its schedule can cause the product to not be successful. He stated, "One-fourth of the lifetime profits attributable to a new product can be lost by an introduction delay of six months" (35).

Another aspect of project management that can cause projects to fail is the lack of project focus.

In the article, "Managing Technical Programs for Success," James J. Collins, P.E., believes that without the proper focus, the project team cannot develop a successful product. If the focus is too wide the team may develop a product that doesn't meet the customer's needs. On the other hand if the focus is too narrow the team may not develop the best possible product. Collins believes that identifying a point of focus for the project and a technical specification are the key elements to a successful project. "The 'point of focus' must focus effort of the entire team on the end product; it must give direction yet must not constrain the team in finding a solution" (33). An example of point of focus was President John F. Kennedy's speech to Congress in 1961 in which he set the goal of landing a man on the moon and returning him safely by the end of the decade. In this brief statement, he set the goals for the program without putting constraints on the team for how to achieve the goal.

The second key element to the project is the technical specification.

> This document must outline all the various aspects associated with successful completion of the project. It should build upon the

> basic point of focus and specify, in detail, each of the attributes required for the program or device. (32-33)

It is important that all members of the project team provide input to the specification. A good Project Manager will question every aspect of the specification to determine if it is relevant, accurate, and meets the customer's needs. It is best to keep the specification as simple as possible.

The wrong type of project management system can also cause projects to fail. Erik W. Larson and David H. Gobeli describe different types of matrix organizations in the article, "Matrix Management: Contradictions and Insights." They believe that some projects fail because the wrong type of matrix management is selected. According to Larson and Gobeli there exists three types of matrix organizations:

> Functional matrix: A person is formally designated to oversee the project across different functional areas. This person has limited authority over functional people involved and serves primarily to plan and coordinate the project. The functional managers retain primary responsibility for their specific segments of the project.
> Balanced matrix: A person is assigned to oversee the project and interacts on an equal basis with functional mangers. This person and the functional managers jointly direct work flow segments and approve technical and operational decisions.

> Project matrix: A manager is assigned to oversee the project and is responsible for the completion of the project. Functional manager's involvement is limited to assigning personnel as needed and providing advisory experience. (129)

This article is based on a study performed by the Project Management Institute. The data is based on the responses of 510 project and functional managers. Eighty-nine percent of the respondents reported that they had used matrix management and would probably continue to use it. Of the three types of matrix management, project matrix was the most popular, with over seventy-eight percent of the respondents reporting that their firm uses this type of management. As far as effectiveness, project matrix received the highest rating, while functional matrix was rated ineffective. Balanced matrix received a marginal rating. It is worth noting that project matrix was rated most effective not only by project managers, but by functional managers also. The project matrix was preferred over the other two types because it enhanced project integration, increased reaction time, diminished power struggles, and improved the control and monitoring of project activities and costs. However, the technical qualities may suffer since

functional areas have less control over their contributions (see Figure 4).

Although all of the items that have been discussed are important to successful project management, probably the most important reason why projects fail is that people and firms do not learn from their mistakes and failures. Richard M. Morris III, the president of R.M. Morris & Associates, Inc., suggests that each project should include a post-implementation review. This review should be:

> ... designed to evaluate the entire program, from the initial design, planning, and analysis phases, to the activities associated with the actual implementation of the project. Ideally, any significant findings from this review should be considered for inclusion as standards or recommendations in the organization's project management practices. (2)

The review should also include a financial perspective. It should look at how funds were spent during the project, and should also evaluate the financial criteria with which the project was originally justified. However, it will usually take some months or even years, before the financial criteria can be fully evaluated. This information is useful in that it tells the firm how well their project's financial justifications are being performed. However, care must

Figure 4

Comparative Advantages and Disadvantages of Three Types of Matrix Structures

Advantages	Functional Matrix	Balanced Matrix	Project Matrix
Resource efficiency	High	High	High
Project integration	Weak	Moderate	Strong
Discipline retention	High	Moderate	Low
Flexibility	Moderate	High	Moderate
Improved information flow	Moderate	High	Moderate
Improved motivation and commitment	Uncertain	Uncertain	Uncertain
Disadvantages			
Power struggles	Moderate	High	Moderate
Heightened conflict	Low	Moderate	Moderate
Reaction time	Moderate	Slow	Fast
Difficulty in monitoring and controlling	Moderate	High	Low
Excessive overhead	Moderate	High	High
Experienced stress	Moderate	High	Moderate

SOURCE: California Management Review. Exhibit from "Matrix Management: Contradictions and Insights," by Erik W. Larson and David H. Gobeli (1987): 131.

be used in how this data is evaluated since there are many things outside the project team's or firm's control that affect the financial aspects of a project. For example, changes in the economic environment, introduction of a new competitor, or changes in laws or regulations. If people and firms learn from their mistakes more projects would be successful.

John Boddie in his article, "The Project Postmortem", agreed that by looking at why a project failed, the team will have a better chance of making the next project successful. He states,

> The payoff of a postmortem is a smarter organization. Once team members have gone through an analysis of how and why a project failed, they can apply this knowledge to subsequent projects. (77)

He also points out that it is important not to let the postmortem turn into a "witch hunt".

Problem Statement

The literature reviewed for this chapter considers the reasons why new product development projects fail, and what can be done to avoid these problems. The research reveals that these projects fail for many reasons, some of which are listed below:

1. Poor communication.
2. Lack of an adequate project plan.
3. Project participants do not understand their roles and responsibilities.
4. Lack of project focus.
5. Poor project monitoring and controlling systems.
6. Lack of a standard, systematic approach to project management.
7. The wrong type of project management system is selected.

The proposed project management manual will address these issues by defining the project management system, the responsibilities of the project participants, and the procedures and policies used to plan, monitor and control the project.

Chapter III

METHODS AND EVALUATION

Subjects

Three people were selected to evaluate the New Product Development Project Management Manual. To be eligible the evaluators had to have worked in a product development environment for at least ten years, have a minimum of five years of project management experience, and possess a Bachelor of Science degree in a technical area. Since all the evaluators currently work for the same company an additional requirement was added, that they have worked for another company in a product development environment.

The first evaluator is Charles Waldorff. He is currently the Vice President of Engineering for Coin Acceptors, Incorporated. Waldorff has also worked for Telxon as the Vice President of Technology and for SCI Systems as the Vice President of Computer Products. The following are examples of the types of products he has been involved with: a family of Unix based small business computers, a new generation of hand held computers, and a new generation vending machine.

Waldorff graduated from the University of Florida in 1971 with a Bachelor of Science Degree in Electrical Engineering.

The second evaluator is Robert McCoy. He is currently employed at Coin Acceptors, Incorporated, where he has held the positions of Principal Engineer and Manager of Vending/Mechanical Products Engineering. McCoy also worked for Aladdin Synergetics, Incorporated, where he held many positions, some of which include New Product Development Manager, Product Manager, and Manager of Value Analysis. At Radak, Incorporated, McCoy held the position of General Manager. His expertise includes health care food service products, food rethermalization equipment, and vending equipment. McCoy graduated from Vanderbilt University in 1973 with a Bachelor of Engineering Degree in Mechanical Engineering. He has also taken courses in Engineering Management.

The third evaluator is Mike St. Clair. He is currently employed at Coin Acceptors, Incorporated, where he has held the positions of Associate Principal Engineer and Project Engineer. St. Clair has also worked for Rowe International and R.C. Allen Company, where he has held the positions of Project Engineer and

Engineer. St. Clair has been involved with a variety of products, including electronic cash registers, vending machine controllers, and electronic coin changers. He graduated from Purdue University in 1975 with a Bachelor of Science Degree in Electrical Engineering.

Instrument

Each evaluator was given an introductory letter, Evaluator Background Questionnaire, Manual Evaluation Questionnaire and a copy of the Project Management Manual. The introductory letter (Appendix A) generally describes the purpose for developing the manual, its content, and how the manual will be used. The balance of the letter offers instructions for evaluating the manual, explaining both the background and evaluation questionnaires.

The "Evaluator Background Questionnaire" (Appendix B) provides data as to the evaluator's background and expertise. The "Manual Evaluation Questionnaire" (Appendix C) is used to summarize the evaluator's comments about the manual. The first section uses a one to five scale to rate different aspects of the manual. The remainder of the questionnaire uses open-

ended questions to elicit the evaluators comments on different aspects of the manual.

Materials

The New Product Development Project Management Manual (Appendix D) is intended to define a method of managing new product development projects within a firm. To accomplish this goal, the manual covers the following areas:

- Define the goals of project management.
- Describe the type of project management organization being implemented.
- Define the job descriptions of the project team members, as they pertain to project management.
- Define the phases of the product development cycle.
- Describe the process of project management.
- Define the procedures/forms to be used to manage projects.

The first step in implementing the proposed project management system, as defined by the manual, would be to have the firm's management team review it. During this review process the system/manual would be

optimized for the firm's products, management philosophy, and to address problems the firm may have had in the past.

After the management review is completed and the manual is updated, all of the firm's project managers and new product development team members should be trained. This will be accomplished with a 2-3 hour seminar.

Annually, a committee will be put together to review and update the manual. They will be given approximately two months to complete their work, after which all project managers and team members will be required to attend a seminar to give them a general review of the project management procedures and update them on changes.

Procedure

The first step was to select potential evaluators. On the morning of January 6, 1992, a meeting was held with each of the potential evaluators. The project was described and they were asked if they would be willing to be an evaluator. They were asked if they could return the questionnaire and marked up manual by January 20, 1992. After the evaluations were

completed, another meeting was held with each evaluator to discuss his comments.

Chapter IV

RESULTS

The first part of the chapter will summarize the evaluators responses to the "Manual Evaluation Questionnaire," while the second part will summarize their comments on each section of the manual. The first section of the questionnaire asked the evaluator to rate different aspects of the manual on a scale of one (poor) to five (good):

Was the manual easy to understand?	4.33
How did the manual cover the subject?	3.33
Was the manual complete?	3.00
Would the manual help you manage a project?	4.00
Average	3.66

The second section asked if there was anything that the evaluator didn't understand: no one responded to this question. The third section asked the evaluator what he would change, add, or delete. The following outlines their responses:

- There are many issues which may or may not be appropriate for this manual.

- The material is presented as if it is the only method or system. I think you need to develop the need for the information and then show that your system gives that information.
- How detailed should you get in order to develop a flowchart, generic product development strategy?
- Strategic planning considerations.
- Sign-off strategy at milestones of development process.

The fourth section asked the evaluators what types of problems the manual would not address. The only response noted that the manual did not detail a product development process system so that each functional area understands the requirements for successfully meeting their portion of the work. The evaluator also noted that this may be beyond the scope of the manual.

The fifth section asked if the manual would help manage a project. The following summarizes the responses:

- The manual outlines a generic overview of how to manage a project with methods for planning and tracking progress. The forms would help to focus attention on the plan, schedule and progress. Overall, the manual is a start in the right direction for a company that has not yet developed a detailed product development process plan.
- The forms presented are comprehensive and would make it easy to start documenting a

new project.

The last section asked for general comments. The following lists the issues the evaluators thought should be added to the manual:

- Production release
- Flowcharts
- Pert Charts
- Standard documentation
  Manufacturing
  Engineering
  Customer
  Sales
- Types of project management needed for product development.
- Project Management versus Program Management
- What makes product development unique versus other forms of project management?
- The manual needs a table of contents.

The remainder of the chapter summarizes the comments throughout the manual:

I. Purpose

- No comments.

II. Goals of Project Management

- To make money should be added.

III. Project Management Organization

- Functional groups should assign rather than loan resources.

- In many cases functional managers out rank project managers.

- The dotted line authority could be to the functional department. Who gives day to day direction?

- A firm's organizational structure depends on the company's financial structure.

- A Project Manager's indirect authority can be a major source of frustration and a source of conflict within the organization. This depends somewhat on how many projects a person is assigned.

IV. Job Descriptions

Program Manager:

- Coordinating projects, setting priorities, reviewing and approving project proposals and plans are normally done at a higher level.

- Program managers are different than what is defined. They run a segment of the company's business.

- A Project Manager could be responsible for the development of a product but not the business issues associated with it.

- Other issues: Strategic Planner, Business Manager, or P&L Manager.

- Coordinate all the projects within the firm or within a certain segment or division.

- Set priorities for the projects, subject to executive staff review and strategic planning.

- He should not approve project proposals and plans.

- Ultimately responsible to the president for the

successful completion of all projects quality, cost, and schedule.

- Interface with customer.

Project Manager:

- The Project Manager should possess what skills and training?
- Who gives the day to day direction?
- What methods should be used to evaluate risk?
- Who does he make recommendations to on business issues?
- He should not recommend team member. He should define the skills needed. The Functional Manager should know the people better.
- He should evaluate the performance of all team members, not just the permanent members.
- Should be a liaison with the customer.
- Other issues: design reviews, budget, production release, production support, build team, coach team, motivate, and build morale.

Functional Manager:

- What role does he play in design reviews?
- If the Project Manager is giving day to day direction what is the Functional Manager's role in the correctness or adequacy.
- Also responsible for the quality of the work done by his group.
- Enhance or acquire the skills needed to meet the functional group and/or project team's requirements.
- Arbitrate technical problems between team players and Project Manager.

All Team Players:

- Change "players" to "members."
- Communicate potential problems and obstacles.
- Communicate recovery plan and/or alternatives when the project is in trouble.
- Design, material selection, test, and verification.

V. Phases of The Product Development Cycle

- The phases are not necessarily sequential.
- Elaborate on what goes into the project proposal (manpower, time, cost, new equipment, etc.).
- The project plan should emphasize the definition of the product.
- If "investigation" is the first part of the project plan, how can the phase start after the "investigation" is complete?"
- Tooling should be part of the development phase.
- The field test should not be part of the production phase.
- A pre-production phase should be added. It would include tooling, qualification test, field test, first production build, and process development.
- The post-project review should be done at three and six months. Look at product performance, cost, tooling, and process issues.

VI. Project Management Process

- Having all corporate functions involved is a staffing issue. People want to be involved but don't have the time.
- Marketing and sales should be developing strategy and product needs to seed the process. Front end process needs to be better defined.

- Who approves project proposal?
- After a project plan is approved the project can begin or will be scheduled.
- Reports do not have to be bi-weekly.
- Weekly meetings are different from formal design reviews where the technical approach is given a thorough critique.
- Need to better define how changes to the original requirements are handled.
- The Project Manager may delegate configuration control to the test group.

VII. Project Management Procedures

Proposal Log:

- Should include the proposal's status.
- What is its purpose?
- Who can submit proposals?

Proposal Form:

- All initial estimates are not binding on the development team. Should not be very detailed.
- The design approach should include technologies used to overcome areas of risk.
- The marketing section should consider the product life cycle.
- The financial section should include sales/promotion cost and service/warranty costs.
- The form should include a sign-off section.

Product Specification:

- Should not limit the number of sections.

- Should include a shipping and handling section.
- Should include a prediction of warranty/service events.
- The definition of errors and failures should be in the definition section.

Project Scheduling:

- Why have level one?
- The levels should be tied to management reviews.
- Should include analysis.
- Service should be added to the marketing section.
- Should include system design, detail design, integration, pre-product (prototypes, engineering models, and pre-production units), and production.
- Other issues: design reviews, simulators, test fixtures, training (field, customer, sales, and systems).
- Should include Pert charts.

Status Reports:

- Should be monthly.
- Should not include the level one schedule.

Meetings:

- Design reviews are different than normal meetings.
- Define different types of meetings, who should attend and responsibilities.

Test Plan:

- Should be tied to requirements and analysis of design.

- Should come before the configuration log section.

- Should field test come after production qualification test?

- Need to define design margin.

- Production qualification is to test manufacturing processes, not to continue the qualification test on a larger number of parts.

- The individual tests should be defined after the developmental test section.

- A title is needed on the first page of the form.

Team Member Performance Reviews:

- The form should include the Functional Manager's comments.

- Should cite examples of achievements or lack of it.

- Should include areas of improvement.

- Other areas to consider: quality of work, quantity, attitude, leadership, and cooperation.

Chapter V

DISCUSSION

Summary

Most of the comments pertained to things that should be added to the manual. It was obvious from some of the comments that the scope, or purpose, of the manual was not explained well enough. The purpose of the manual was not to teach the reader about project management, but to propose a new product development project management system for a typical firm. To avoid this problem the "Purpose" section of the manual was expanded to better describe the purpose, and to propose an implementation plan. Since every company has different types of organizations, products, and problems, the plan outlines a way that they can customize the manual to their company's needs. During this process additional details and procedures should be added to the manual. The following are some examples:

- Design/product development strategy for each functional area.
- Sign-off strategies.

- Product release procedures.
- Expanded job descriptions and skills required for each.

Another suggestion was to add "to make money" to the "Goals of Project Management" section. It should be every company's goal to make money. However, some products cannot be financially justified by themselves. For example, a company may not be able to justify the development cost for a piece of support equipment. However, this equipment may be needed to sell other products. Therefore, it was not added to this section, but a similar statement was added to the "Project Management Process" section where it discusses approving project proposals.

There are many types of project management organizations and reasons for them. This is an area that should be customized for each firm. This section was changed to indicate that the functional groups will "assign" rather than "loan" resources to the project team. Although the two terms are similar, "assign" was selected because it better describes the team member's relationship with the project in that their primary direction will come from the Project Manager. To better describe the organizational levels, the position

of Program Manager was renamed Director of Product Planning, and the functional management side was described better. Although functional managers sometimes out rank Project Managers, the Project Manager should be at the same level or even higher. Since successful products are responsible for the company's profits, more emphasis should be given to the product development process.

Ideally, day to day direction of the project team should come from the Project Manager. This works best if the Project Manager is knowledgeable in the technical area of the project or there is a strong technical base in the functional areas. However, this depends more on the expertise of the team members and the structure of the team. This can vary between firms, or even between different projects within a firm.

Under the "Job Descriptions" section, the Program Manager was renamed Director of Product Planning. This title better fits the original job description (such as: coordinating projects, setting priorities, reviewing and approving project proposals and plans.) In a very large company there may be more than one Director of Product Planning, each specializing in

different segments of the company's business. This person should be part of the strategic planning group which sets the direction for the company.

The Project Manager is the lead person on the product development team. The following describes the changes to the Project Manager's job description:

- Make recommendations on business issues to the Director of Product Planning.
- Define the skills needed for the project. Who is assigned to the project is a negotiation process with the functional managers.
- Evaluate the performance of all team members.
- Primary liaison with the customer.
- Be a team builder, coach, and motivater.
- Be objective.

The following are the changes to the Functional Manager's job description:

- Be part of the design review process for their functional area. This will allow them to evaluate the performance of their people, and will keep them informed how the projects are going.
- Responsible for the quality of the work done by his group.
- Enhance or acquire the skills needed to meet the project's needs.
- Arbitrate technical problems between team members and Project Manager.

The title of the "All Team Players" job description was changed to "All Team Members." The following recommendations are being incorporated:

- Communicate potential problems and obstacles.
- Communicate recovery plan and/or alternatives when the project is in trouble.

Design, material selection, test, and verification are functions that are performed by team members. However, these types of functions should be defined in specific job descriptions for each job classification.

There are many ways to define the phases of the product development process. Given some of the comments, it needs to be noted that there is additional information on the project proposal and project plan in other sections of the manual. To clarify the "investigation" part of the project plan, it is being renamed "feasibility study." A note was added that if the feasibility study was required, it should be well defined in the project proposal. It was recommended that the tooling phase be part of the developmental phase. There are valid arguments for both positions. It was left in and a note was added that the tooling phase could run in parallel with both the development phase and pre-production phase. To more clearly define

the production phase it is being renamed pre-production. The post-project review phase is being renamed production phase and will be lengthened to include about six months of start-up production support, ending with a post-project review. However, this may vary between firms or even projects. A note was also added to have an annual post-project review for the first three years of the product and that this review would not be part of the project schedule.

Flowcharts are being added to the "Project Management Process" section to better illustrate the process. The following recommendations are also being incorporated:

- Define the roles of strategic planning, sales, and marketing in the product proposal process.
- Define how and who approves project proposals.
- A project doesn't have to start when it is approved, it can be scheduled to start later.
- Define the difference between weekly status meetings and design reviews.
- Define how changes to the original requirements are handled.
- The Project Manager can delegate tasks.

One of the evaluators noted that having all of the corporation involved in the project proposal and

planning phases is a staffing function. He said, "people want to be involved but don't have the time." This can lead to many problems. If the project plan is not right the project may not meet its goals. It is usually less expensive and better to do the job right the first time, rather than do it over or miss the project's goals.

A new sub-section titled "Standard Documentation" was added to "Project Management Procedures" section. The new section will include a list of documentation that may be needed for a new product. This list can then be customized for a given project and expanded as the project progresses. All of the recommendations for the "Proposal Log, Proposal Form, Product Specification and Project Scheduling" sub-sections are being included.

There were two recommendations for the "Status Report" sub-section: they should be monthly and the level one schedule is not needed. The report timing is being changed to monthly. However, the level one schedule is being left in since it gives the reader a quick overview of the project's status and doesn't require any additional effort.

All of the recommendations for the "Test Plan"

sub-section are being included, with the exception of the three concerning the order in which items are placed in the manual. The "Configuration Log" sub-section needs to stay in front of the "Test Plan" sub-section because the users need this knowledge before they get to the "Test Plan" sub-section. Since the location where the individual tests are defined is such a minor issue, it was left alone. Production qualification tests are usually performed after the first pilot. This test should be completed before the field test so that there is a high confidence level in the product before it goes to the field.

The following is being added to the "Team Member Performance Review": quality of work, quantity, leadership, cooperation, and Functional Manager's comments. Requiring examples of achievements (or lack of them), or areas of improvement are not being included, to keep the form simple to complete. The idea is to have more, simpler reviews, and only require comments if the person either did something very good or bad.

Limitations

The primary flaw in the evaluation of the manual

was the fact that the evaluators didn't fully understand the purpose of the manual. The manual was intended to present one way to manage new product development, not to discuss the differences or advantages/disadvantages of other project management systems. There are many types of project management; the one presented was believed to be the best for a middle size company doing commercial product development. However, there are many items to consider when selecting the right system for a company.

Suggestions for Future Research

The proposed manual is the first step in developing a new product development project management system within a firm. The following lists some of the items that may be needed to fully develop a first class product development organization/system:

- General project management training. This would allow the organization to understand the advantages and disadvantages of different project management systems, so that they could better customize a project management system for their company/project.
- Better define the tools that are used to manage a project. For example: how to use the scheduling program, what word processor is used to generate reports, etc.
- Better define the approval/sign-off strategies.

- Develop design/product development strategies for each functional area.

- Develop manufacturing procedures/standards.

- Develop product documentation/release/change procedures.

- Define job descriptions for every employee.

- Automate the proposed project management tools. For example: keep all project information (schedules, memos, test plans, etc.) stored on a local area computer network; use data base programs to maintain things like the proposal log, project log, problem list, etc; and to store product documentation.

- Set up a system to track success rates and key project variables.

Appendix A

January 6, 1992

Dear Evaluator,

I would like to start by thanking you in advance for evaluating my "New Product Development Project Management Manual." This manual is part of my culminating project for a Master of Business Administration degree at Lindenwood College. The purpose of the manual is to define a systematic approach to managing new product development projects in a typical firm. It would also be used to train project managers and their team members.

Before reading the manual please complete the "Evaluator Background Questionnaire." Please remember that anything you give me during this evaluation may be published. Therefore, do not include anything that may be considered confidential. After completing this questionnaire you may read the manual. Please mark up the manual with any comments or corrections. After you have read the manual please complete the "Manual Evaluation Questionnaire," and return questionnaires and the manual to me. If possible I would like to get your input by January 20, 1992.

After I complete the culminating project I will give you a copy, which will include an updated manual. If you have any questions please feel free to give me a call. Thank you for your time.

Sincerely,

Ronald Hoormann

Appendix B
Evaluator Background Questionnaire

Evaluator's Name _____

I. Educational Background:

	School	Degree	Date
1.			
2.			
3.			

II. Work History: (Please list your last three jobs.)

	Company	Position(s)	Date
1.			
2.			
3.			

III. List any project management training you have received.

IV. How long have you worked in a product development environment?

V. List some of the products you have developed, or have been part of the development team.

VI. How long have you worked as a Project Manager? (Anyone who is responsible for a product development project, some firms use different titles.)

VII. Describe two or three projects for which you have been responsible.

VIII. Describe some of the problems you have had managing a product development project.

Appendix C
Manual Evaluation Questionnaire

I. Please rate the following:	Poor				Good
1. Was the manual easy to understand?	1	2	3	4	5
2. How did the manual cover the subject?	1	2	3	4	5
3. Was the manual complete?	1	2	3	4	5
4. Would the manual help you manage a project?	1	2	3	4	5

II. Was there anything you didn't understand? Please explain.

III. What would you change, add, or delete?

IV. What types of problems would this manual <u>not</u> address?

V. How would the manual help you manage a project?

Additional Comments:

Appendix D

NEW PRODUCT DEVELOPMENT

PROJECT MANAGEMENT MANUAL

March 5, 1992

TABLE OF CONTENTS

I. Purpose

The purpose of this manual is to define a method of managing new product development projects within a firm. To accomplish this goal, the manual will cover the following areas:

- Define the goals of project management.
- Describe the type of project management organization being implemented.
- Define the job descriptions of the project team members, as they pertain to project management.
- Define the phases of the product development cycle.
- Describe the process of project management.
- Define the procedures/forms to be used to manage projects.

It will be necessary to customize the manual for a particular firm. This will allow the manual to be optimized for the firm's products, management philosophy, and to address problems they may have had in the past. The following outlines one way this may be accomplished:

- Train the management team (upper level management, functional managers, and project

managers) on project management techniques.

- Set up a project management review committee to customize the manual. The following are some of the things they should consider adding to the manual:
  a. Training procedures
  b. What tools will be used
  c. Approval/sign-off strategies
  d. Design/product development strategies
  e. Manufacturing procedures/standards
  f. Product documentation/release/change procedures
  g. Job descriptions/skills required for all employees
  h. What project management tools can be automated by the use of computers
  i. System to track success rate and key project variables.

- Train/review the customized project management system with the management team.

- Make required changes.

- Train all team members on basic project management techniques and the new project management system.

Annually, the Director of Product Planning should put together a review committee to update the manual. They should be given approximately two months to complete their work, after which all project managers and team members should be required to attend a seminar to give them a general review of the project management procedures and update them on changes.

II. Goals of Project Management

The goals of project management are to develop a product that meets the customer's needs within the project's budget, product cost, and schedule goals.

III. Project Management Organization

Firms can organize their projects in different fashions: functional organizations, matrix organizations, and/or project organizations. A matrix organization was selected because it takes advantage of the strength of both functional and project organizations, in that theoretically the Project Manager has the optimal resources and focus to accomplish the project's goals. In a matrix organization, functional groups such as engineering, marketing, finance, and manufacturing retain their respective technical expertise. The functional groups will then assign resources to the respective Project Managers to accomplish a given project. Functional Managers and Project Managers should report to the same level. However, if they are going to report to different levels, the Project Manager should report to the higher. Since successful products are responsible for the company's profits, more emphasis should be

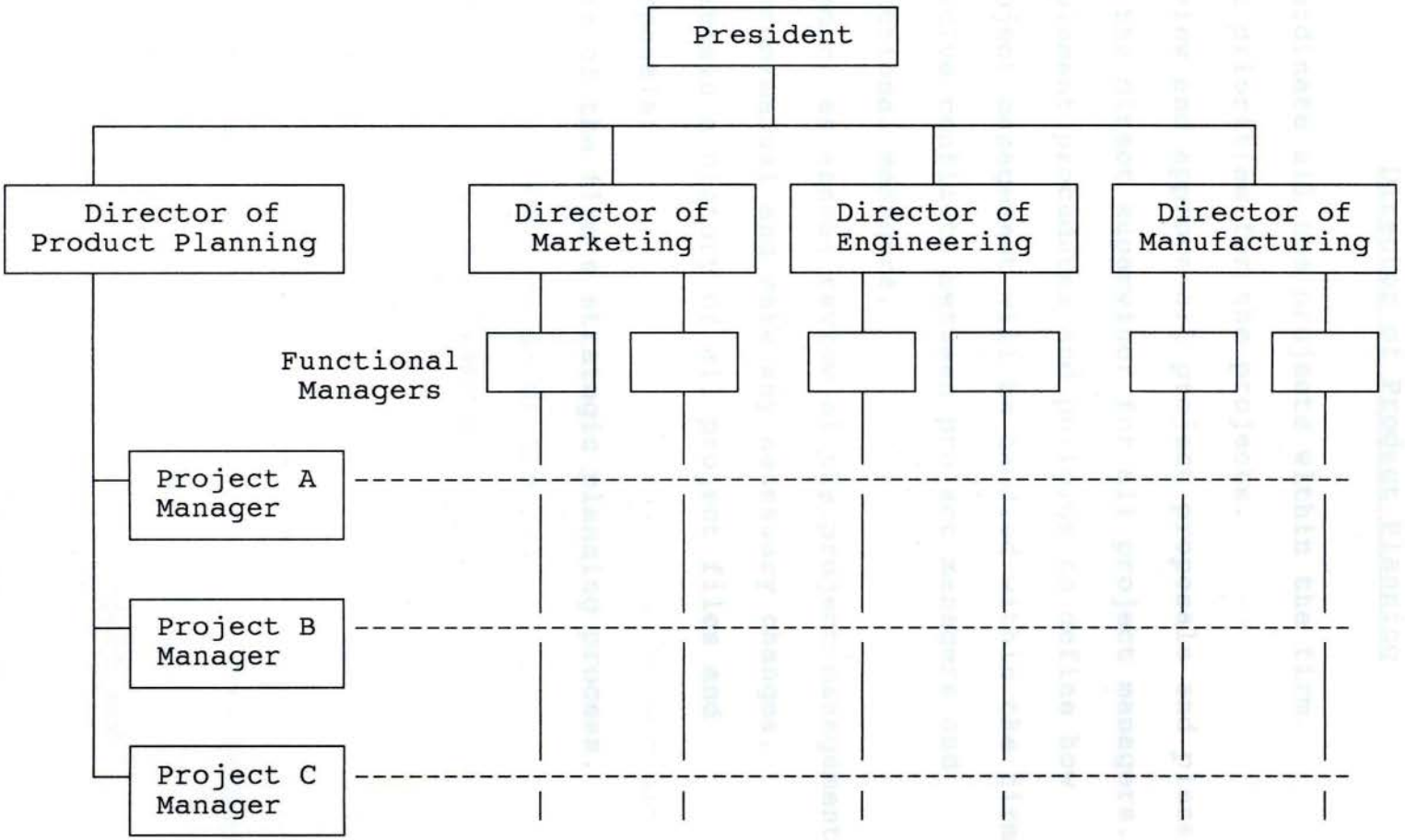
given to the product development process.

Ideally, day-to-day direction of the project team should come from the Project Manager. This works best if the Project Manager is knowledgeable in the technical area of the project or there is a strong technical base in the functional areas. However, it depends more on the expertise of the team members and the structure of the team. This can vary between firms, or even between different projects within a firm.

The primary disadvantage of a matrix organization is that it violates the principle of unity of command, in that workers will have two bosses, their Functional Manager and the Project Manager.

IV. Job Descriptions

The following will define the responsibilities of the Director of Product Planning, Project Manager, Functional Manager and team members as they relate to project management.


President
Director of Product Planning
Director of Marketing
Director of Engineering
Director of Manufacturing
Functional Managers
Project A Manager
Project B Manager
Project C Manager

Director of Product Planning

- Coordinate all the projects within the firm.
- Set priorities for the projects.
- Review and approve all project proposals and plans.
- Be the direct supervisor for all project managers.
- Implement procedures and policies to define how project management will be handled within the firm.
- Resolve conflicts between project managers and functional managers.
- Conduct an annual review of the project management system/manual and make any necessary changes.
- Maintain a history of all project files and proposals.
- Part of the firm's strategic planning process.

Project Manager

- Coordinate and direct the activities of the team members across functional lines to meet the goals of the project.
- Work with the project team to define the project's requirements.
- Ensure the project team understands the project's goals, and that each member understands his responsibilities with respect to these goals.
- Communicate to upper management the status of the project, particularly when it is not proceeding as planned.
- Evaluate the areas of risk within the project and make appropriate contingency plans.
- Make recommendations as to the business aspects of the project to the Director of Product Planning.
- Resolve conflicts within the project team.
- Ensure that all functional groups are brought into the project at the appropriate time.
- Ensure that there is adequate communication between the functional groups within the project.
- Define the skills needed for the project and recommend team members.
- Evaluate the performance of each team member at the

end of the project, or at least every six months.

- Recommend the removal of team members who are not performing satisfactorily.
- Maintain a project file that contains: the project plan, revisions to the project plan, proposed changes, design related documentation, test reports and data, minutes to meetings, memo's, etc.
- Be the primary liaison with the customer.
- Be a team builder, coach, and motivater.
- Be objective.

Functional Manager

- Work with the Project Manager to develop project proposals and project plans.
- Assign appropriate people to the project teams.
- Make sure that the technical work done by the functional group is correct, adequate, and meets the project goals.
- Arbitrate technical problems between team members and the Project Manager.
- Be part of the design review process for their functional area.
- Make sure that the agreed upon resources are provided to the project team.
- Maintain the technical competency of the functional group.
- Enhance or acquire the skills needed to meet the projects need's.
- Be responsible for the quality of the work done by their group.

All Team Members

- Communicate potential problems/obstacles up the chain of command (technical problems, schedule slippages, impacts to product cost, etc.).
- It is every team member's responsibility to follow up on anything they need to accomplish their tasks. (That is, make sure that what you need to do your job is there when you need it.)
- Provide estimates of the time and resources needed to accomplish their part of the project.
- Perform the work needed to accomplish the project goals. (If your part of the project falls behind, you are expected to do whatever it takes to catch up.)
- Communicate recovery plan and/or alternatives when the project is in trouble.
- Help other team members when they are having problems.

V. Phases of The Product Development Cycle

The product development cycle can be broken into six phases: project proposal, project plan, development, tooling (optional), pre-production, and production.

Project Proposal: The project proposal is a rough estimate of what it will take to develop a particular product. Proposals are typically fairly accurate if the product being proposed is similar to the existing products and technology the company is currently using. However, if the product is substantially different, the firm may want to complete the project plan (which goes into additional detail) before a decision is made.

Project Plan: The first part of this phase is a feasibility study of areas of unproven technology that may be used in the proposed product. After this investigation is completed the project plan can be started. This plan will include the same information as the project proposal, however, with substantially more detail. In addition, it will also include a product specification, definition of team members, and testing requirements. It is important to note that the project plan may be substantially different than the

project proposal. After the project plan is complete a management review will be held, at which time the plan may be approved, rejected, or sent back for changes. If the plan is approved the project will continue. This plan will be used to track and manage the remainder of the project.

Development: This phase is normally the longest phase in the product development cycle. During this phase the product is designed and tested. The Project Manager must report on the status of the project as it relates to the project plan, and resolve problems that arise during the process.

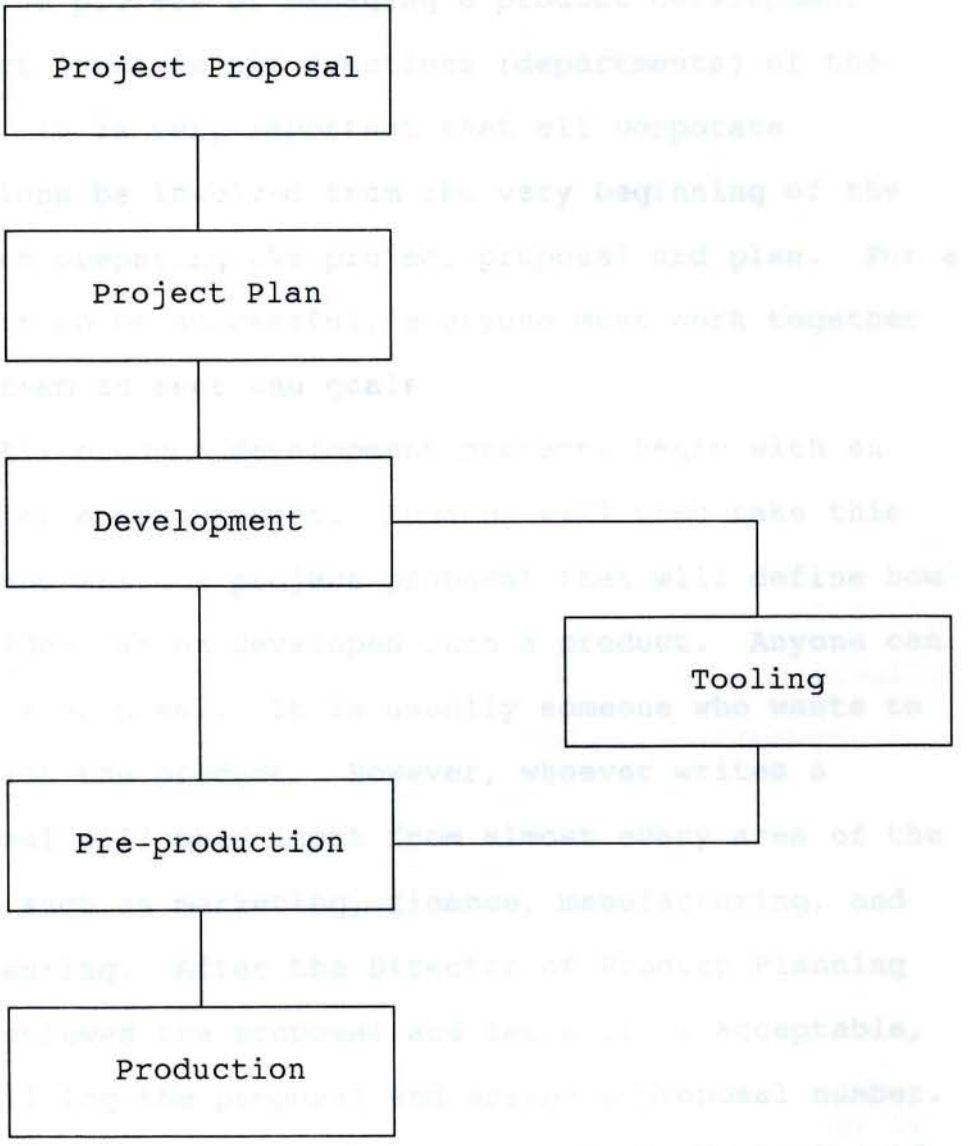
Tooling: This phase is only needed if the product being developed needs special tooling, fixtures, or facilities. In most cases the tooling phase starts after the design has been thoroughly tested. However, it can run in parallel with both the development phase and pre-production phase.

Pre-production: The first step in the pre-production phase is a pilot production run. This is followed by production qualification testing, field test, and production ramp-up schedule. In large projects, there may actually be more than one pilot

scheduled.

Production: After the product is in full production there is usually a period of time in which the project team will need to support the product. During this time team members will be phased out of the project. As this occurs the Project Manager will complete a final Team Member Performance Review and the team member will be asked to complete a Project Review form. At the end of the production phase the Project Manager will perform a post-project review (Project Summary form). An Extended Project Review will be completed annually for the next three years. However, these reviews will not be shown in the project's schedule.

Product Development Cycle



VI. Project Management Process

The process of managing a product development project involves all functions (departments) of the firm. It is very important that all corporate functions be involved from the very beginning of the project preparing the project proposal and plan. For a project to be successful, everyone must work together as a team to meet the goals.

All product development projects begin with an idea for a new product. Someone will then take this idea and write a project proposal that will define how this idea can be developed into a product. Anyone can write a proposal. It is usually someone who wants to champion the product. However, whoever writes a proposal will need input from almost every area of the firm, such as marketing, finance, manufacturing, and engineering. After the Director of Product Planning has reviewed the proposal and feels it is acceptable, he will log the proposal and assign a proposal number. The primary purpose of this review is to determine if the proposal is complete and reasonable. It is not to determine if this would be a good product for the firm.

The proposal will then usually go to a management review. They will be looking for such items as: does

the product fit into the firm's strategic plans, do they have the resources to do the project, and will the project meet the firm's financial guidelines (will they make money either directly or indirectly)?

If the project proposal is accepted the Director of Product Planning will log the project, assign a project number, and Project Manager. The Project Manager will then meet with the functional managers to develop a project team. The team will then develop the project plan. Note that the project plan may be substantially different than the project proposal. In the process of developing the plan, the team may change the scope of the project or determine that the original proposal was inaccurate. The Director of Product Planning will review the project plan when it is complete. In cases where the project plan is substantially different from the project proposal, a management review meeting may be required, at which time the project may be cancelled, sent back for changes, or approved. If the overall project plan is very similar to the project proposal, the Director of Product Planning will usually approve the project, after which the development phase will begin or be scheduled.

The project plan will be used as the blueprint for the remainder of the product development project. The Project Manager has five basic tools to monitor and control the project. These consist of the project status report, project review meetings, design review meetings, configuration log, and problem log. The Project Manager can also delegate tasks to any of the team members. However, this does not relieve him of the responsibility for the overall project.

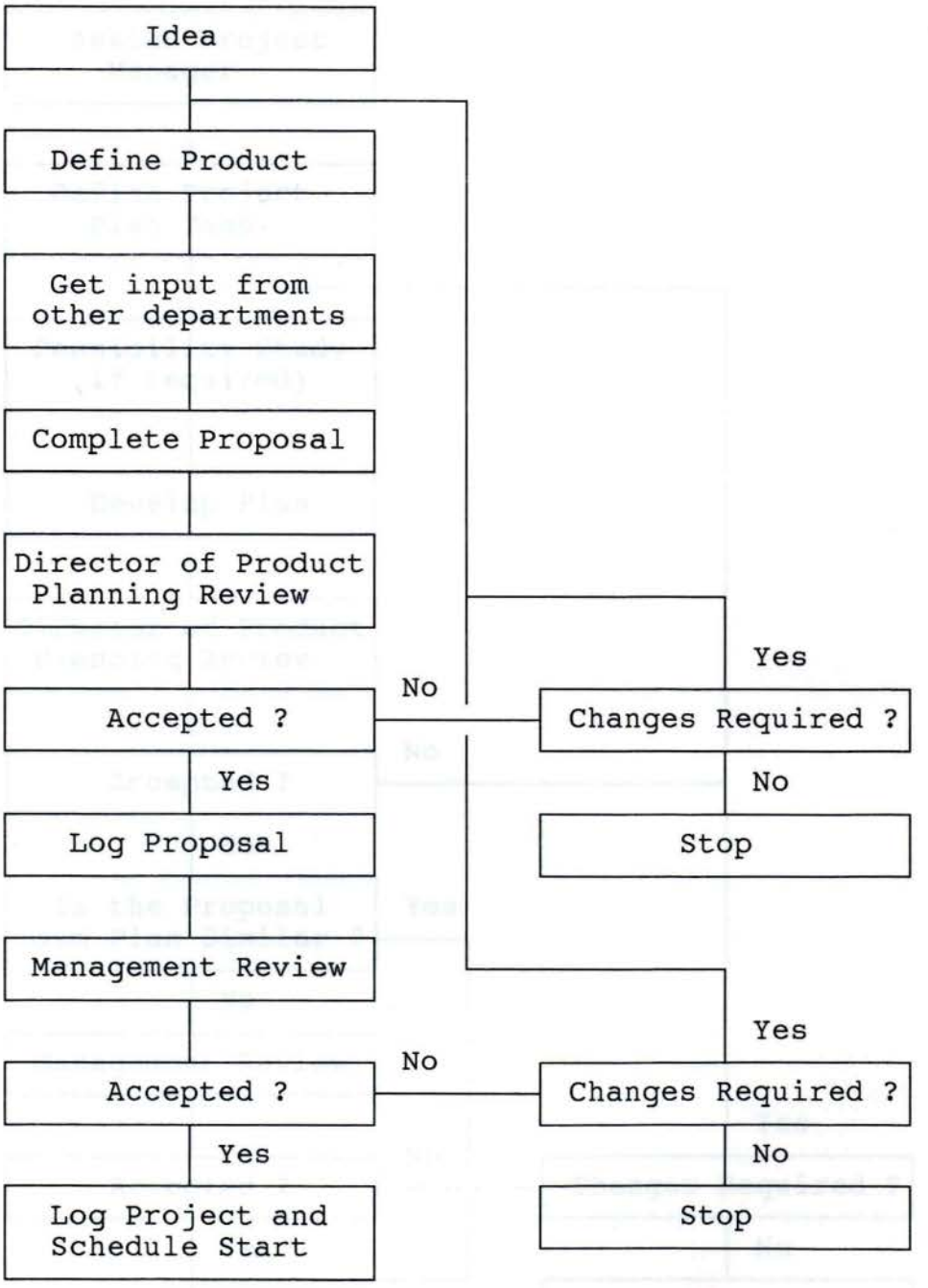
The project status reports are periodic reports used primarily to keep upper management and functional managers informed of the project's progress. The Project Manager will also have weekly project review meetings with representatives of all the corporation's functional groups. These meetings are intended to review the project's status, to address problems that occur during the project, and to assign action items to resolve unplanned issues. Design review meetings are similar to the project review meetings, with the exception that they are more technical in nature, and may be attended by a different group of people. Their primary propose is to review the direction of the design and whether there are any technical problems. During qualification testing the Project Manager will

use the configuration log to control what is being tested and what changes are being made. The problem list is a list of all unresolved problems.

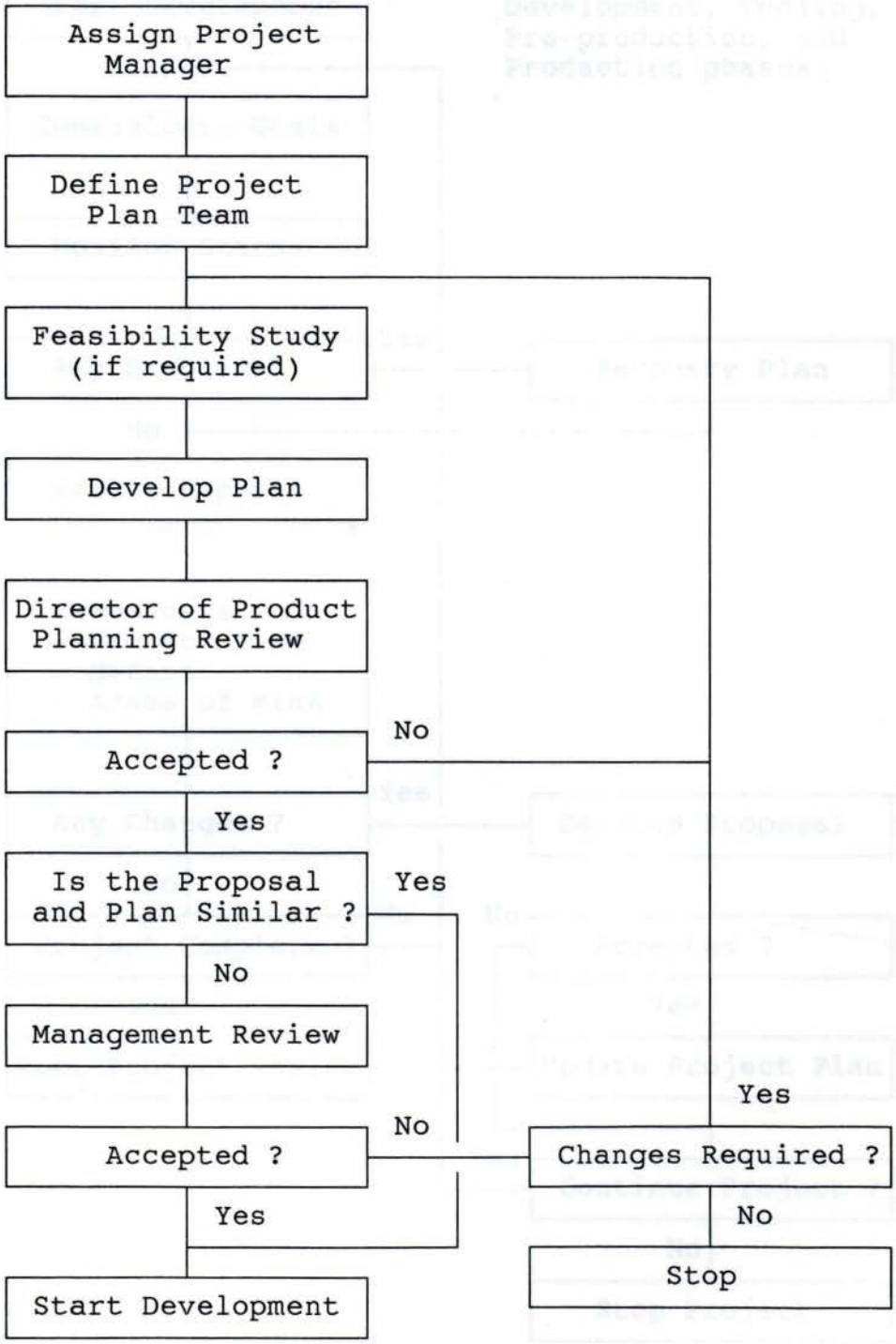
The Project Manager must continuously re-evaluate the project plan, market, and areas of risk. Changes to the original requirements should be written up as a project proposal. However, this type of proposal should only list the changes from the existing project plan. These proposals will be submitted to the Director of Product Planning. If necessary he will call a management review meeting. If the proposal is accepted, the project plan will then be updated to reflect the proposed changes. However, in some cases it may be necessary to cancel the project if the proposal is not accepted.

The Project Manager will complete a Team Member Performance Review for each permanent member every six months and at the completion of the project. At the end of the project, the Project Manager will complete a Project Summary Report, while all of the team members will complete a Project Review Report. The Director of Product Planning will use these reports to evaluate the performance of the project managers, team members, and the project management system.

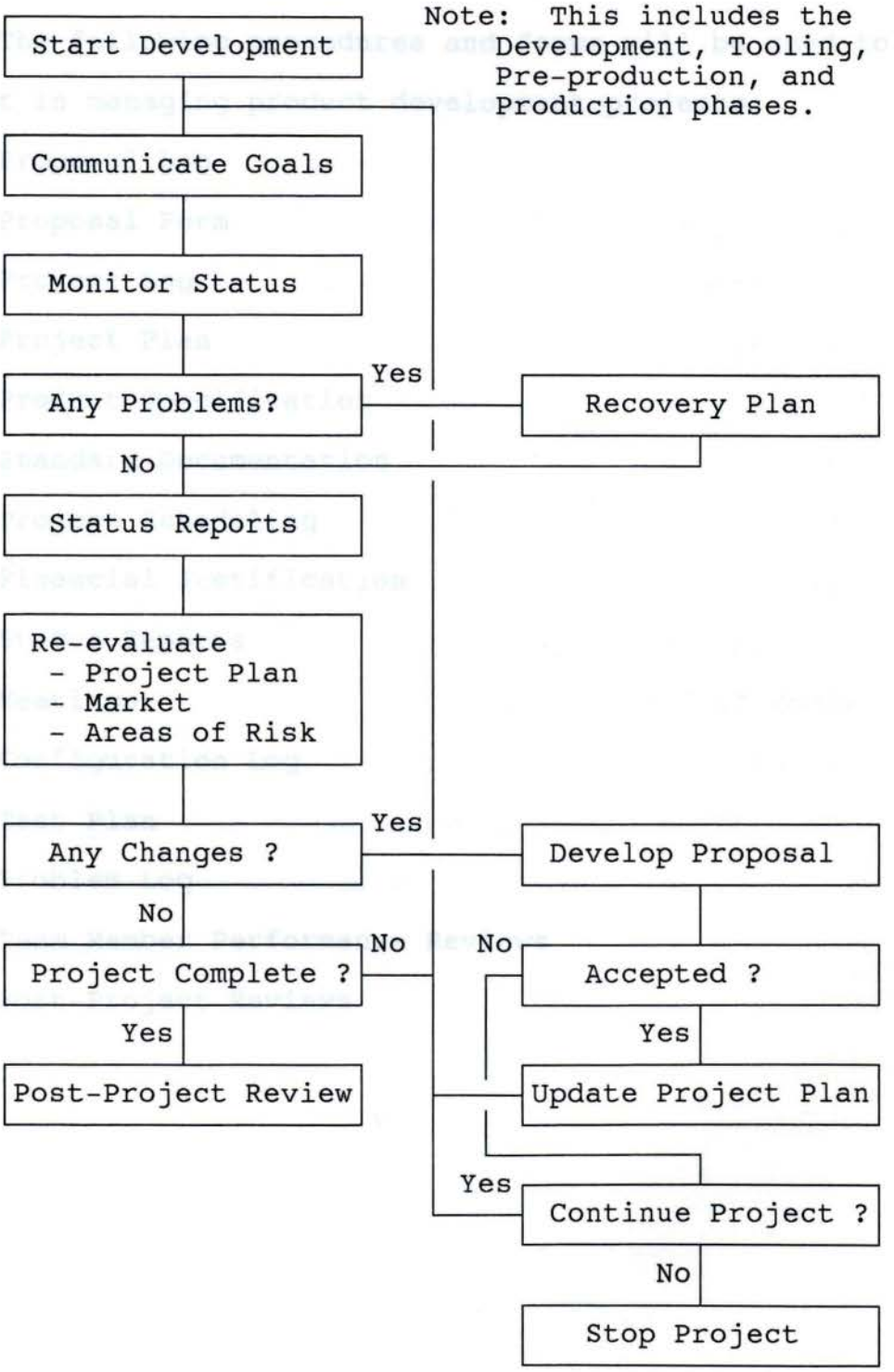
Proposal Flowchart



Project Plan Flowchart



Development Flowchart



VII. **Project Management Procedures**

The following procedures and forms will be used to assist in managing product development projects:

Proposal Log

Proposal Form

Project Log

Project Plan

Product Specification

Standard Documentation

Project Scheduling

Financial Justification

Status Reports

Meetings

Configuration Log

Test Plan

Problem Log

Team Member Performance Reviews

Post-Project Reviews

Proposal Log

The proposal log is maintained by the Director of Product Planning. After a proposal has been written and the Director of Product Planning has reviewed it, he will assign a proposal number and log the proposal. The proposal number is a five digit number, with the first two digits representing the last two digits of the firm's fiscal year. The next three digits are assigned in sequential order. The log also includes the proposal title, the date the proposal was logged, proposal status, and the name of the person who wrote the proposal. The project status will be either accepted, rejected, or active. The Director of Product Planning should keep a file of all proposals. Note: It is not necessary to assign a new proposal number for minor revisions of a proposal during the review process.

Proposal Log

FY 1991

Proposal Number	Title	Date	Status	Written By
91001				

Proposal Form

The proposal form includes a summary page and seven sections. The top of the summary page includes the proposal title, date, written by, and proposal number. The middle of the summary page should include the Product Goals Summary. This should be a short paragraph that describes the purpose of the proposed product, and sets a point of focus for the project. The bottom of this page includes the project duration. This is the total amount of time from the beginning of the project until the post-project review is complete. It will also include the total project cost, which includes the development cost, tooling cost, equipment cost, and material cost. Next will be the product cost, followed by the product selling price and profit margin. Then the estimated volume per year, followed by the payback period in years. Note that the proposal is not binding on the development team. For the most part the proposal should not be very detailed, it should only give the reader a good idea of what the product is and what it will take to develop the product. It should not be a week by week list of activities. This will be done in the project plan.

Section 1, Product Requirements - This section should list all of the known requirements for the product. If detailed requirements are not known, relevant requirements should be included, such as similar to XYZ's model ABC with the following exceptions or improvements.

Section 2, Design Approach - This section should describe how each of the product's major modules will be developed, what types of technology will be used, how technical risk will be addressed, or any other technical information.

Section 3, Schedule - The schedule should define the time and manpower for each functional group required for each phase of the project development cycle (a level 2 schedule).

Section 4, Marketing Section - This section should include a preliminary market plan which would include a proposed product price, a sales forecast, how the product is going to be promoted, how the product is going to be distributed, and describe the product's life cycle.

Section 5, Manufacturing Section - This section will

define the manufacturing methods that will be used, and any impacts caused by this project, such as building a new plant, implementing new technology, etc.

Section 6, Financial Section - This section should list an estimate of the product cost (material, labor, and overhead), development cost, tooling cost, equipment cost, material cost, sales/promotion cost, and service/warranty cost. This section should also include a financial justification for the project.

Section 7, Comments - This section is for general business comments, listing areas of risk, assumptions, or whatever else is needed.

Proposal Form

Proposal Title: _____

Date: _____

Written By: _____

Proposal Number: _____

Approval: _____

Product Goals Summary:

Project Duration: _____(months)

Total Project Cost: _____

Product Cost: _____

Product Selling Price: _____ (Profit Margin_____)

Volume Per Year: _____

Pay Back Period: _____(years)

"Proposal Title"

Page 2 of ____

1.0 Product Requirements:

2.0 Design Approach:

3.0 Schedule:

4.0 Marketing Section:

5.0 Manufacturing Section:

6.0 Financial Section:

7.0 Comments:

Project Log

The Project Log is maintained by the Director of Product Planning. After a proposal has been accepted, the project is added to the project log. The project log includes the project number, project name, date, Project Manager, and project status. The project number is a four digit sequential number that is assigned to each project. The project status is either active, complete, or suspended.

Project Log

The Project Log is maintained by the Director of Product Planning. After a proposal has been accepted, the project is added to the project log. The project log includes the project number, project name, date, Project Manager, and project status. The project number is a four digit sequential number that is assigned to each project. The project status is either active, complete, or suspended.

Project Log

Project Number	Product Name	Date	Project Manager	Status

Project Plan

The Project Plan is very similar to the project proposal, however, it should include substantially more details. The top of the first page of the project plan should include the project name, project number, and Project Manager. The revision summary will include the date, description of change, and approved by (which should be the Director of Product Planning). The second page will start with a summary of the projects goals. This should set a "point of focus" for the project team. The next six sections of the project plan will be essentially the same as the project proposal, however, additional details should be added. Two sections will be added after Section 6, the Financial Section. Section 7 will include a list of the team members (permanent and part time) assigned to this project and an Organization Chart. Section 8 will be an outline of the testing requirements for this product. The Comment Section will then be Section 9. Appendix A will include the product specification.

Project Plan

Product Name: _____

Project Number: _____

Project Manager: _____

Date	Description of Change	Approved By
	Initial Release	

"Product Name/Project Number"

Product Goals Summary:

1.0 Product Requirements:

2.0 Design Approach:

3.0 Schedule:

4.0 Marketing Section:

5.0 Financial Section:

6.0 Manufacturing Section:

7.0 Team Members:

8.0 Test Requirements:

9.0 Comments:

Appendix A Product Specification

Product Specification

The product specification defines the product being developed. The first page includes the product name, project number, who wrote the document, and information pertaining to the release of the document. This information includes the date, reason for the release, and approval (which should be the Project Manager.) The actual specification is divided into nine sections:

Scope
Definition
Applicable Documents
Physical Characteristics
Operational Functions
Environmental Data
Maintenance
Reliability
Manufacturing Requirements
Shipping and Handling

The scope should include a brief description of the product and its intended uses. If applicable, it should also define the different models that will be available, such as, will it be available in different

colors, different voltage models, or any other characteristics that may be applicable.

The definition section should define technical terms that are particular to this product. This section will also define terms such as errors and failures. The applicable documents section should list the standards or documents that are referenced by this specification and how they pertain to this product. This could include other product specifications, manufacturing specifications, safety agencies requirements (UL, CSA, VDE, etc.), shipping standards, such as the National Safe Transit Association's standards, or government regulations, such as Federal Communication Commission's standards.

The physical characteristics section should include information such as dimensions, mounting methods, electrical interface, strength, or any other physical parameter.

The operational functions should describe how the unit will function in its intended application. If applicable, these functions should be broken into different sections so that they can be better described in detail.

The environmental data section should include

information about the environment the unit will function in or be subjected to. This could include specified operating voltage range, temperature/humidity requirements for operation and storage, or installation requirements.

The maintenance section should describe any periodic or normal maintenance that should be performed on the product. For example, changing the oil on a car every 3,000 miles, checking the fan belt, etc.

The reliability section defines how well the product should work in application. The first sub-section defines the field utilization equivalency. This section will define how the product is used in typical application, such as: "The door will be opened three times per day. The unit will operate at 117 volts 90 percent of the time, 100 volts 5 percent of the time, and 127 volts 5 percent of the time." The next sub-section is called errors. This section will include examples of errors and a minimal acceptable error rate. This could be either mean time between error or mean cycles between error, whichever is more applicable for the product. The next sub-section is called failures. This section will also include examples of failures and minimal acceptable failure

rate, either mean time between failure or mean cycle failure. The last major sub-section will be life. This section will define the expected life of the product, that is, the time over which the error and failure rates will be valid. It will also predict the type and number of warranty repairs/service calls.

The next section of the specification will be manufacturing requirements. This section will define any adjustments and/or assembly requirements that are not defined in the normal product documentation. It will also define any diagnostics or test modes that are built into the product. The last section will list any special shipping and handling requirements.

Product Specification

Product Name _____

Project Number _____

Releases:

Date	Reason	Written By	Approval

"Product Name/Project Number"

1.0 Scope

2.0 Definition

2.1 Errors

2.2 Failures

3.0 Applicable Documents

4.0 Physical Characteristics

5.0 Operational Functions

6.0 Environmental Data

7.0 Maintenance

"Product Name/Project Number"

8.0 Reliability

8.1 Field utilization equivalency:

8.2 Errors

8.2.1 Examples:

8.2.2 Minimum acceptable error rate:

8.3 Failures

8.3.1 Examples:

8.3.2 Minimum acceptable failure rate:

8.4 Life

9.0 Manufacturing Requirements

10.0 Shipping and Handling

Standard Documentation

This section is a list of standard product documentation, it will be expanded to include all the documentation required for a given project. It's primary use is to track the status of the documentation. By the end of a project each document should be listed and marked complete.

Documentation

Product Name: _____

Project Number: _____

Document	Status			Complete
Engineering Drawing				
Mechanical				
Electrical				
Manufacturing				
Tooling				
Fixture				
Process				
Sales				
Manuals				
Brochures				
Presentations				
Training Material				
Price List				

Project Scheduling

Scheduling involves making a work breakdown structure for all the activities within the project. A work breakdown structure is a tree type of structure that is used to outline the activity within the project. Level 1 is simply a summary of all tasks within the project. Level 2 involves the five phases of the product development cycle. (The project proposal is not included in the schedule.) Level 3 then breaks down the activities within each of the different phases. Level 4 then breaks down the activities in Level 3, and so on. In most projects, no more than four or five levels will be necessary. The first four levels of a typical project are shown below:

Level 1	Level 2	Level 3	Level 4
Project "Example"			
	Project Plan		
		Feasibility	
		Develop Plan	
		Management Review	
	Development		
		System design	
			Design
			Design Review
		Design Module 1	
			Design
			Design Review
			Prototype
			Developmental Testing
		Design Module 2	
			Design

Level 1	Level 2	Level 3	Level 4
			Design Review
			Prototype
			Developmental Testing
		Test Plans	
			Developmental
			Qualification
			Production Qualification
			Field Test
		Marketing Plan	
			Pricing
			Promotion
			Distribution
			Service
		Integration	
			Build Prototypes
			Refine Design
			Developmental Testing
			Reviews
		Manufacturing Plan	
			Develop Mfg Methods
		Qualification	
			Design Qualification Testing
		Documentation	
			Engineering Drawings
			Sales Literature
		Management Review	
	Tooling		
		Part 1	
			Tool Design
			Build tool
			Test / Rework
			First Part Inspection
			Tool Approval
		Part 2	
			Tool Design
			Build tool
			Test / Rework
			First Part Inspection
			Tool Approval
		Fixtures	
			Fixture Design
			Build Fixtures
			Test / Rework
			First Part Inspection
			Fixtures Approval

Level 1	Level 2	Level 3	Level 4
		Management Review	
	Pre-production		
		Pilot #1	
		Production Qualification	
		Field Testing	
		Production Ramp-Up	
		Management Review	
	Production		
		Support	
		Post-Project Review	
		Management Review	

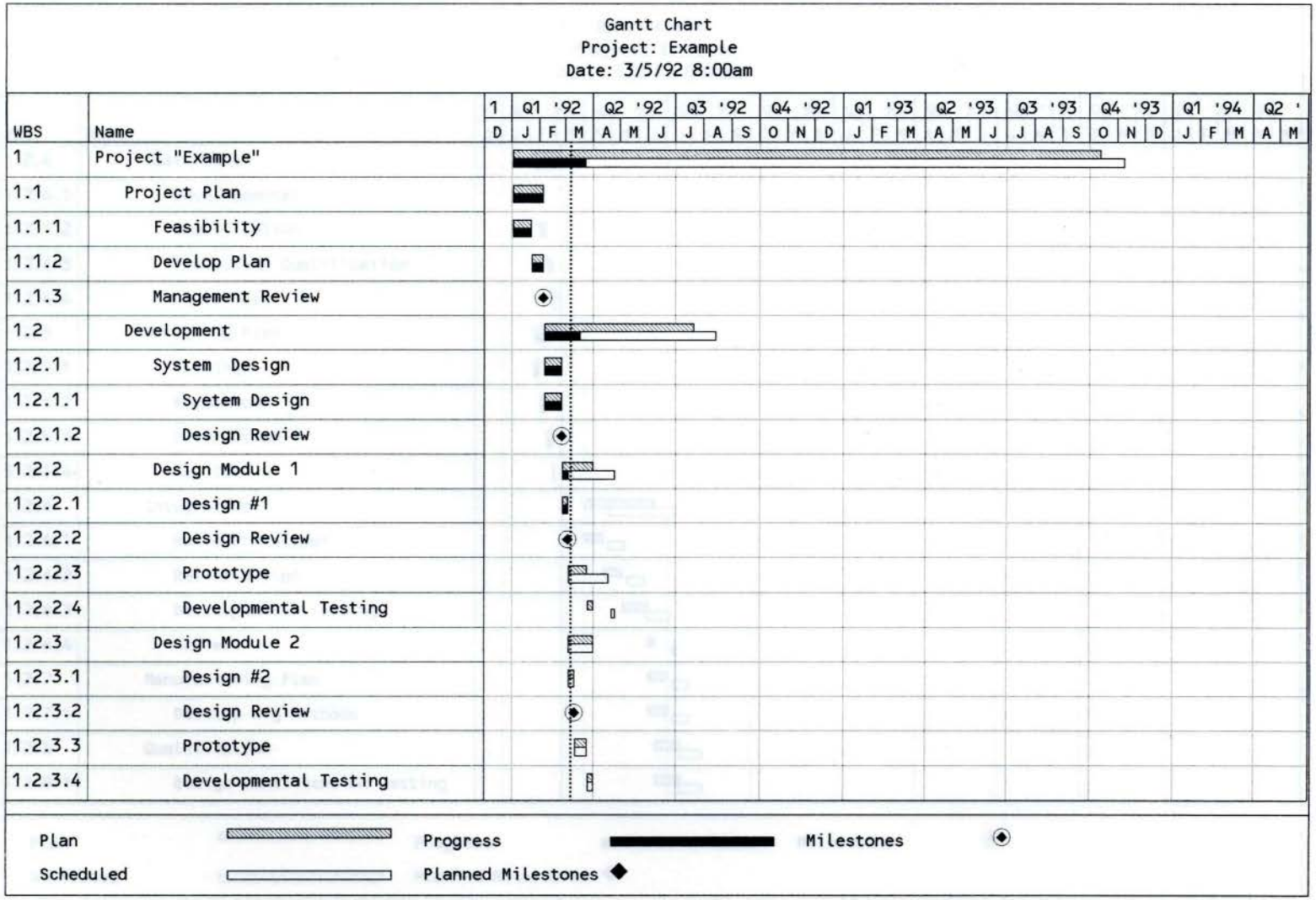
A Project Schedule involves three sets of dates for each task. The planned dates are the dates from the project plan. As a project plan is executed, some activities will change. The new dates will be called scheduled dates. The final set of dates will be the actual start and completion dates for the task. The Project Manager should review the schedule weekly and update the schedule dates and actual dates.

To facilitate the scheduling process, some type of project management scheduling software package should be used. For the purpose of this manual, MicroSoft Project for Windows was selected. However, other software packages are available that will perform the same type of task. Using the software packages, reports can be generated in many different formats.

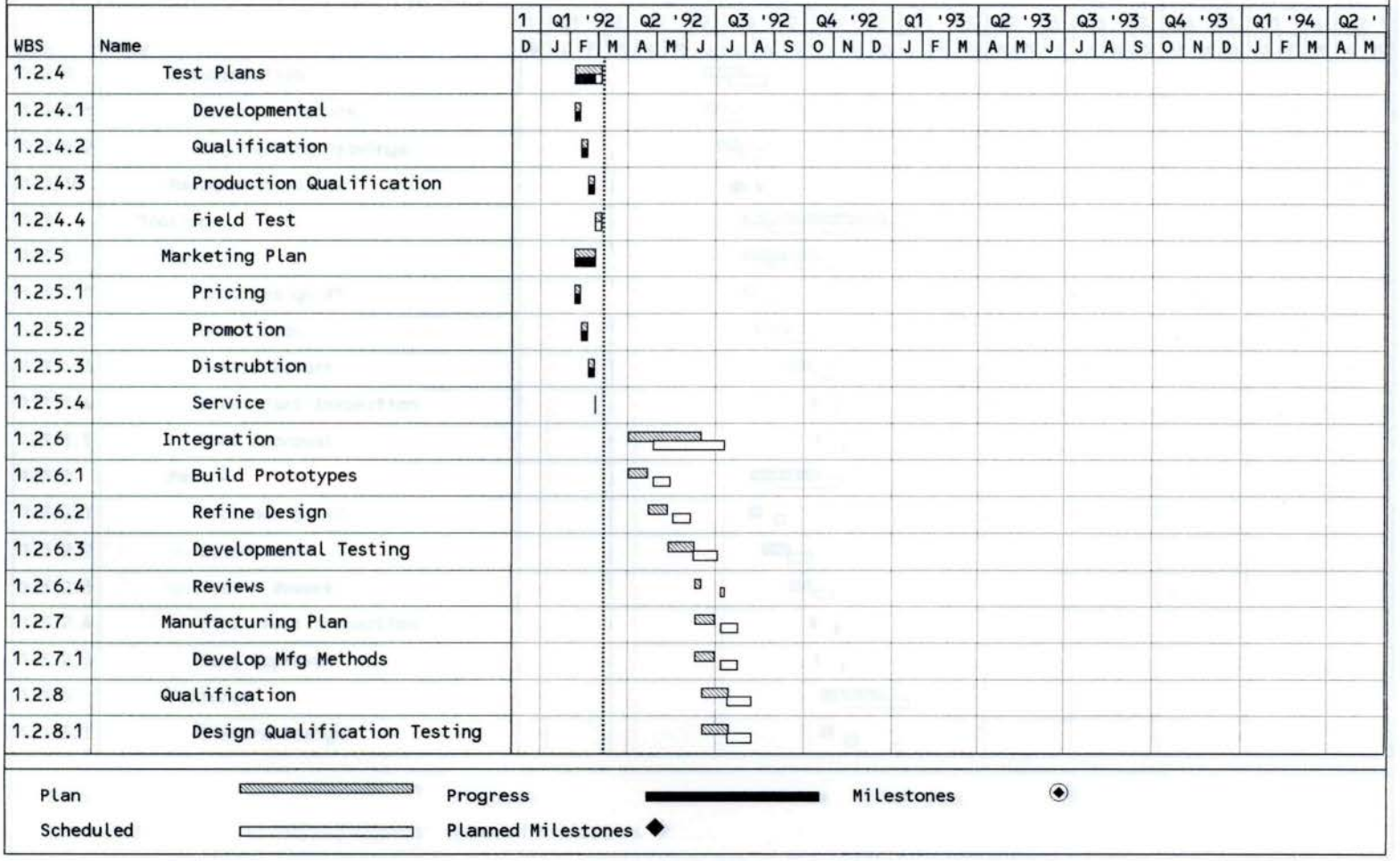
These programs can also be used to track the product development costs. However, some firms will

have other systems to collect these costs. The following is an example of a project schedule in both "Grantt" and "PERT" formats. When developing a schedule for new projects, the example schedule should be used as a template and customized to meet the project's needs.

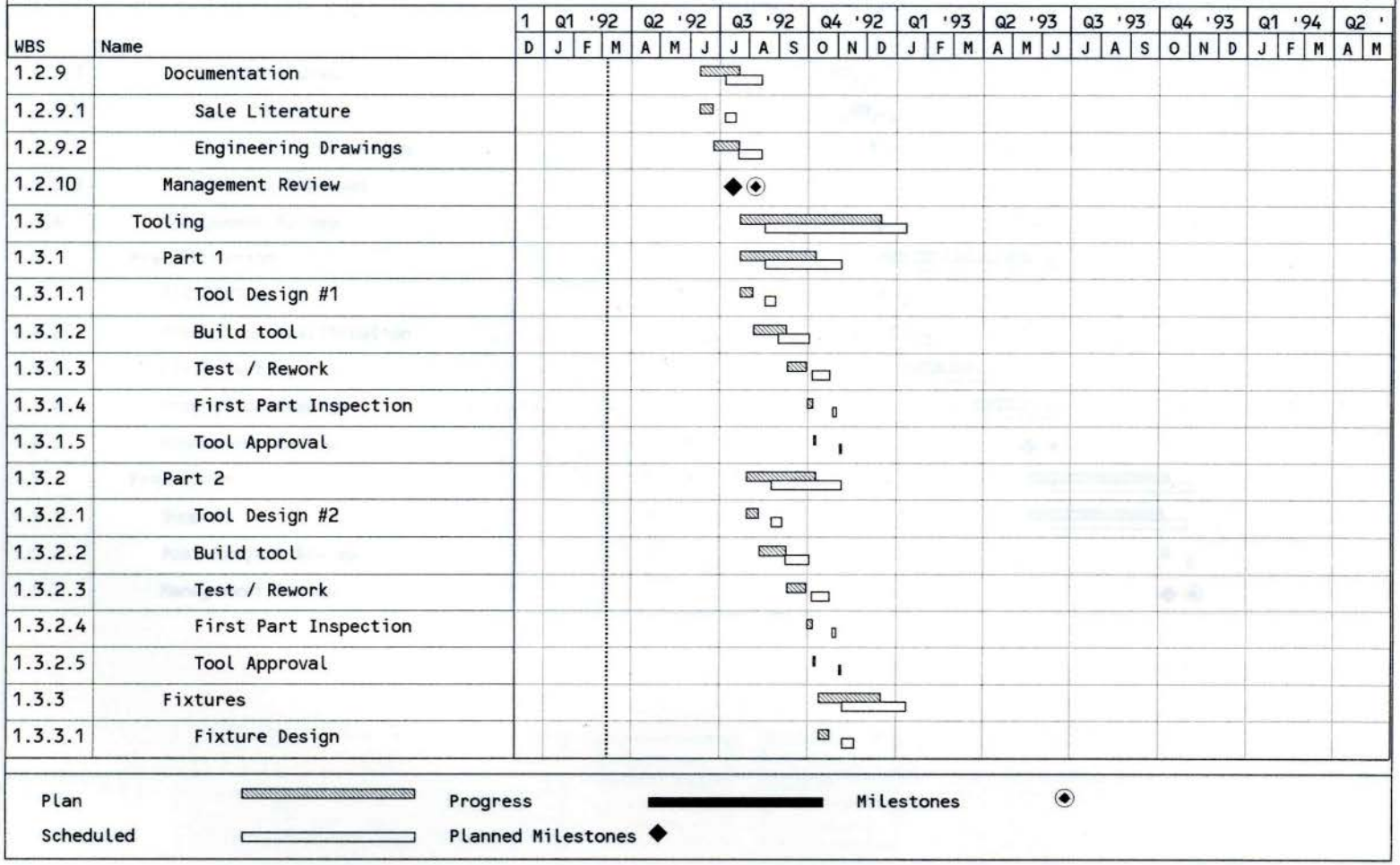
Gantt Chart
Project: Example
Date: 3/5/92 8:00am



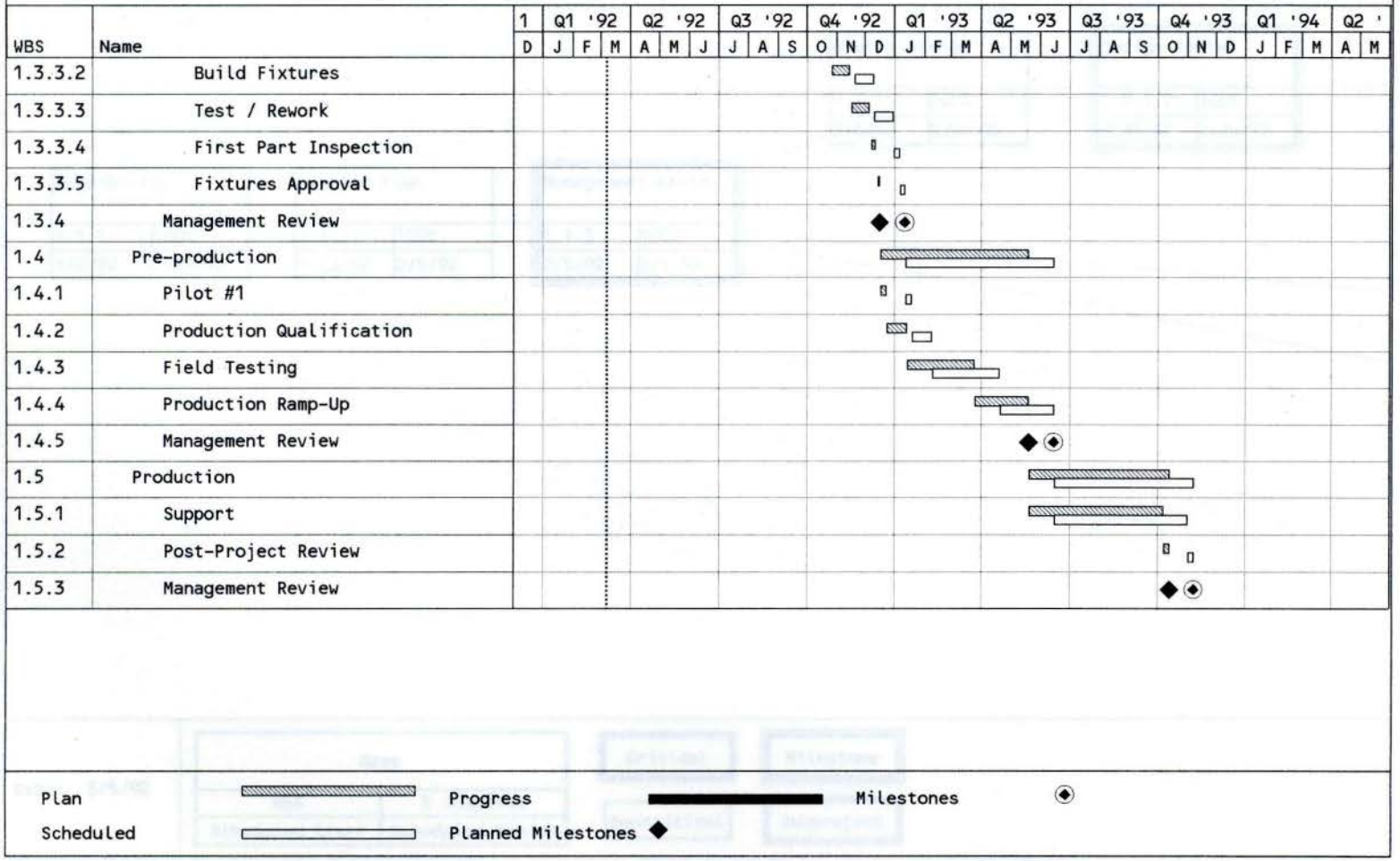
Gantt Chart
Project: Example
Date: 3/5/92 8:00am

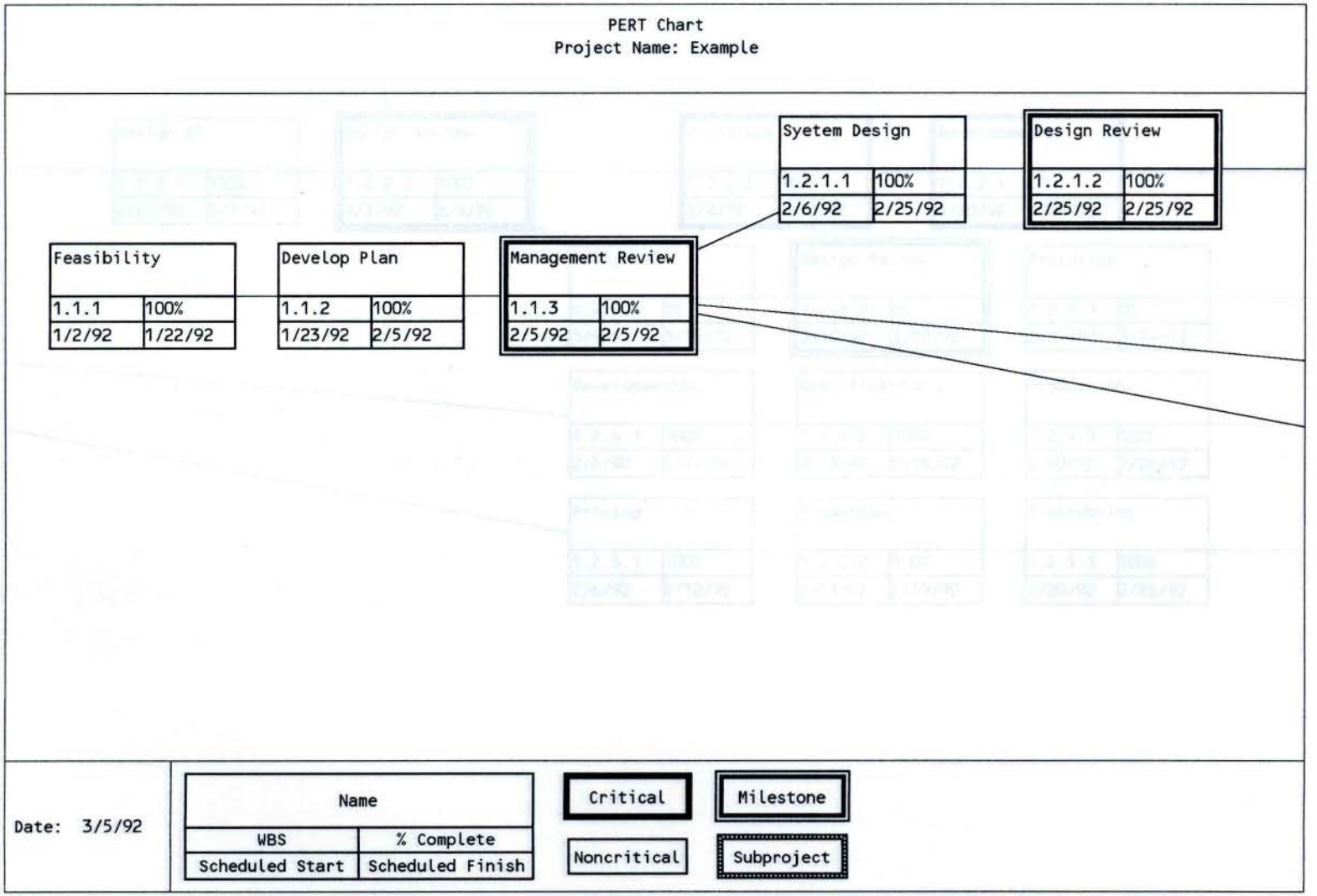


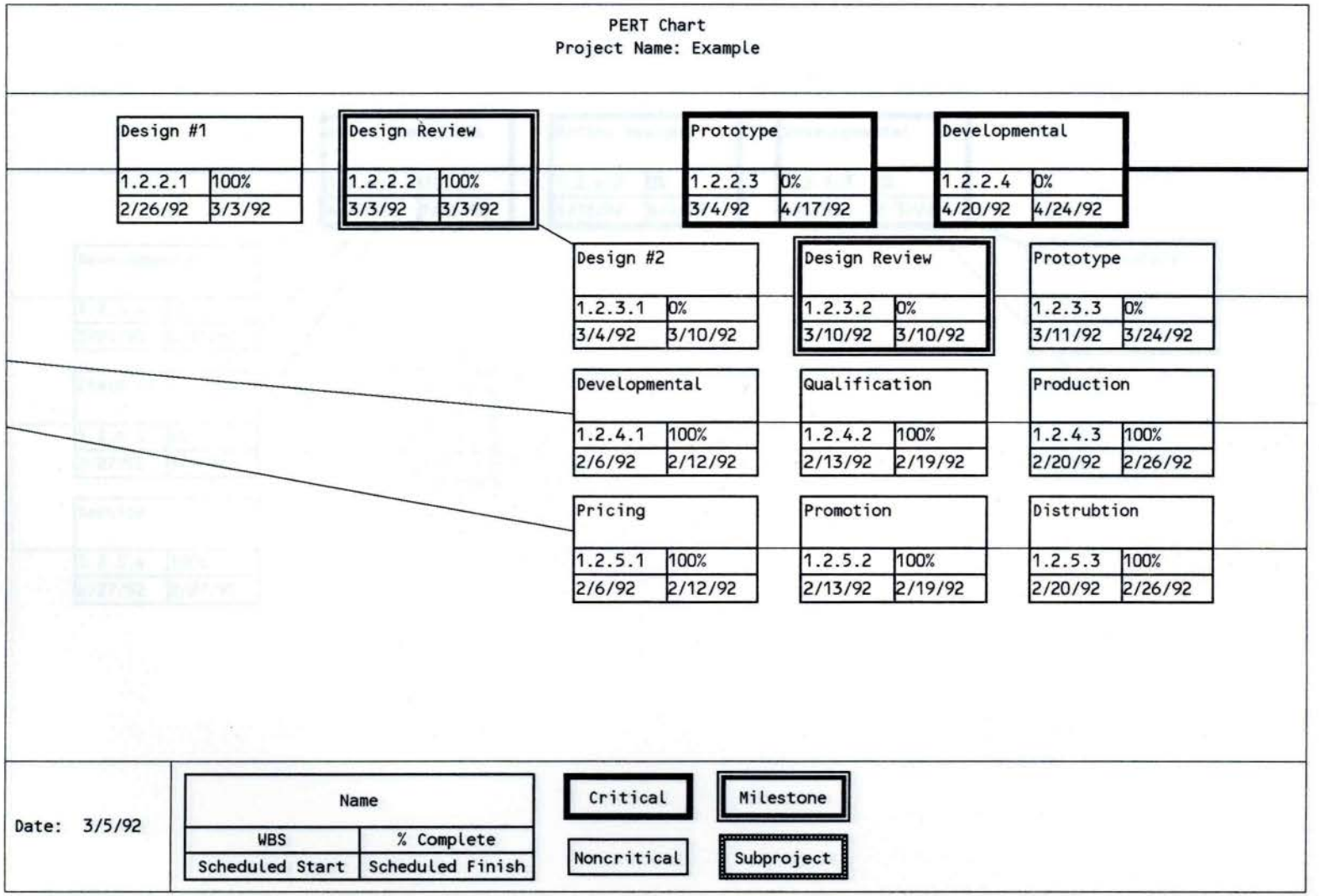
Gantt Chart
Project: Example
Date: 3/5/92 8:00am

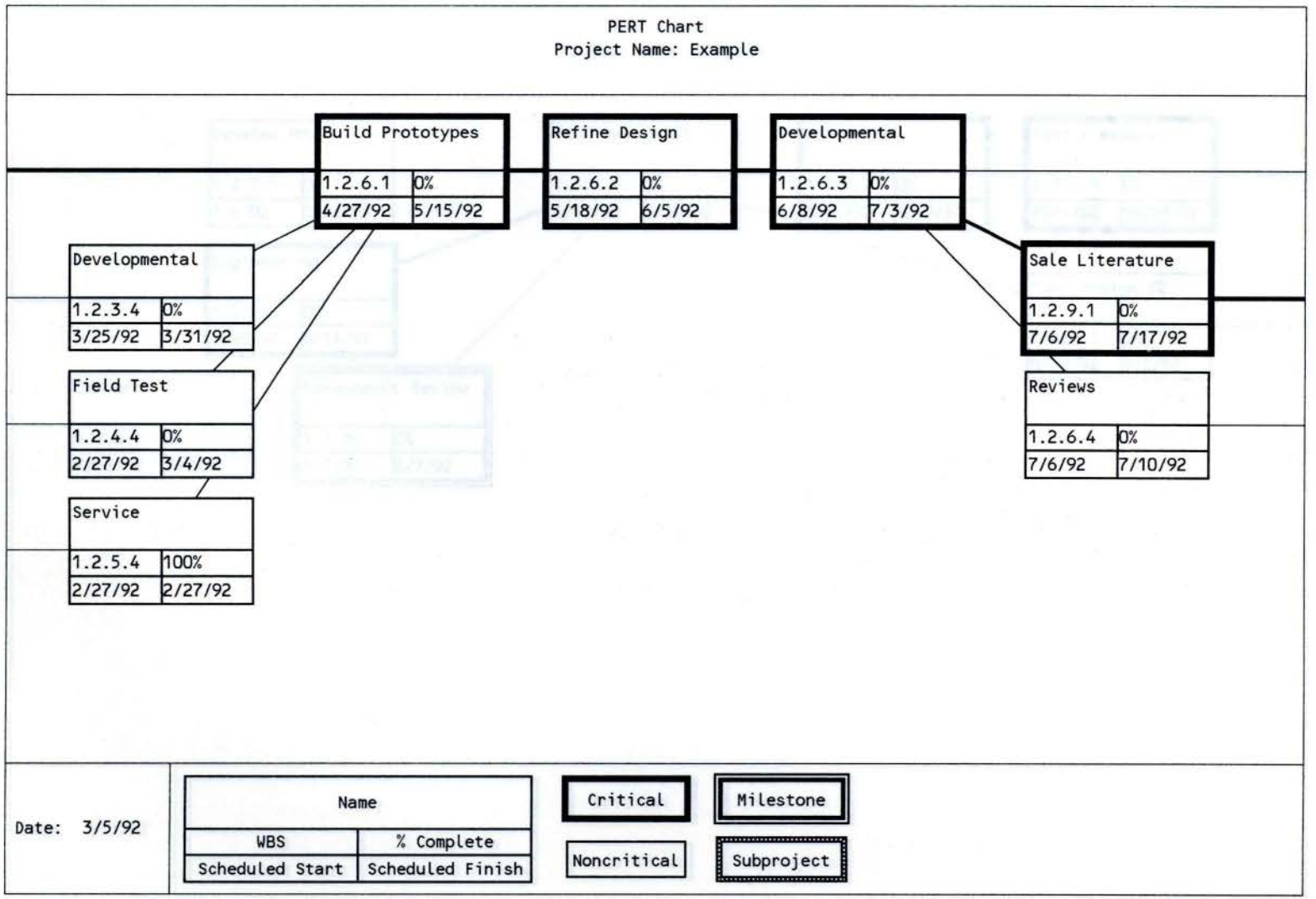


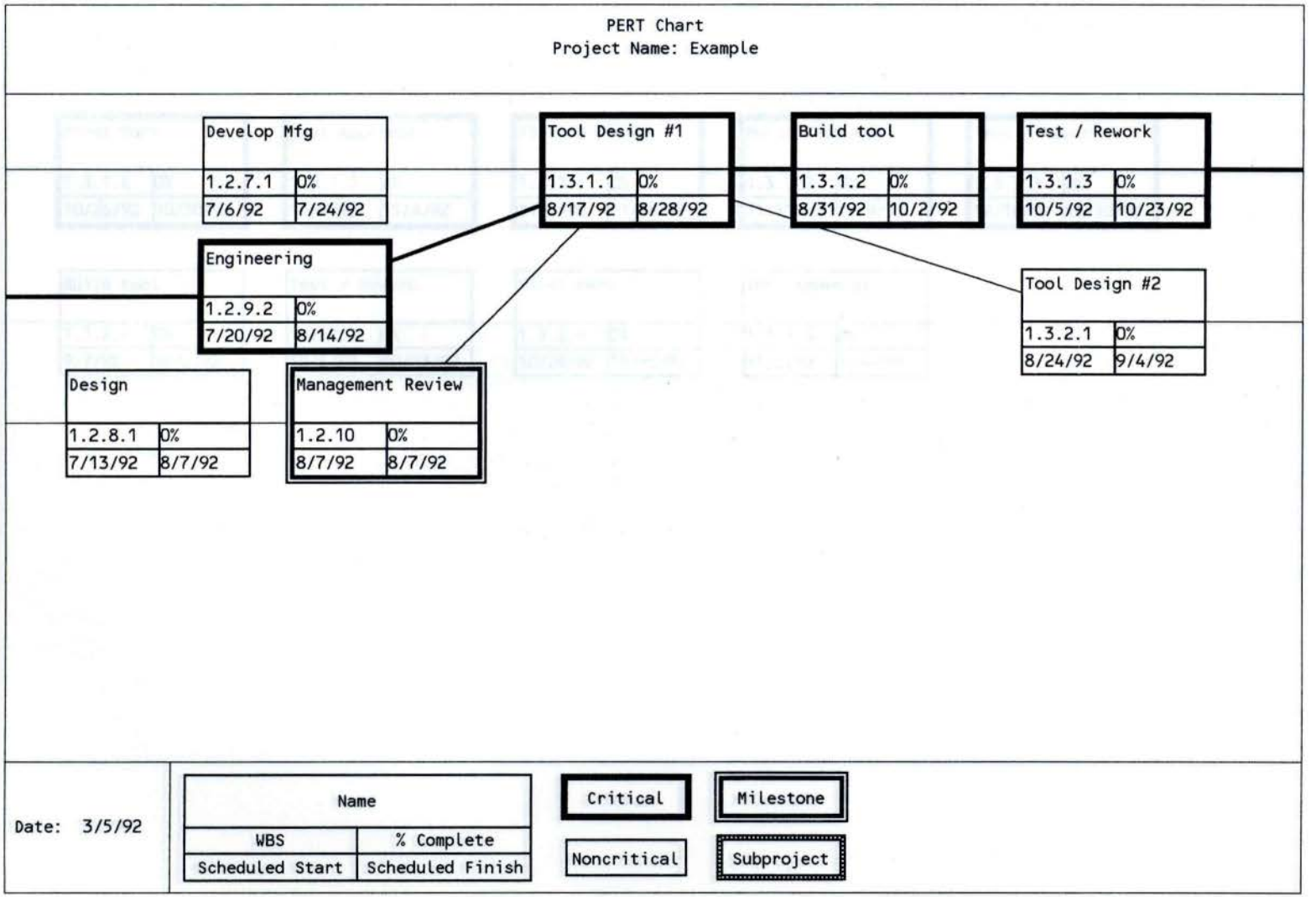
Gantt Chart
Project: Example
Date: 3/5/92 8:00am

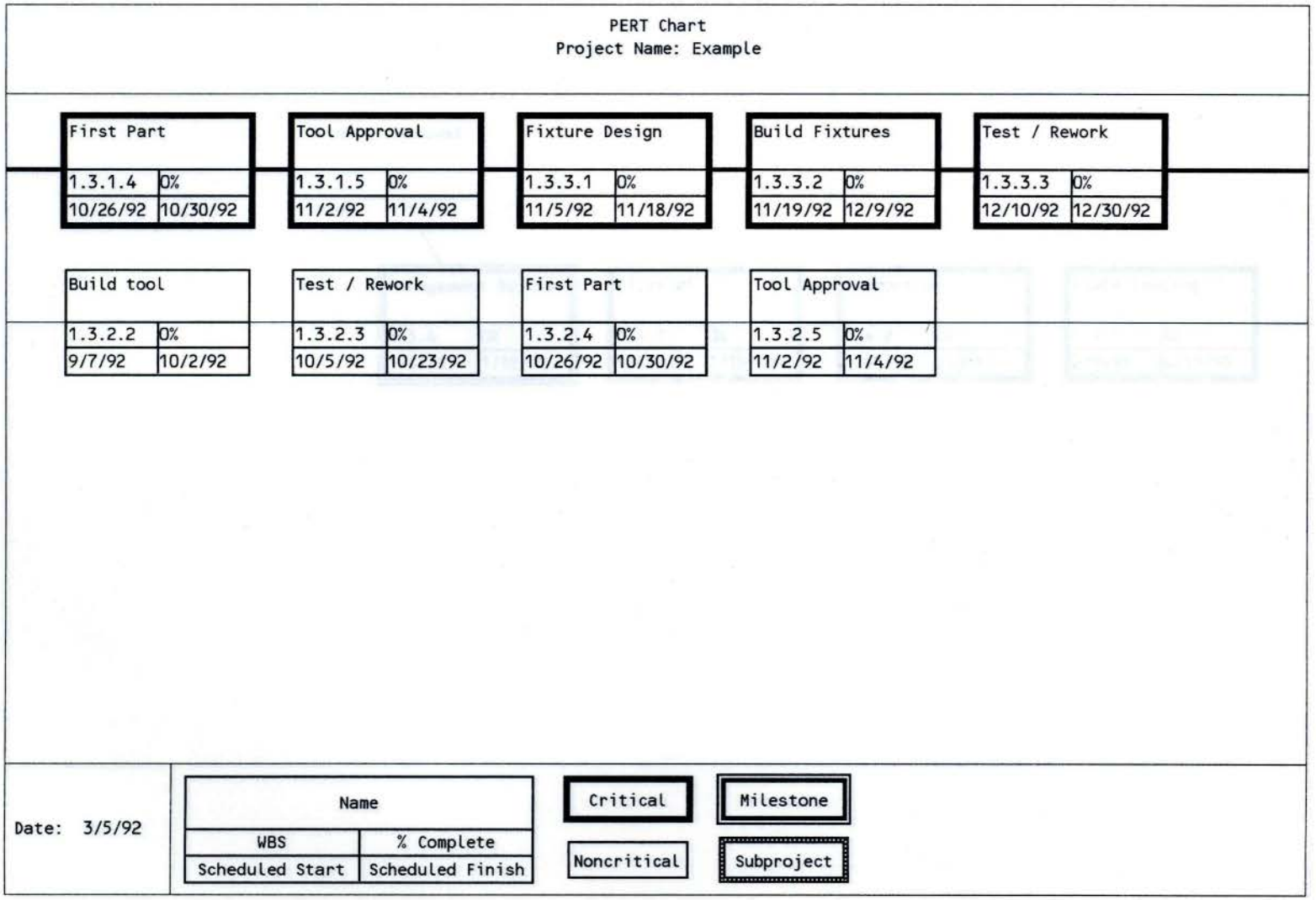


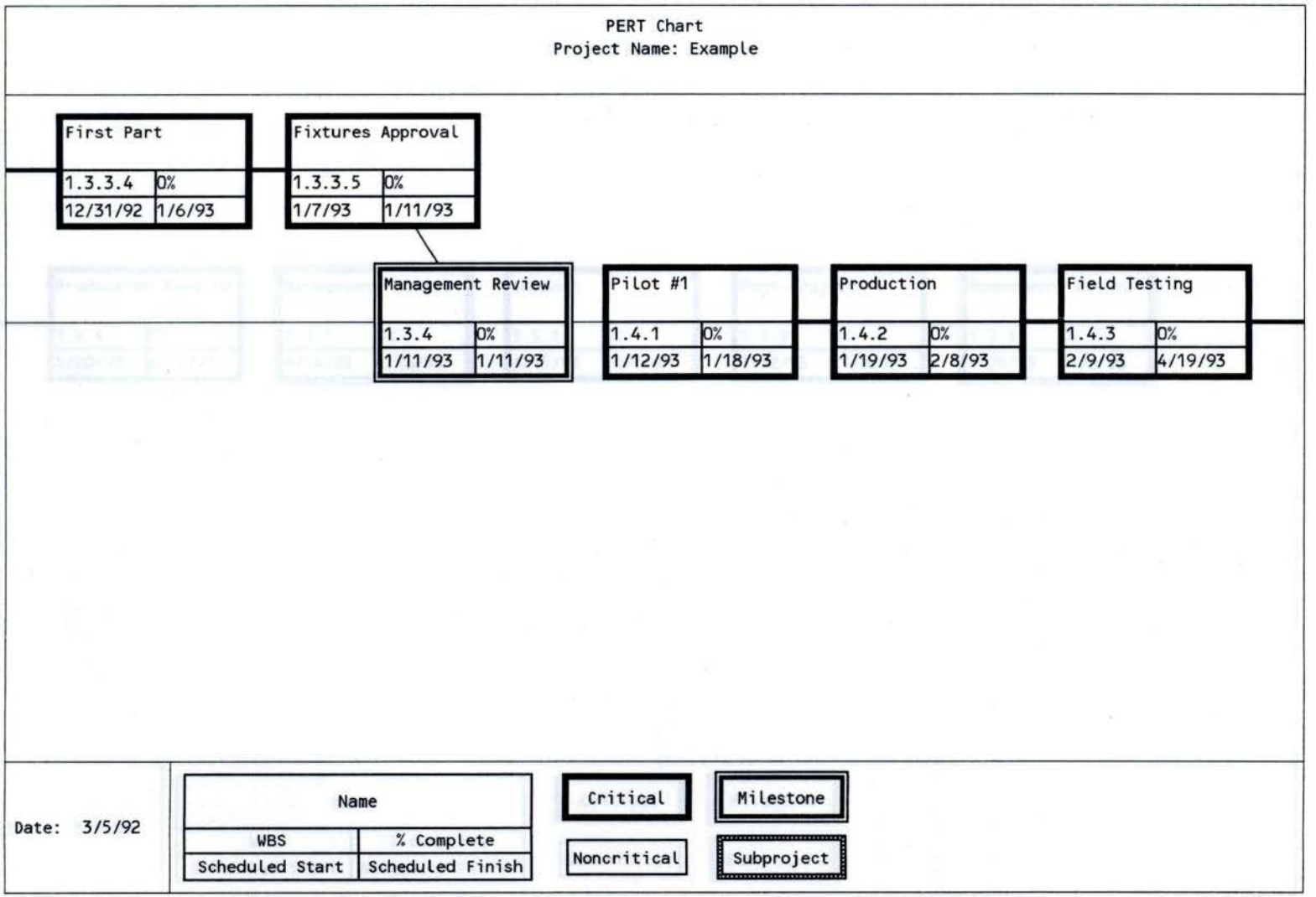

PERT Chart
Project Name: Example
Feasibility
1.1.1
100%
1/2/92
1/22/92
Develop Plan
1.1.2
100%
1/23/92
2/5/92
Management Review
1.1.3
100%
2/5/92
2/5/92
Syetem Design
1.2.1.1
100%
2/6/92
2/25/92
Design Review
1.2.1.2
100%
2/25/92
2/25/92
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Noncritical
Milestone
Subproject


PERT Chart
Project Name: Example
Design #1
1.2.2.1
100%
2/26/92
3/3/92
Design Review
1.2.2.2
100%
3/3/92
3/3/92
Prototype
1.2.2.3
0%
3/4/92
4/17/92
Developmental
1.2.2.4
0%
4/20/92
4/24/92
Design #2
1.2.3.1
0%
3/4/92
3/10/92
Design Review
1.2.3.2
0%
3/10/92
3/10/92
Prototype
1.2.3.3
0%
3/11/92
3/24/92
Developmental
1.2.4.1
100%
2/6/92
2/12/92
Qualification
1.2.4.2
100%
2/13/92
2/19/92
Production
1.2.4.3
100%
2/20/92
2/26/92
Pricing
1.2.5.1
100%
2/6/92
2/12/92
Promotion
1.2.5.2
100%
2/13/92
2/19/92
Distrubtion
1.2.5.3
100%
2/20/92
2/26/92
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Milestone
Noncritical
Subproject

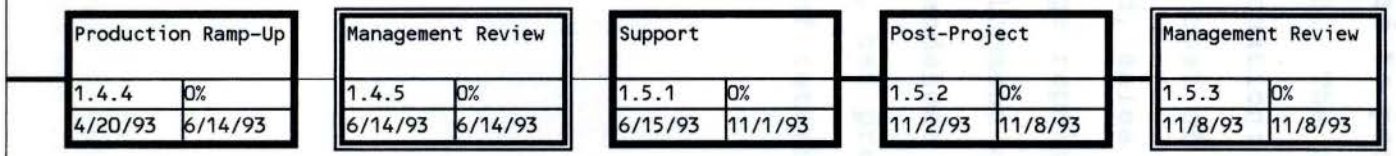

PERT Chart
Project Name: Example
Build Prototypes
1.2.6.1
0%
4/27/92
5/15/92
Refine Design
1.2.6.2
0%
5/18/92
6/5/92
Developmental
1.2.6.3
0%
6/8/92
7/3/92
Developmental
1.2.3.4
0%
3/25/92
3/31/92
Field Test
1.2.4.4
0%
2/27/92
3/4/92
Service
1.2.5.4
100%
2/27/92
2/27/92
Sale Literature
1.2.9.1
0%
7/6/92
7/17/92
Reviews
1.2.6.4
0%
7/6/92
7/10/92
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Milestone
Noncritical
Subproject


PERT Chart
Project Name: Example
Develop Mfg
1.2.7.1
0%
7/6/92
7/24/92
Engineering
1.2.9.2
0%
7/20/92
8/14/92
Design
1.2.8.1
0%
7/13/92
8/7/92
Management Review
1.2.10
0%
8/7/92
8/7/92
Tool Design #1
1.3.1.1
0%
8/17/92
8/28/92
Build tool
1.3.1.2
0%
8/31/92
10/2/92
Test / Rework
1.3.1.3
0%
10/5/92
10/23/92
Tool Design #2
1.3.2.1
0%
8/24/92
9/4/92
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Noncritical
Milestone
Subproject


PERT Chart
Project Name: Example
First Part
1.3.1.4
0%
10/26/92
10/30/92
Tool Approval
1.3.1.5
0%
11/2/92
11/4/92
Fixture Design
1.3.3.1
0%
11/5/92
11/18/92
Build Fixtures
1.3.3.2
0%
11/19/92
12/9/92
Test / Rework
1.3.3.3
0%
12/10/92
12/30/92
Build tool
1.3.2.2
0%
9/7/92
10/2/92
Test / Rework
1.3.2.3
0%
10/5/92
10/23/92
First Part
1.3.2.4
0%
10/26/92
10/30/92
Tool Approval
1.3.2.5
0%
11/2/92
11/4/92
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Milestone
Noncritical
Subproject


PERT Chart
Project Name: Example
First Part
1.3.3.4
0%
12/31/92
1/6/93
Fixtures Approval
1.3.3.5
0%
1/7/93
1/11/93
Management Review
1.3.4
0%
1/11/93
1/11/93
Pilot #1
1.4.1
0%
1/12/93
1/18/93
Production
1.4.2
0%
1/19/93
2/8/93
Field Testing
1.4.3
0%
2/9/93
4/19/93
Date: 3/5/92
Name
WBS
% Complete
Scheduled Start
Scheduled Finish
Critical
Milestone
Noncritical
Subproject

PERT Chart
Project Name: Example



Date: 3/5/92

Name	
WBS	% Complete
Scheduled Start	Scheduled Finish

Critical | Milestone

Noncritical | Subproject

Financial Analysis

Attached you will find an example of a Lotus Spreadsheet used to perform a cash flow analysis on a typical project. The user will need to input the following information: marginal tax rate, average turnover rate, cost of capital, product cost, material, labor, overhead, sales price, product mean time between failure, average repair cost, estimated sales quantity per year, development cost, tooling cost, and equipment cost. The spreadsheet will then calculate the cash flows per year, net present value for a project, internal rate of return, and the profit margin.

CASH FLOW ANALYSIS

PRODUCT NAME _____

PROJECT NUMBER _____

PRODUCT COST		COMPANY INFORMATION	
MATERIAL	$50.00	MARGINAL TAX RATE	39%
LABOR	$10.00	AVG TURNOVER RATE	4
OVERHEAD	$20.00	COST OF CAPITAL	10%
TOTAL	$80.00		
SALE PRICE	$140.00		
PRODUCT MTBF (YEARS)	6		
AVG. REPAIR COST	$15.00		

YEAR	0	1	2	3	4
EST. SALES QTY.		10,000	20,000	20,000	20,000
R&D COST	($1,000,000)				
TOOLING COST	($600,000)				
EQUIPMENT COST	($100,000)				
WORKING CAPITAL (NOTE 1)		($125,000)	($125,000)	$0	$0
WORKING CAPITAL RECOVERY					$250,000
SALES		$1,400,000	$2,800,000	$2,800,000	$2,800,000
COST OF GOODS SOLD		$800,000	$1,600,000	$1,600,000	$1,600,000
WARRANT COST (1 YEAR)		$23,028	$46,055	$46,055	$46,055
NET PROFIT		$576,972	$1,153,945	$1,153,945	$1,153,945
PROFIT AFTER TAXES		$351,953	$703,906	$703,906	$703,906
DEPRECIATION TAX SAVING (NOTE 2)		$68,250	$68,250	$68,250	$68,250
TOTAL CASH FLOWS	($1,700,000)	$295,203	$647,156	$772,156	$1,022,156

NET PRESENT VALUE OF PROJECT	$346,805
INTERNAL RATE OF RETURN	18%
PROFIT MARGIN	43%

NOTE 1: THIS AND THE NEXT LINE SHOULD BE REMOVED IF THE PRODUCT REPLACES A CURRENT PRODUCT.

NOTE 2: ASSUMES 4 YEAR STRAIGHT LINE DEPRECIATION.

Cash Flow Analysis
LOTUS 123 Spreadsheet Formulas

```
C1: 'CASH FLOW ANALYSIS
B2: 'PRODUCT NAME _____
B3: 'PROJECT NUMBER _____
A6: [W30] 'PRODUCT COST
D6: 'COMPANY INFORMATION
A7: [W30] \-
B7: \-
D7: \-
E7: \-
F7: \-
A8: [W30] 'MATERIAL
B8: (C2) 50
D8: 'MARGINAL TAX RATE
F8: (P0) 0.39
A9: [W30] 'LABOR
B9: (C2) 10
D9: 'AVG TURNOVER RATE
F9: (G) 4
A10: [W30] 'OVERHEAD
B10: (C2) 20
D10: 'COST OF CAPITAL
F10: (P0) 0.1
A11: [W30] \=
B11: \=
A12: [W30] 'TOTAL
B12: (C2) @SUM(B10..B7)
A14: [W30] 'SALE PRICE
B14: (C2) 140
A15: [W30] 'PRODUCT MTBF (YEARS)
B15: (G) 6
A16: [W30] 'AVG. REPAIR COST
B16: (C2) 15
A19: [W30] 'YEAR
B19: (G) 0
C19: (G) 1
D19: (G) 2
E19: (G) 3
F19: (G) 4
A20: [W30] \-
B20: \-
C20: \-
D20: \-
E20: \-
F20: \-
```

```
A21: [W30] 'EST. SALES QTY.
C21: (,0) 10000
D21: (,0) 20000
E21: (,0) 20000
F21: (,0) 20000
A23: [W30] 'R&D COST
B23: -1000000
A24: [W30] 'TOOLING COST
B24: -600000
A25: [W30] 'EQUIPMENT COST
B25: -100000
A27: [W30] 'WORKING CAPITAL (NOTE 1)
C27: -(C21/$F$9)*$B$8
D27: -((D21-C21)/$F$9)*$B$8
E27: -((E21-D21)/$F$9)*$B$8
F27: -((F21-E21)/$F$9)*$B$8
A28: [W30] 'WORKING CAPITAL RECOVERY
F28: -@SUM(C27..F27)
A30: [W30] 'SALES
C30: +$B$14*C21
D30: +$B$14*D21
E30: +$B$14*E21
F30: +$B$14*F21
A31: [W30] 'COST OF GOODS SOLD
C31: +$B$12*C21
D31: +$B$12*D21
E31: +$B$12*E21
F31: +$B$12*F21
A32: [W30] 'WARRANT COST (1 YEAR)
C32: (1-@EXP(-1/$B$15))*C21*$B$16
D32: (1-@EXP(-1/$B$15))*D21*$B$16
E32: (1-@EXP(-1/$B$15))*E21*$B$16
F32: (1-@EXP(-1/$B$15))*F21*$B$16
A33: [W30] 'NET PROFIT
C33: +C30-C31-C32
D33: +D30-D31-D32
E33: +E30-E31-E32
F33: +F30-F31-F32
A35: [W30] 'PROFIT AFTER TAXES
C35: +C33*(1-$F$8)
D35: +D33*(1-$F$8)
E35: +E33*(1-$F$8)
F35: +F33*(1-$F$8)
A36: [W30] 'DEPRECIATION TAX SAVING (NOTE 2)
C36: -@SUM($B$24..$B$25)*$F$8*0.25
D36: -@SUM($B$24..$B$25)*$F$8*0.25
E36: -@SUM($B$24..$B$25)*$F$8*0.25
F36: -@SUM($B$24..$B$25)*$F$8*0.25
```

```
A37: [W30] \-
B37: \-
C37: \-
D37: \-
E37: \-
F37: \-
A38: [W30] 'TOTAL CASH FLOWS
B38: @SUM(B23..B28)
C38: @SUM(C23..C28)+C35+C36
D38: @SUM(D23..D28)+D35+D36
E38: @SUM(E23..E28)+E35+E36
F38: @SUM(F23..F28)+F35+F36
A41: [W30] 'NET PRESENT VALUE OF PROJECT
C41: @NPV(F10,B38..F38)
A42: [W30] 'INTERNAL RATE OF RETURN
C42: (P0) @IRR(0.4,B38..F38)
A43: [W30] 'PROFIT MARGIN
C43: (P0) 1-($B$12/$B$14)
A45: [W30] 'NOTE 1:  THIS AND THE NEXT LINE SHOULD BE
     REMOVED IF THE PRODUCT REPLACES A CURRENT PRODUCT.
A46: [W30] 'NOTE 2:  ASSUMES 4 YEAR STRAIGHT LINE
     DEPRECIATION.
```

Status Reports

Each project will require regular project status reports. In most cases, every month will be adequate, however, this may vary from firm to firm or on a particular project. The first section of the status report is the schedule status. It will include a level 1 and 2 schedule, along with all level 3 activities that are in progress or scheduled to start within the next four weeks. The next section will be development cost. The development cost is the total project development costs, such as manpower, materials, tooling, etc. This section includes the budget-to-date and actual expenditures. The product cost section includes the cost goal, which comes from the project plan, and the latest estimate and its date. The achievements section includes any general achievements that occurred during the project since the last status report. The next section is exceptions. This section includes any problems that have occurred on the project and are still ongoing, such as technical difficulties, schedule impacts, etc. It also includes what is being done to correct the situation. The last section is future. This section should outline the major activities that should occur during the next 8 weeks.

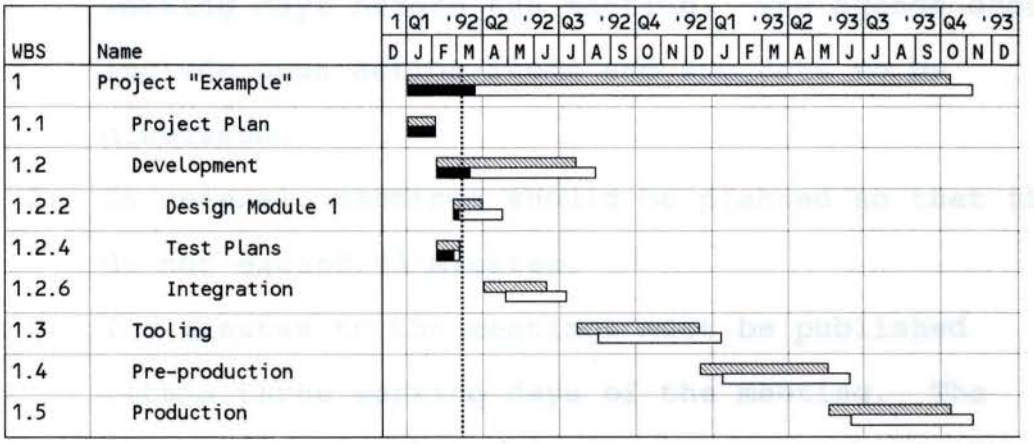
Status Report

Product Name _____

Project Number _____

Date _____

Schedule Status:



Development Cost: Budget to Date _____
Actual _____

Product Cost: Goal _____
Last Estimate _____ Date _____

Achievements:

Exceptions:

Future:

Meetings

The following procedure must be followed for all project review and design review meetings, and is recommended for all other project related meetings.

1. An agenda must be sent to all people invited to the meeting so that they receive it at least three working days before the meeting. The agenda should include open action items and subjects to be discussed.
2. In general, meetings should be planned so that they do not exceed 90 minutes.
3. The minutes to the meetings must be published within three working days of the meeting. The minutes should include a general outline of what was discussed, decisions or agreements that were reached, and any other issues that came up during the meeting. The minutes should also include action items. Each action item should have a person assigned to it, a date issued, and a scheduled completion date. The minutes should be sent to all of the attendees, their functional managers, and the Director of Product Planning. The following gives an example of a typical meeting's minutes report.

Meeting Minutes

To: Attendees
_____
_____
_____

From: _____

Subject: Minutes of _____

Attendees: _____ _____
_____ _____

General Minutes:

Action Items:

1. Assigned to: _____

   Date assigned: _____ Scheduled completion: _____

   Description:

2. Assigned to: _____

   Date assigned: _____ Scheduled completion: _____

   Description:

Configuration Log

The configuration log will define the configuration of each version of the product that is tested since the beginning of the design qualification phase. This includes the configuration number, the date, and a description of the configuration that adequately defines the product. The configuration number will begin with the released version of the product's bill of materials, a period, and then a letter, beginning with A. If the product has not been released, 0 will be used for the revision of the bill of materials.

Product Name _____

Project Number _____

Configuration Log

Configuration Number _____ Date _____

Description:

Configuration Number _____ Date _____

Description:

Test Plan

Product Testing is broken into four major groups: developmental testing, design qualification, production qualification, and field test. The developmental test phase occurs during the design process, and should be tied to the requirements and analysis of the design. This phase includes module level, component, and early prototype testing. This could include such things as power supply testing, gear box life testing, testing off-the-shelf component, or any other type of module or component that is used in the design.

The next phase is the design qualification testing. This is the first formal testing of the prototype of the final product. Also, during this phase the test group will start tracking the product configuration and will keep a problem log. After the pilot production run, a production qualification test is performed. This is very similar to the design qualification test, however some additional tests may be added at this point which would not be appropriate to be performed on prototype units. Its primary purpose is to test the manufacturing process. The final phase is the field test. This phase involves putting a number of units out on location or with

customers for their evaluation. After the field test is complete, the product will be ready for full production.

The product test plan involves several sections, which are listed below:

Title page

Developmental Test Summary

Design Qualification Summary

Production Qualification Summary

Field Test

Individual test procedures

The title page will include the product name and project number, a list of the people responsible for writing the test plan (the first name will be the person responsible for coordinating the overall testing), and finally, a historical release section, which includes the date, reason for the change, and an area for the Project Manager's approval.

The next section will be the developmental test summary. Developmental tests are any component, module, or unit tests that are performed during the design phase of the project that are used to verify that the product will meet its functional and reliability goals. These tests should also be designed

in such a way as to test the design margin (how far out of spec can critical parameter be before the product will not work.) The primary difference between these tests and qualification tests is that the developmental tests are usually not performed on the final product configuration. This section lists the names of each of the developmental tests and the date that the test was successfully completed.

The design qualification summary includes a list of all the tests performed by the unit configuration during the design qualification phase. After each test is completed, a P (pass) or F (fail), and the date the test is finished, is put under the appropriate configuration column.

The production qualification summary is very similar to the design qualification, with the exception that additional tests are usually added which are either not appropriate to be conducted with prototype units or couldn't be run because of the limited number of prototypes available.

During the field test, a number of units are tested in real life field conditions. The first part of this section will list the locations to be used for field testing, the number of units for each location,

the start and end date, and the configuration of the units to be placed in the field. The second section, methods of collecting data, should answer the following questions:

1. What data will be collected?
2. How will the data be collected? (survey forms, monitoring devices, etc.)
3. How will the data be analyzed?
4. Define the criteria for passing the field test.

The final section will report the findings of the field test and indicate whether the test was successful or not.

Each individual test will have a specific test procedure. This will include a test name, the scope, resources needed, procedures, and results. The scope should be a short paragraph to define what is being tested and the purpose for the test. The resources needed section should define any equipment that is needed to run the test, number of test units required, and the type of personnel and estimated time required to run the test. The third section, procedure, should define the test to an appropriate level for the personnel to perform the test. It should also define

the criteria for passing or failing the test.

The results section will include the date and configuration for each time the test is run, along with a summary of the results. If all the test data is not reported in this section, it should also define where this data can be found. A new section should be added to the results section each time the test is performed.

The test plan will usually have at least five releases. The first will be the initial release after the completion of the test plan. There will also be a release after each of the four major sections of the testing is completed (developmental testing, design qualification testing, production qualification testing, and field testing). On some projects, it will be necessary to release the test plan as soon as the developmental section is complete, so that this testing can begin while the rest of the test plan is developed in parallel. If any changes are required to the test plan, additional releases will also be necessary.

Test Plan

Product Name _____

Project Number _____

Written By _____

Releases:

Date	Reason	Approved
	Initial Release	

Product Name _____

Project Number _____

Developmental Tests Summary

Test Name	Date Passed

Product Name _____

Project Number _____

Design Qualification Summary

P = passed
F = failed

Test Name	Configurations				
	O.A.				

Product Name _____

Project Number _____

Production Qualification Summary

P = passed
F = failed

Test Name	Configurations					
	1.A.					

Product Name _____

Project Number _____

Field Test

Locations	Number of Units	Start Date	End Date	Configuration

Method of Collecting Data:

Results:

Test Name _____

Written By _____

Scope:

Resources needed: Time (man-hours):

Procedure:

Results:

Date_____ Configuration_____ Performed By_____

Date _____ Configuration_____ Performed By_____

Problem Log

The problem log summarizes any problems that occur during the testing process. All problems will be classified into four problem types:

Safety - A performance anomaly, or tendency of the product which would endanger the safety of the user, repair person, factory personnel, or test personnel (in which case the testing should be stopped).

Critical - A deficiency whereby the unit fails to perform as specified, or as expected, on an important parameter. In other words, a deficiency that would be noticeable by the customer and deemed unacceptable. This type of defect would tend to render the unit unsuitable, inoperable, or unreliable.

Minor - A deficiency whereby the product fails to perform as specified, but the nature of the deficiency, or its severity, is such that the impact to

the customer is no more than an inconvenience. This type of defect would not render the unit inoperable.

Observation - A characteristic or behavior of the unit that appears to be abnormal, but is not covered by the specification, and has no perceived detrimental effect on its intended use.

The first page of the problem log is a summary. This includes the problem number, date, problem type, a short description of the problem, and the actual resolution date. The second section of the problem log also includes the date, problem type, and a more detailed description of the problem, who was assigned to resolve the problem, the scheduled and actual resolution dates, and a detailed description of the corrective action to resolve the problem. The resolution date represents the date the correction successfully completed testing. A summary of the unresolved problems should be distributed to all appropriate team members on at least a weekly basis.

Product Name _____

Project Number _____

Problem Log

Problem Number	Date	Problem Type	Description	Actual Resolution Date

Product Name _____

Project Number _____

Problems

1. Date _____ Problem type _____

   Description:

   Assigned to _____

   Resolution dates - Scheduled _____ Actual _____

   Corrective Action:

2. Date _____ Problem type _____

   Description:

   Assigned to _____

   Resolution dates - Scheduled _____ Actual _____

   Corrective Action:

Team Member Performance Reviews

The Project Manager should complete a team member performance review form for each permanent team member every six months, and at the completion of the project. The Project Manager should get the Functional Manager's comments before giving copies of the performance review to the team member, the team member's Functional Manager, and the Director of Product Planning. If the team member has any comments or questions concerning the review, he is encouraged to talk to either the Project Manager or Director of Product Planning, and to add his comments to the form and return a copy to the Director of Product Planning.

Team Member Performance Review

Team Member: _____
Project Manager: _____
Product Name: _____
Project Number: _____
Date: _____

Performance Ratings:

1 - Unacceptable
2 - Poor
3 - Below Average
4 - Average
5 - Above Average
6 - Very Good
7 - Outstanding
NA - Not Applicable

Note: Any ratings of a "1" or "7" must include a comment as to why.

	Rating							
1. General Attitude	1	2	3	4	5	6	7	NA
2. Cooperation	1	2	3	4	5	6	7	NA
3. Responsiveness to requests	1	2	3	4	5	6	7	NA
4. Willingness to make aggressive commitments	1	2	3	4	5	6	7	NA
5. Ability to meet commitments	1	2	3	4	5	6	7	NA
6. Leadership	1	2	3	4	5	6	7	NA
7. Quality of work	1	2	3	4	5	6	7	NA
8. Quantity of work	1	2	3	4	5	6	7	NA
9. Teamwork	1	2	3	4	5	6	7	NA
10. Overall performance	1	2	3	4	5	6	7	NA

Average Score _____

Performance Review (cont.)

Project Manager's Comments:

Functional Manager's Comments:

Team Member's Comments:

Post Project Review

At the end of each project, a project review form will be given to each team member. This form is used to evaluate the Project Manager's performance and the project management system. Each team member should complete the form and return it to the Director of Product Planning.

The Project Manager will complete a project summary form at the end of the production phase. This form summarizes the performance of the project. It compares the planned project duration, product cost, development cost, material cost, tooling cost, and equipment cost to the actual. The performance summary section is used to describe the performance of the final product. Did the product exceed its expected performance level? Did it just meet the performance level, or was it below its original expected performance level, however, deemed to be acceptable? The next section will describe the changes that occurred to the project since the original project plan. The major project problem section should define any major problems that occurred during the product development cycle. The last section is a recommendation for future projects. In this section

the Project Manager should describe anything that he would like to do differently on future projects and make recommendations for changes to the project management system. After the end of the production phase the Extended Project Summary form will be completed annually for the first three years.

Project Review

Name (optional): _____
Project Manager: _____
Product Name: _____
Project Number: _____
Date: _____

	Performance Ratings				
	poor		average		good
Project Manager					
1. Ability to communicate project requirements	1	2	3	4	5
2. Fairness	1	2	3	4	5
3. Ability to lead a project	1	2	3	4	5
4. Understanding of the technology used to develop the product	1	2	3	4	5

Comments:

Project Management System

1. How would you rate the Project Management System?

2. What type of problems did you have?

3. What would you change?

4. Comments:

Project Summary

Product Name: _____
Project Number: _____
Project Manager: _____
Date: _____

Project Performance:

	Planned	Actual	Variance
Project duration			
Product Cost			
Development Cost			
Material Cost			
Tooling Cost			
Equipment Cost			

Performance Summary:

Description of Project Changes:

Major Project Problems:

Recommendations for Future Projects:

Extended Project Summary

Product Name: _____
Project Number: _____
Project Manager: _____
Date: _____
Date of Last Review: _____

	Planned	Actual	Variance
Product Cost:			

Performance Summary:

Description of Project Changes:

Cost of Changes:

Major Project Problems:

Recommendations for Future Projects:

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