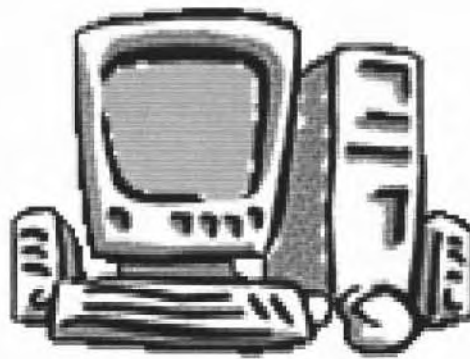# PRACTICAL PROJECT

BY

David Douglas Lyon

Guidelines for Project Engineers

PROCESSES - TOOLS - APPROACHES

"Best Practices" for the 21st Century

PRACTICAL PROJECT

"GUIDELINES FOR PROJECT ENGINEERS AND PROGRAM MANAGERS"

by

David Douglas Lyon

RAVEN

"PRACTICAL PROJECT"

Guidelines For Project Engineers

RAVEN

Acknowledgments

Acknowledgments are in order for the folks whose names I will mention here plus the many others who have helped me throughout my professional career and personal life. I wish I could list you all in these pages but that is not possible.

Special thanks are due my wife, Kathleen, and my daughter, Jennifer, who provided constant encouragement when it was most needed and who accepted my absence from family activities over the time it took to complete this book.

My sincere appreciation goes out to John Williamson, Ken Parker and Ron Magee of United Technologies Corporation who showed me what it takes to "get the job done" in the Project Engineering field.

I would also like to thank Evan Stutz, my Drafting supervisor from my long past engineering apprentice days at the General Electric Company for teaching me the importance of "paying attention to detail".

Thank you all.

ddl

Forward

This book will provide you with Project Engineering "best practices" for today's and tomorrow's business environments. It will also provide you with a methodology to handle the obstacles which you will encounter and show you how to deal effectively with people as you move your projects along the path to success.

I have included herein "how-to" guidelines for both the new and the practicing Project Engineer (PE). This book describes your role as a PE throughout your product's life cycle, starting with the program planning activities and the proposal process, through contract negotiation and finalization, system requirements definition, detailed design and development, transition to production, and finally production and support. It describes the tools that you will utilize to support your project coordination and control activities. It then provides you with the most effective approach for performing your duties as the PE.

Other parts of this book will, in both serious and humorous context, attempt to cover the topic of how to deal with people. The subject of what a PE is and why one would want to become one is addressed along with the significance of and the need for PEs in today's and tomorrow's business environments.

The processes, tools and approaches described herein have been implemented in several large international corporations and have withstood the test of real world operation.

The format and presentation of this information is somewhat different from other books dealing with the subject of Project Engineering. I hope you will find it enjoyable to read and easy to digest.

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List of Acronyms

The following acronyms and abbreviations are used throughout this book. They are presented alphabetically in this listing for ease of reference. Detailed definitions are presented in the text where appropriate.

AI	Action Item
AT	Acceptance Test
CAC	Corrective Action Committee
CAD	Computer Aided Design
CCB	Configuration Control Board
CDRL	Contract Data Requirements List
CI	Configuration Item
CITIS	Contractor Integrated Technical Information Services
CM	Configuration Management
CMP	Configuration Management Plan
CN	Change Notice
COTS	Commercial Off The Shelf
CPS	Consolidated Purchasing System
CSA	Configuration Status Accounting
CVA	Configuration Verification Item
DES	Design
DFT	Drafting
DM	Data Management
DoD	Department of Defense
ECP	Engineering Change Proposal
EIA	Electronics Institute of America
ENG	Engineering
FAI	First Article Inspection
FCA	Functional Configuration Audit
FW	Firmware
HW	Hardware
ISO	International Standards Organization
MFG	Manufacturing
MRB	Material Review Board
MRT	Material Review Team
MRP	Material Resource Planning

List of Acronyms (Cont'd)

MIL SPEC	Military Specification
MIL STD	Military Standard
MS	MicroSoft Corporation
PBL	Product Baseline
PC	Personal Computer
PCA	Physical Configuration Audit
PDM	Product Data Manager
PRB	Problem Resolution Board
QA	Quality Assurance
REV	Revision
RFD	Request For Deviation
RFP	Request For Proposal
RFW	Request For Waiver
RI	Responsible Individual
SW	Software
TDP	Technical Data Package
W/D	Waiver/Deviation
WIP	Work In Progress

Introduction

"Practical Project" provides "how-to" guidelines for both the new and the practicing Project Engineer (PE). It describes your role as PE throughout your product's life cycle, starting with the initial program planning activities and the proposal process, through contract negotiation and finalization, system requirements definition, detailed design and development, transition to production, and finally production and support. It describes the processes and tools that you will utilize to support your project coordination and control activities, including the latest Project Management PC software solutions. It then provides you with the most effective approach for performing your duties as the PE.

A section is included which discusses obstacles that you will most likely encounter as your project evolves. Advice is provided for ways to overcome these obstacles. Other parts of the book will, in both a serious and humorous context, attempt to cover the topic of how to deal with people.

The topic of what a PE is and why one would want to become a PE is addressed along with the significance of and the need for PEs in today's and tomorrow's business environments.

This book will identify 'Best Practices" for you to study so that you will have the information you need to become an effective and successful PE. Templates and illustrations are provided to support the basic instruction material.

Once you start to use the processes and tools described herein and follow the recommended approach, you should not stumble or falter the way I did when I started off on my journey to becoming a PE. Let me share with you a snapshot from my early days.

"I'm a good Project Engineer!" I remember saying this to myself as I crossed the hallway from my office to the crib where we kept parts for the prototype automobile engine hot test cell for which I was responsible. It had been a terrible day up to that point. Everything had gone wrong, despite the horrendous effort I was making. I had thought out everything, at least I thought I had. I'd covered all the bases, either while I was at work or at home during the evenings when I fooled myself into thinking I was relaxing. The project never stopped pulling at my mind. I was always worrying about something. So, with all this good work and dedication on my part, how could things be going so wrong? Too many things were going wrong.

I wasn't about to give up. I had struggled through God knows how many bad times. I couldn't see any light at the end of the tunnel but I wasn't going to quit. Oh, I knew - I felt sure - that I wasn't going to last in this job, not with the way things were going. They would have to fire me, though. I was a good PE (I kept telling myself), and I wasn't going to quit. I was determined to continue on. I would just look ahead and do the next thing, and then the next, and then the next. So, I went into the crib, found the part I needed, drove over to the building that housed my prototype, and made the necessary repairs.

Now, let's skip ahead a bit - I don't want to bore you with too many personal details at this point. NOTE: Throughout this book, I will stress the importance of attention to detail and dedication to basics. These principles are an important part of the approach that will save you and your projects from mediocrity or failure and transform you into a confident and successful PE.

As you might have guessed. I made it through that day. Things got better. My prototype got built and tested (behind schedule and over budget). It worked well and paved the way for a decent production contract. I can still see it in my minds eye - a hulking machine, wrapped about with cables running off to a computer sitting in a dark corner of a big old Quonset hut style building. I have worked on many projects since that one. I got better. Now, there are less sleepless nights. My projects are better planned and executed. I meet schedules and budgets more often than not.

My purpose in writing this book is to provide you with an encapsulation of "lessons learned" from my experiences - both good and bad. I will try to present the elements of the PE discipline in a logical order so as to give you a firm grasp of the "Best Practices" to employ during your projects. Finally, I will provide you with a set of "Project Templates" that you can use to assure that you properly apply these "best practices" and also to assure that you cover all the bases as you plan and execute your projects.

Although the processes, tools and approaches described in this book are presented in the context of projects designed and developed by large corporations, I believe they can also be applied to medium and small sized businesses.

I don't claim that this book is the "be all" and "end all" for program and project management. I am sure, however, that the processes, tools and approaches provided herein can form the basis for success and outstanding performance in your PE career.

There is no substitute for diligent work and persistence in the accomplishment of any task. However, you must keep your goals in clear focus and not become like the fanatic "who redoubles his efforts even when he has lost sight of the goal".

You must "earn your success" in any endeavor. Project Engineering is no different.

Part 1 - The Project Engineer

Introduction: In this first section of the book, I will provide you with background information on the role of the Project Engineer (PE) in today's business environment. I will then proceed to supply answers to the following questions:

1) What is a Project Engineer?
2) Why have a Project Engineer?
3) Why be a Project Engineer?

Background: If you are employed by a large business or corporation, you probably work with or for a Program Manager who has overall responsibility for an entire program, with the technical, cost and schedule responsibilities for the Engineering operation allocated to your PE. In this scenario, other personnel are delegated responsibility for coordinating and controlling the Manufacturing, Quality Assurance, Configuration Management, Product and Customer Support, Technical Publications, and other operations, or the Program Manager might assume direct responsibility for these non-Engineering business operations.

I believe that this business scenario is representative of the general case. It follows that the coverage of this situation will provide the most benefit to the reader. Therefore, this scenario will form the basis for the description of the PE activities discussed in this book. I will also describe herein the relationship your PE has to to those other "Program Management" personnel who have performance, cost and scheduling responsibility for your non-Engineering business areas.

In some businesses, however, the PE has total responsibility for all business operations. If this is the case for your business, the material provided herein will still apply. Just substitute the term "PE" for the term "Program Manager"

What is a PE? Your PE is your *"single point of responsibility"* for the technical, cost and schedule aspects of the Engineering design, development, integration, test, transition to production, production support, and customer support portions of your program or project. The burden of responsibility for all of these activities falls squarely upon the shoulders of your PE.

Your PE will be the "initiating factor" for your projects and programs. By this, I mean that he or she will initiate the planning and execution of all events and processes which control the

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Engineering portion of your product(s)' life cycle. It is your PE's job to assure that "all the bases are covered" and that the job is done right. In this respect, he is the conscience of your Engineering operation.

Your PE will also be the "motivating force" for several levels of personnel within and external to your business, i.e., vendors, suppliers, sub-contractors, and your customer. It is the PE who is responsible to "do whatever it takes to get the job done".

If you have a "Team-based" organization, your PE will be your Engineering Team Leader (more on this subject later). He or she* will act as the "mother/father" figure for all Engineering personnel assigned to his project. The buck stops with your PE.

Why Have a PE? Your business needs a PE to assure, in conjunction with your Program Manager, that your product is developed, produced and delivered on time, within budgeted costs and that all contractual technical requirements are met (as far as your Engineering activities and responsibilities are concerned). He will cover all the bases and set the tone for your project activities, i.e., cultivate a winning, positive attitude among your Engineering personnel. He will do this through the use of the processes, tools and approaches articulated herein.

Your PE will be aggressive but not adversarial with your internal functional level personnel, your business' external contacts and your customers. Your PE will use a dependable, methodical approach to all project tasks and assure that the appropriate level of follow-up and feedback is utilized throughout the life cycle of your products.

In short, your PE will be the "hub" around which the spokes and rim of your business's Engineering "wheel" rotates.

Why be a PE? Do you like challenges? Do you prefer being a leader to being a follower? Are you a "builder"? Do you get satisfaction from a job well done? Do you like to work with people - to stimulate and motivate them to greater achievement?

If the answer to these questions is yes, then providing you have the appropriate educational background and the right amount and type of experience, you very likely have what it takes to become a good PE. If you already are a PE, then I believe that you can become a better one by utilizing the processes, tools and approaches presented within the pages of this book.

* I will stop using the terminology "he or she" from now on to save time and space. Please assume that "she" or "her" can be substituted in every "business-related" sense for "he" or "him".

In actuality, we are all PE's to some extent. Every task you undertake, every action you consider and execute, and every event you plan requires elements of the processes, tools and approaches of the PE trade. If you are inclined to be a leader, and if you possess leadership traits, you are a good candidate for a PE.

NOTE: I use the terms "program" and "project" interchangeably throughout this text. The only reason why I don't use the single term "project" is that some business situations just normally (or historically) have called a particular contractual activity a "program" rather than a "project". There is, in reality, no difference between the two, and I want to use terms that are familiar to most people.

Part 2 - The Process

Introduction: In this section, we will discuss the various processes employed in a typical program or project and identify the role of the PE in planning, coordinating and controlling these processes. We will first consider the advance planning and negotiation activities conducted prior to the actual initiation of contractual efforts and then move on to the contracted design and development activities, integration and test activities, production and delivery activities, and finally, maintenance and support activities. In other words, we will look at the role of the PE from cradle to grave (programmatically speaking) for the life cycle of the product. As we cover each topic, I will provide you with "best practices" for these processes and tasks. These "best practices" will be italicized for easy reference.

2.1 Starting the Project:

Your first challenge as a PE will be to establish favorable conditions and goals for the accomplishment of your project. You will establish the proper business environment and define the desired project goals during the planning phase of your program.

Before Contract Award:

Project Planning: Project planning can be initiated either as a result of Internal Research and Development (IR&D) activities, as a response to a Request For Proposal (RFP) or as the result of a Product Market Survey "hit". The PE is a major player during this process. He must provide the stimulus and motivation to move the project from the "idea" stage to the "funded work" stage of the program.

Internal Research and Development: Most large (and some small) businesses and corporations conduct Internal Research and Development (IR&D) programs on a "more or less" continuous basis. Some of these IR&D programs are paid for by customer funded contract vehicles - either fixed-price or cost recovery contracts. Others are internally funded out of company profits in the hope of developing new product lines, thereby enhancing the prospects for increased future profits.

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As the IR&D program progresses, new ideas are generated and evaluated as to their impact upon the direction the evolving designs are heading. A *Concept Design Review* is usually held at this point in time with all effected internal functional organizations attending and contributing. Sometimes the customer is also invited to participate, especially if he is supplying the funding for this activity or if his organization is the proposed market target area for the product.

The desired outcome of the *Concept Design Review* is a firm, documented agreement among the attendees that the proposed product is viable and worth pursuing further. Tradeoffs of cost versus benefits and profitability are identified and discussed. The producibility of the proposed design is evaluated to determine whether or not it can be built without incurring unacceptable Engineering redesign expenses and production facility modifications. Material procurement, quality assurance test and inspection requirements, deployment/delivery and product support considerations are addressed. Planning for configuration management of the design and product is also discussed at this review. Design and production budget estimates are presented and discussed.

At this point, if all goes well, and an agreement is reached to proceed, contract proposal activities are initiated.

Best Practice: Assure that you have "buy-in" from all key personnel in your organization for your proposed project. This will help to guarantee that you will have their full support as the project evolves. This support will be indispensable to the success of your project.

Project Engineer Selection: Your PE will be the cornerstone of this new venture. He will be the "hub" around which the spokes of your business "wheels" revolve. Your PE should be familiar with your design methodologies and tools, plus the computer resources and networks utilized by your organization. He should be knowledgeable in configuration and data management processes plus he should have experience in all functional areas within your business, and have a successful track record of completing projects on time, within program budgets and within successful performance criteria. He must keep your Management and the Proposal Team (later the Project Team) fully informed as to the progress of the project, it's areas of concern and any re-direction or workarounds that must be undertaken. He should be the individual responsible for assuring that all action items are clearly articulated and assigned to specific individuals with a definite closure date identified. He or she must drive these action items to completion within the allotted time.

Above all, your PE should be a dedicated individual who demonstrates "ownership" for all aspects of this new venture. You should be able to trust him to successfully lead your business along the path to excellence as your program evolves.

Best Practice: Select the PE who is going to be responsible for your new project at this time. Your PE will be the "single point of responsibility" for the successful completion of all Engineering tasks and events.

Project Proposal: The following paragraphs present the processes that you, as the PE, should follow during the proposal phase of your program.

Proposal Team: Your Proposal Team should consist of a core group of members from the following functional organizations, with other personnel contributing to the team as required:

* Engineering
* Drafting
* Manufacturing
* Quality Assurance
* Product Support
* Configuration Management
* Program Management

The PE or the Program Manager will serve as chairman of the Proposal Team.

Proposal Kickoff Meeting: It's now time for you to hold a proposal "kickoff" meeting. Invite all Proposal Team members plus anyone else who might be required to define tasks and submit quotations for the effort. Also invite representatives from all levels of management. You will need their support as the project unfolds. You don't want to hear anything like: "What is this ABC Project? I never heard anything about it!" later on.

Generate and present "draft" project schedules and milestone charts at the kickoff meeting. It doesn't matter if they are not completely accurate at this point in time. Use whatever information you have available. Also, present as much information as you can about the project funding. Pass out handouts - folks don't always remember what they see and hear, and different interpretations may be obtained by different personnel during the meeting. Remember, this is your first step in an unending dialog and communication effort that will either assure the success of your project or result in a misunderstanding of the facts at crucial moments in the program, leading to damage or disaster.

The give and take of information is an iterative process. Your project will thrive on the evolution and update of information as time goes by.

Establish a schedule for regular meetings of your core Proposal Team. Additional "splinter" meetings may also be appropriate when items are brought up at the regular Proposal Team meetings that cannot be readily or immediately dealt with. The Proposal Team meetings and the splinter team meetings don't have to last long - one hour is usually sufficient to get the job done. Demand regular attendance and punctuality at these meetings. This is the time and place where you must set the tone and discipline for your project. A lax attitude here will snowball later on, guaranteeing missed milestones and project failure.

Best Practice: Make sure that you "beat the bushes" to identify all tasks and to ferret out all related costs. It's better to find out about these items now, when you are in a position to negotiate them with your customer than to find out about them later when you will have to pay for them out of profits. Your motto should be: "NO SURPRISES!"

Action Item List: It is extremely important to generate, follow up on and maintain current an action item list for all activities addressed, discussed and disposed of during your Proposal Team meetings. Specific individuals should be assigned specific action items to be completed by specific dates. Only when complete ownership is assigned and accepted can there be assurance that tasks will be faithfully completed on time. You, as the PE, will be responsible for following up on action items and making sure that closure is effected on schedule. You will use this tool throughout your project. See Figure 1 for an example of an Action Item List Data Input Sheet.

Best Practice: Create an Action Item List, and assure that responsibility for each action item is assigned to a specific individual. Require that individual to report upon the status of his action item at the regularly scheduled Proposal Team meetings. Demand action item closure per scheduled dates.

Project Schedule: One of the single most important tools you will need to support the development of your Program Plan is a Project Schedule. Start right away to create one by using the checklist shown in Figure 2 to identify your project's major and minor tasks.

Don't worry about making mistakes and selecting too many or too few tasks. Just do it! I can't stress this enough. Your Project Schedule will become a living document, and it will change as your proceed. My key message is to create a "strawman" schedule as early as possible. Put in estimated dates. I don't care how crazy they may seem to you at this point. You will have plenty of time to "get it right". The very act of creating your schedule will force you to think about the things that you have to do. It will require you to talk to your people and to solicit their input. This activity in itself, will generate invaluable information. Every hour you spend on your schedule will

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provide you with many happy rewards down the road. Figure 3 provides a sample Project Schedule.

Best Practice: Generate a Project Schedule as the first task in your proposal activities.

Configuration Management: You should start to plan your Configuration Management (CM) program at this point in time.

Each element of CM, i.e., Identification, Change Control, Status Accounting, and Audits is inexorably linked to and interwoven with Engineering design methodologies plus Quality Assurance inspections and audits and Manufacturing production processes, no matter how simple or complex the program, and is thus integral to the process.

Tradeoffs exist every step along the way. These tradeoffs involve cost versus control of the design and visibility into how the hardware and software products relate to the design at any given point in time.

Manual, labor intensive CM activities involving baseline capture and control with change approval and incorporation processes employing multiple forms, databases and meetings induce images of wasteful, expensive pillaging of program coffers to Program and Functional Managers.

Thus proposals are often trimmed of CM-related quotes and activities even before the program or project begins. This usually results in additional costs down the line from excessive changes to the design package, non-conforming hardware, repairs to or reworking of the product hardware and software, and failures experienced in product performance after delivery to the customer. You must assure that this does not occur on your program.

Everything we do involves change. Configuration Management (CM) is the process of managing change. Design, development, integration, test, production, deployment, delivery, maintenance, and support are all manifestations of the change process.

Of course, the CM process of which I speak here is not the classical "green eye shades" occupation where rooms of squinty old men (or CM "persons") record data by hand in CM logbooks or enter data into out-of-date databases when they are not carrying around forms to be signed and bothering engineers and other important persons for clarifications and approvals.

A new CM tool, a Product Data Manager, will capture baselines and control changes, distribute documentation "in-place" and save gobs of money for businesses and stockholders. Also, a well

defined, efficient, workflow-driven CM system will replace the old, time worn reactive process of "fighting fires".

This transition won't be as easy as falling off a log, though. There are many steps to be taken and many "hoops" to be jumped through. There will also be a considerable selling job to be done. This transition is going to be a culture change "in spades" for many.

If it were up to your engineers, they would work on their designs until they were thoroughly tested, updated and proofed out before they presented them to your CM people for baselining and subsequent formal Configuration Control. After that event, each change presented to their peers and to your management clearly points out the inadequacies of their design (from their perspective). On the other hand, your CM personnel want to put that design under some kind of control from the word go. A tug-of-war usually ensues.

In today's business environment, neither approach is acceptable or feasible. Shortened design cycles and early transition to production schedules require a more flexible but controlled approach.

Wherever Engineering departments exist, a consistent engineering design methodology, integrated with a CM mindset, must be employed, based upon events which define the transition points from one level of control to another. People must know their roles and responsibilities and understand what is expected of them at specific points in the evolution of the design. The concept of planning engineering or CM milestones by calendar dates just doesn't work because schedules often slip. Event-driven milestones are much more effective. This methodology can be tailored to fit your projects or programs.

Tailoring your business' CM "Best Practices" and procedures to fit your customer's CM-related requirements is an important planning activity during this initial phase of your program. I will cover the major CM activities at the appropriate points during the life cycle of your product. For a complete treatment of the subject of CM and the transition from your old paper CM systems to a new electronic Product Data Management (PDM) system , refer to "Practical CM", another book by this author.

Best Practice: Establish a sound CM program by tailoring your CM "Best Practices" to fit your customer's need and your program's requirements for baseline capture and control, status accounting and audits. Also, transition your business from a paper-based CM system to an electronic based CM system utilizing a Product Data Management (PDM) system, if possible.

Program Plan: Document the results of your program planning activities in a Program Plan. Your Program Plan should address, at a minimum, the following topics:

1) Technical Requirements
2) Schedules (program and internal)
3) Milestones (program and internal)
4) Budgets (overall and functional unit)
5) Description of how you will meet the RFP requirements. Supplement with Proposal Team meeting vu-graphs, as applicable
6) Deviations from the RFP and recommended workarounds, if applicable
7) Engineering discipline processes to be employed for this project:
   * Systems analysis/specification development processes
   * Hardware/Software/Firmware Development Plans
   * Configuration Management Plan
   * Commercial Off The Shelf (COTS) materials Plan

NOTE: The plan documents specified above need not be completed as part of the development of the Program Plan. They need only be addressed to the extent that the reader can obtain a broad understanding of their purpose, scope and depth and glean a general understanding of the methodologies to be employed in the topic areas covered by each plan.

Best Practice: Plan your plans, now - early in the process, i.e., determine, with the support of your Proposal Team members, the plans required for your project. Don't forget to include the cost of generating these plans in your budgetary calculations.

A sample Program Plan Outline is presented in Figure 4.

At your first Proposal Team meeting, establish a milestone for an update to your Program Plan after inputs have been received regarding detailed tasks, schedules and budgets. These project elements are sure to change as the "hands-on" personnel get a chance to review requirements and identify "real-life" tasks that must be undertaken. Discuss each milestone and task at each Proposal Team meeting and evaluate design-driven schedule changes as they apply to the overall program schedule and to the detailed functional design unit schedules. Apply the same thinking and examination to integration, production, test, and delivery schedules.

Best Practice: Document everything you can get your hands on. You will be surprised at the kinds of information you will need to support your project as time goes by. Record as much information as possible via electronic media, i.e., computer databases, text files, graphics files, etc. This methodology will make it easier to retrieve data in the future.

Negotiations: Your company will be ready to initiate negotiations with your prospective customer when your Program Plan is completed. However, there are a few things to do before you reach that point in your process.

You will actually begin your internal organization negotiations during your Proposal Team meetings. Your task here is to communicate, negotiate, compromise, and agree upon the technical, cost and schedule aspects of the project. This is an iterative process and one which will test your communication skills and patience. It is very important to get this job done right. During these internal negotiations, you will be developing your own credibility among your co-workers. It is vital that you hone your listening skills to a fine edge while persuasively moving the project in the right direction.

Best Practice: Be assertive but not argumentative.

Demonstrations and Presentations: In preparation for your presentation to your customer, you should conduct "dry runs". Though often uncomfortable, these dry runs will sort out the "wheat from the chaff" in your customer presentations.

Your dry runs should be attended by all functional representatives contributing to the proposal effort. Unit and mid-level management personnel should also attend. Presenters will get nervous and screw up portions of their presentations but that is part of the process. It's better to weed out flaws in the content of the presentation or demonstration and in the presenter's performance now than later in the presence of your potential customer.

You may say: "Well, what if I provide my customer with a written proposal instead of a presentation and/or demonstration?" My answer is the same - do a dry run of the written proposal. Send out review copies and then gather the reviewers together for a "roast" of your written proposal. The spontaneous inputs generated during these dry runs are invaluable . No one person or group of people can think of everything, regardless of their level of expertise or experience.

Best Practice: Flush out errors and redundancy, improve the wording and put more "punch" in your proposal at your dry runs.

Submit your Proposal to your Customer: Establish a meeting date with your customer (this date may be defined in your RFP), and present your proposal. The personnel in attendance at this presentation should include yourself, as the PE, your Program Manager and your Marketing Manager. Don't take supporting personnel with you to this initial proposal meeting. They can be called upon later, if necessary. You should be thoroughly familiar with all aspects of your proposal (technical, cost, schedule). You need to immediately start to build your personal credibility with your potential customer at this point in time.

Solicit inputs from your customer, and review his or her reactions to your proposal with your Proposal Team. Make technical, cost and schedule adjustments as necessary. Remember that this is an iterative process. Make sure that you keep all promises you make to your customer after you have received "buy-in" from your internal personnel. Be careful to faithfully record and comply with agreements you make with your internal personnel. You will not be able to satisfy everyone. Just make sure you are fair, truthful and honest in your dealings with all concerned.

With a good product, a good proposal, good communications during negotiations, and a bit of good luck, you will win your contract!

Best Practice: Don't promise anything you can't follow through on. Never assume anything. Communicate! Communicate! Communicate!

After Contract Award:

Program Plan Update: The chances are pretty good that, during the negotiation stage leading up to contract award, several changes will have been made to the content of the Program Plan, i.e., technical, cost and schedule modifications. Now is a good time to make sure that you have communicated these changes to all appropriate personnel within your organization. You should also update your Program Plan to reflect the current state of your program.

Milestones: Update your Project Schedule. Use all of the information and agreements that came out of your contract negotiations - both internally and externally. As mentioned earlier, this schedule update activity is an ongoing process. If faithfully followed, it will minimize your project risk and provide a path for you to follow plus provide accurate direction for your supporting functional organization personnel. If you are managing multiple projects, your project-specific schedules will be an invaluable tool to keep you and your company out of trouble in the vital areas of performance, deliveries and cost.

Buy-In - Internal: It is critical that you have "buy-in" - both from your internal functional organization personnel and from management. The support of both is vital to the success of your project, and you won't have their support if you go ahead in any area without their concurrence. No one likes to left out of the picture. You must, therefore, establish a system of downloading and uploading information to the "do-ers" and the managers in your organization. The TOOLS section of this book will provide you with what you need to accomplish this important task.

Be advised that some folks will not agree one hundred percent with all of your plans. That's OK. People are human, and you can't please everyone all the time. You can, however, demand their concurrence. That is to say that they must indicate a willingness to go along with your plan even though they may not like it as well as something else (their idea, for instance). They must, however, be able to "live with it" (your plan).

Best Practice: Document your project planning agreements and require your internal organization personnel to acknowledge ownership for these tasks plus the project schedule and budgets in your Program Plan. These documents will help you later on down the road just in case someone "forgets" what they agreed to do.

Buy-In - Customer: Your customer must also buy-in to your Program Plan. The best way to accomplish this is to get him to agree to and sign a Statement Of Work (SOW). Suffice it to say at this point that you must have everyone on board for your project and concurring with your Project Plan.

Preparations for the Start of Contract Work: Take one more pass at updating your Project Schedule, project budgets, Work Breakdown Structure (WBS) and SOW. I know you are itching to get started on the development tasks that you have contracted for but it is worth the time it takes to update these documents now. You will be rewarded for very hour you spend bringing these project control vehicles up to date as your project evolves.

Establish a system for tracking contract task performance, cost and schedule. There are many good computer programs available to do this. You can computerize your schedules, action item lists, budgets, SOW, Program Plan, and contract. You should implement automatic "flags" to show either accomplishment or lack of accomplishment for each task, schedule event, and budget figure. Make sure you are always "on top" of your project.

I won't say: "forget about your family or personal life" from now on. That would be silly. But the fact is that you must get used to the idea that, as the PE, you will always have your project on

your mind. That's OK. You can deal with thinking about more than one thing at a time. You will get used to it. Others have done it. I have done it. You can do it!

You should start to chat with your design personnel in greater detail about the scope of and procedures for your design reviews at this point in time. Update your design review schedule. Have your design leads generate draft design review procedures. You and your management personnel can review them. Mark them up, return them to your design people for update, and then hold a meeting to discuss comments and to resolve problems. Update these design review procedures, capture them in a company-wide information retrieval system (more about this in the TOOLS section) and distribute them to all who will need them. Send a copy to your customer, also. It will make him feel involved and part of the team.

Best Practice: Make sure you are always "on top" of your project. Capture all internal procedures and processes via Internal Procedure documents.

Orientation Meetings: When you have all your project control vehicles updated and prior to commencement of contract work, you should once again hold orientation meetings for all concerned. I know this may sound redundant but - trust me - it's important. If you learn nothing else from this book, you should walk away from it with the admonition "*communication, communication, communication*" firmly embedded in your mind.

Get your Program Manager, Functional Unit Managers, leads, working level personnel (not that your managers and leads don't "work"), and supporting personnel of all types into a large room and review the project status with them. This will do wonders for their attitudes and feeling of self worth even if they are already familiar with the details. You may someday need to call upon several of these folks to perform "above and beyond" the call of duty in order to achieve some milestone. You need their good will. It is indispensable!

Review roles and responsibilities as well as project tasks and schedules. Try to make it an interactive and interesting meeting. I can still remember a meeting called by the president of a company I worked for in the 60's which lasted past the normal "go-home" time. The purpose of this meeting was to let us know how things were going with the organization and with our project in particular. We maintained our high level of commitment to that project partly because he took the time to talk to us.

People need and respond to attention. They need to know what's going on for their sense of security. It's surprising how little extra effort it takes to make a lasting impression. I'm sure that the president of the company mentioned above had no idea that his consideration for the moral of his "troops" would still be sticking in my mind twenty years later.

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It's not easy to inspire people these days but it can be done through consideration, communication and leadership. You, as the PE, have a unique opportunity to inspire people to greater efforts and a more rewarding experience in their daily lives. You need to do this to be successful yourself. The benefit to others is a gift. Its a "win-win" situation.

Action Item List Data Input Sheet

Task ID: 1   **Source** Project Engineer

Project Name Space Station Transport Pod

Task Description: Obtain samples for evaluation of external skin material thermal properties

Start Date: 2/25/99   **Current Date** 3/10/99

Action Item Due Date: 3/25/99

Assigned Action: Select (3) vendors and obtain samples for evaluation

Responsible Individual John Smith

Task Status Three vendors contacted; material samples received at incoming inspection

Task Closure Date

Task Closure Approval

Figure 1

Project Schedule Checklist

1) PROGRAM MILESTONES
      * Program level milestone chart
      * Detailed task schedules
      * Budgets
            - Program level
            - Functional unit level

2) ENGINEERING MILESTONES
      * Specifications
      * Design Reviews (DR)
            - DR schedule DR #1 through DR#n
            - DR package to reviewers
            - DR package comments collected
            - DR comments resolved
            - DR package updated
            - DR meeting
            - DR action items closed out
            - DR approved or disapproved
            - DR report issued
      * Engineering Prototype
            - Material procurement
            - Fabrication
            - Design updates incorporated
            - Simulations
    * Software unit test
    * Hardware/software integration
    * Design evaluation tests
    * Qualification tests
    * Functional Configuration Audit (FCA)
    * Physical Configuration Audit (PCA)
    * Release to Manufacturing

Figure 2

Project Schedule Checklist (Cont'd)

3) MANUFACTURING AND QUALITY ASSURANCE MILESTONES
* Production unit delivery schedules
* Production material orders
    - Long lead items
    - Production material
* Production Test and Inspection Plan

4) CONFIGURATION MANAGEMENT (CM) MILESTONES
* Contractual CM requirements tailored, negotiated and documented
* Configuration Management Plan generated and approved
* Baseline data capture plan established
    - Transition events planned (Design Reviews)
* Electronic data and paper vaulting and control strategy negotiated and documented
* Configuration Control Board planned and in place
* Development Baseline captured and under formal Configuration control
* Problem Resolution Board (PRB) in place
* Material Review Board (MRB) in place
* Design, Manufacturing and Purchasing databases verified
* Transition to production plan negotiated and documented
* FCA Plan generated and approved
* PCA Plan generated and approved
* FCA conducted
* PCA conducted
* Product Baseline captured and under formal Configuration control

Figure 2 (Cont'd)

Project Schedule

ID	Task Name	1999	2000	2001
		N D J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D J F M A
1	PROGRAM MILESTONES			
2	IR&D Program Complete	11/23		
3	Concept Design Review	Smith		
4	Project "Go-Ahead"	11/27		
5	PE Selection	Malloy		
6	Proposal Team Establish	Malloy/Klinger		
7	Proposal Kickoff Meeting	Malloy/Klinger		
8	Project Team			
9	Action Item List	Klinger		
10	Project Schedule	Malloy/Klinger		
11	Budget Estimates	Malloy/Klinger		
12	Program Plan	Malloy/Klinger		
13	Proposal Submission	Malloy/Klinger		
14	Contract Negotiations	Malloy/Klinger		
15	Contract Award	5/14		
16	Program Plan Update	Klinger		
17	Project Team Established	Klinger		
18	Orientation Meetings	Klinger		
19	ENGINEERING MILESTONE			
20	Specifications			
21	System Req'ts Spec	MacLean		

Project: Project Schedule
Date: 12/28/98

Task		Summary		Rolled Up Progress	
Progress		Rolled Up Task			
Milestone	◆	Rolled Up Milestone	◇		

Figure 3

Project Schedule

Figure 3

Project Schedule

ID	Task Name
43	Integration and Test
44	Design Review #4
45	Engineering Prototype
46	Material Procuremer
47	Fabrication
48	Design Changes Inc
49	Simulations
50	HW/SW Integration
51	Design Evaluation T
52	Qualification Tests
53	FCA
54	PCA
55	Product Baseline Establis
56	Release to Manufacturing
57	Transition Team
58	PRB Established
59	Database Verification
60	Project Scedule upd
61	Vendor Coordination
62	MFG & QA MILESTONES
63	Prod Unit Delivery Schedi

Project: Project Schedule
Date: 12/28/98

Task		Summary		Rolled Up Progress	
Progress		Rolled Up Task			
Milestone		Rolled Up Milestone			

Figure 3

Project Schedule

ID	Task Name	Timeline
64	**Prod Mat'l Orders**	(summary bar, 2000)
65	MRP System Load	Jacobson
66	Long Lead Items	Jacobson
67	Prod Material	Jacobson
68	Prod Test & Insp Plan	Zuckerman
69	Prod Unit Fab & Test	Ja
70	Start Prod Unit Deliveries	◉
71	CM MILESTONES	(rolled up progress bar)
72	Req'ts tailored/negotiated	SteigerKlinger
73	Baseline Capture Plan	Steiger
74	Elec Data Control Strateg	Steiger/Klinger
75	CM Plan	Steiger
76	DM Support	Steiger
77	CCB Established	◆ 1/19
78	Devel Baseline Captured	Steiger
79	MRB Established	◆ 1/19
80	CSA Database Updated	Steiger
81	FCA Plan	Steiger
82	PCA Plan	Steiger
83	Product Baseline Establis	◆ 11/16
84	Start CVA's	S

Timeline headers: 1999 | 2000 | 2001 — N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A

Legend:
- Task
- Progress
- Milestone ◆
- Summary
- Rolled Up Task
- Rolled Up Milestone ◇
- Rolled Up Progress

Project: Project Schedule
Date: 12/28/98

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Figure 3

Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	PROGRAM MILESTONES	145d	11/23/98	6/11/99	
2	IR&D Program Complete	0d	11/23/98	11/23/98	
3	Concept Design Review	5d	11/23/98	11/27/98	2
4	Project "Go-Ahead"	0d	11/27/98	11/27/98	3
5	PE Selection	10d	11/30/98	12/11/98	4
6	Proposal Team Establish	10d	12/14/98	12/25/98	5
7	Proposal Kickoff Meeting	5d	12/28/98	1/1/99	6
8	Project Team	60d	1/4/99	3/26/99	7
9	Action Item List	10d	1/4/99	1/15/99	
10	Project Schedule	30d	1/4/99	2/12/99	
11	Budget Estimates	30d	1/4/99	2/12/99	
12	Program Plan	60d	1/4/99	3/26/99	
13	Proposal Submission	5d	3/29/99	4/2/99	12
14	Contract Negotiations	30d	4/5/99	5/14/99	13
15	Contract Award	0d	5/14/99	5/14/99	14
16	Program Plan Update	20d	5/17/99	6/11/99	15
17	Project Team Established	10d	5/17/99	5/28/99	15
18	Orientation Meetings	10d	5/31/99	6/11/99	17
19	ENGINEERING MILESTONE	695d	5/3/99	12/28/01	
20	Specifications	90d	6/14/99	10/15/99	
21	System Req'ts Spec	60d	6/14/99	9/3/99	18

Gantt chart (1999): N D J F M A M J J A S O N

- 1 PROGRAM MILESTONES — summary bar
- 2 IR&D Program Complete — milestone 11/23
- 3 Concept Design Review — Smith
- 4 Project "Go-Ahead" — milestone 11/27
- 5 PE Selection — Malloy
- 6 Proposal Team Establish — Malloy/Klinger
- 7 Proposal Kickoff Meeting — Malloy/Klinger
- 8 Project Team — summary bar
- 9 Action Item List — Klinger
- 10 Project Schedule — Malloy/Klinger
- 11 Budget Estimates — Malloy/Klinger
- 12 Program Plan — Malloy/Klinger
- 13 Proposal Submission — Malloy/Klinger
- 14 Contract Negotiations — Malloy/Klinger
- 15 Contract Award — milestone 5/14
- 16 Program Plan Update — Klinger
- 17 Project Team Established — Klinger
- 18 Orientation Meetings — Klinger
- 19 ENGINEERING MILESTONE — summary bar
- 20 Specifications — summary bar
- 21 System Req'ts Spec — MacLean

Legend:
- Task
- Progress
- Milestone ◆
- Summary
- Rolled Up Task
- Rolled Up Milestone ◇
- Rolled Up Progress

Project: Project Schedule
Date: 12/28/98

Figure 3

Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors								1999						
						N	D	J	F	M	A	M	J	J	A	S	O	N
22	Allocated Req'ts Spe	45d	7/26/99	9/24/99														MacLean
23	Hardware Req'ts Sp	45d	8/16/99	10/15/99														Moore
24	Software Req'ts Spe	45d	8/16/99	10/15/99														Tromble
25	Firmware Req'ts Spe	30d	9/6/99	10/15/99														Tromble
26	Design State Definition	60d	5/3/99	7/23/99														MacLeanKlinger
27	**Hardware Design**	**560d**	**6/14/99**	**8/3/01**														
28	Design Task Schedu	60d	6/14/99	9/3/99	18													Moore/Klinger
29	Design Review #1	20d	9/6/99	10/1/99	21													Moore/Klin
30	Detailed Design	180d	10/4/99	6/9/00	29													
31	Design Review #2	20d	6/12/00	7/7/00	30													
32	Final Design	120d	7/10/00	12/22/00	31													
33	Design Review #3	20d	12/25/00	1/19/01	32													
34	Integration and Test	120d	1/22/01	7/6/01	33													
35	Design Review #4	20d	7/9/01	8/3/01	34													
36	**Software Design**	**560d**	**6/14/99**	**8/3/01**														
37	Design Task Schedu	25d	6/14/99	7/16/99	18													Trombley/Klinger
38	Design Review #1	20d	9/6/99	10/1/99	21													Trombley/K
39	Detailed Design	180d	10/4/99	6/9/00	38													
40	Design Review #2	20d	6/12/00	7/7/00	39													
41	Final Design	120d	7/10/00	12/22/00	40													
42	Design Review #3	20d	12/25/00	1/19/01	41													

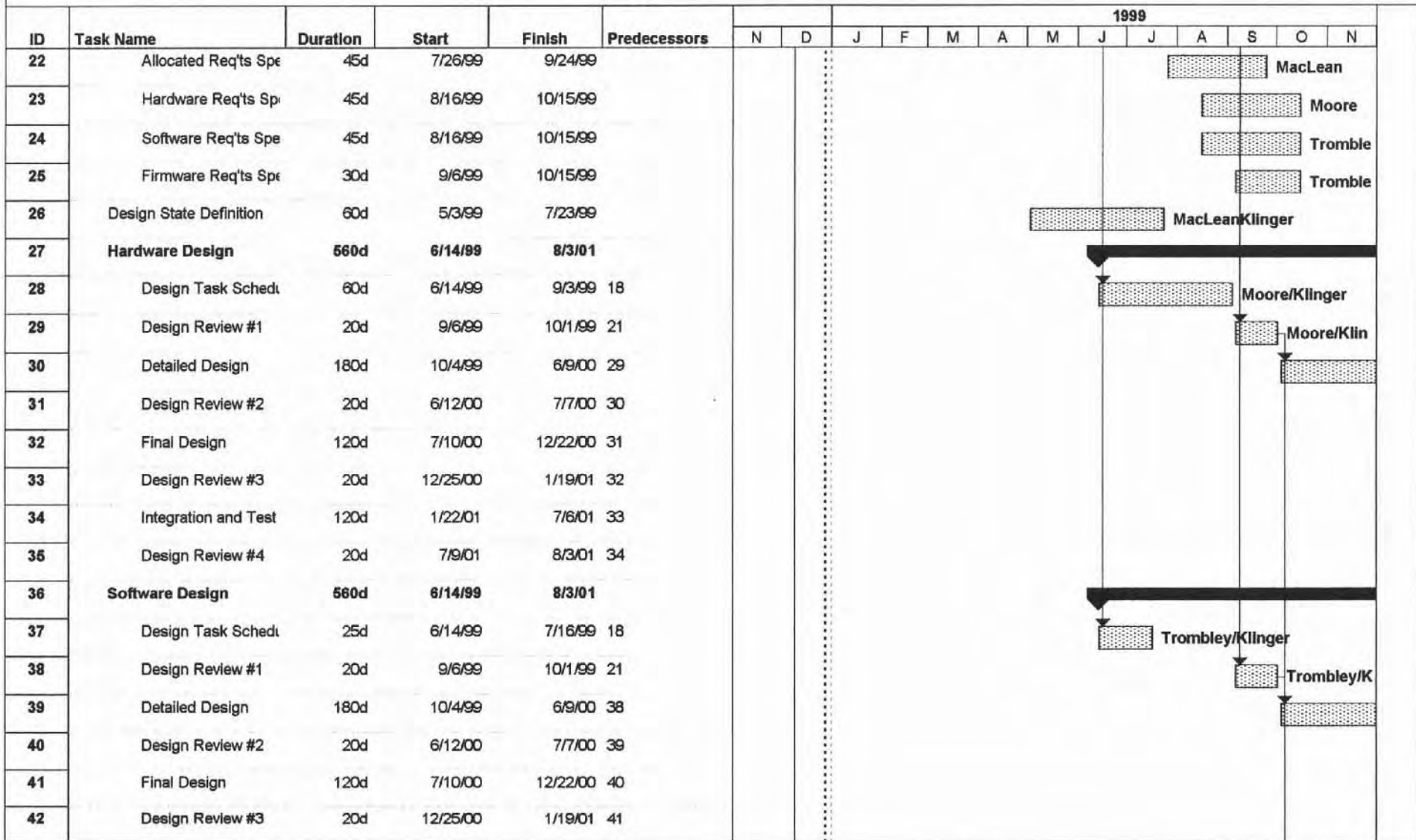Project: Project Schedule
Date: 12/28/98

Task	▨▨▨	Summary	◥━━◤	Rolled Up Progress	▬▬▬
Progress	▬▬▬	Rolled Up Task	▨▨▨		
Milestone	◆	Rolled Up Milestone	◇		

Figure 3

Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
43	Integration and Test	120d	1/22/01	7/6/01	42
44	Design Review #4	20d	7/9/01	8/3/01	34
45	**Engineering Prototype**	**475d**	**10/4/99**	**7/27/01**	
46	Material Procuremer	210d	10/4/99	7/21/00	29
47	Fabrication	150d	7/10/00	2/2/01	31
48	Design Changes Inc	120d	8/21/00	2/2/01	
49	Simulations	60d	1/22/01	4/13/01	33
50	HW/SW Integration	60d	1/22/01	4/13/01	33
51	Design Evaluation T	45d	4/16/01	6/15/01	50
52	Qualification Tests	30d	6/18/01	7/27/01	51
53	FCA	25d	7/30/01	8/31/01	52,43
54	PCA	30d	9/3/01	10/12/01	53
55	Product Baseline Establis	25d	10/15/01	11/16/01	54
56	Release to Manufacturing	30d	11/19/01	12/28/01	55
57	**Transition Team**	**145d**	**1/24/00**	**8/11/00**	
58	PRB Established	25d	7/10/00	8/11/00	40
59	Database Verificatio	30d	1/24/00	3/3/00	
60	Project Scedule upd	20d	2/7/00	3/3/00	
61	Vendor Coordination	45d	1/31/00	3/31/00	
62	**MFG & QA MILESTONES**	**451d**	**7/10/00**	**4/1/02**	
63	Prod Unit Delivery Sched	60d	7/10/00	9/29/00	40

Timeline header: 1999 — N | D | J | F | M | A | M | J | J | A | S | O | N

Legend:
- Task (shaded bar)
- Progress (solid bar)
- Milestone (◆)
- Summary (solid tapered bar)
- Rolled Up Task (shaded bar)
- Rolled Up Milestone (◇)
- Rolled Up Progress (solid bar)

Project: Project Schedule
Date: 12/28/98

Figure 3

Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
64	Prod Mat'l Orders	200d	10/2/00	7/6/01	
65	MRP System Load	60d	1/22/01	4/13/01	33
66	Long Lead Items	180d	10/2/00	6/8/01	
67	Prod Material	120d	1/22/01	7/6/01	33
68	Prod Test & Insp Plan	150d	7/10/00	2/2/01	40
69	Prod Unit Fab & Test	65d	12/31/01	3/29/02	56
70	Start Prod Unit Deliveries	1d	4/1/02	4/1/02	
71	CM MILESTONES	874d	11/30/98	4/4/02	
72	Req'ts tailored/negotiated	45d	11/30/98	1/29/99	4
73	Baseline Capture Plan	45d	12/21/98	2/19/99	
74	Elec Data Control Strateg	45d	1/11/99	3/12/99	
75	CM Plan	80d	2/1/99	5/21/99	72
76	DM Support	345d	10/4/99	1/26/01	29
77	CCB Established	0d	1/19/01	1/19/01	33
78	Devel Baseline Captured	140d	7/10/00	1/19/01	31
79	MRB Established	0d	1/19/01	1/19/01	77
80	CSA Database Updated	30d	12/18/00	1/26/01	
81	FCA Plan	45d	10/30/00	12/29/00	
82	PCA Plan	30d	12/4/00	1/12/01	
83	Product Baseline Establis	0d	11/16/01	11/16/01	55
84	Start CVA's	3d	4/2/02	4/4/02	70

Legend:
- Task
- Progress
- Milestone
- Summary
- Rolled Up Task
- Rolled Up Milestone
- Rolled Up Progress

Project: Project Schedule
Date: 12/28/98

Figure 3

Program Plan Outline

1) INTRODUCTION
   * Mission statement
   * Project scope, depth, content
   * High level project description

2) ORGANIZATION
   Project Team
   - Members
   - Roles & responsibilities
   - Comment discussion & resolution process
   - On-line work process for external members
   - Meeting plan

3) REQUIREMENTS
   * System
   * Allocated
   * Detailed Design
   - Hardware
   - Software
   - Firmware

4) PROJECT SCHEDULES
   * Program level milestone chart
   * Detailed task schedules
   * Design Review schedule

5) BUDGETS
   * Program level budgets
   * Functional unit level budgets
   * Financial data capture & reporting system

Figure 4

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Program Plan Outline (Cont'd)

6) PLANNING
   * System analysis
   * Specification development process
   * Design tools
   * Design approach
   * Design data capture methodology
   * Design Review Plan
   * Hardware/Software/Firmware Development Plans
   * Configuration Management Plan
   * COTS Development Plan
   * Transition to Production Plan
   * Production and Support Plan
   * Financial Control Plan
   * Training program
   * Test program
            - Design Evaluation tests
            - Qualification tests
            - Acceptance tests

7) DEVIATIONS FROM THE RFP
   * Workarounds

Figure 4 (Cont'd)

2.2 Development

The development phase of your project is where you conduct your specification generation activities, detailed design activities (hardware, software and firmware), fabricate prototype(s), conduct performance analyses, order long-lead materials, and verify that your design meets the physical and functional requirements identified in your system level specifications. You will be working especially closely with your Engineering, Test, Quality Assurance, Configuration Management, Purchasing, Producibility, Reliability, Human Factors, Logistics, Production Planning, and Cost Management personnel. Your communication skills will be put to the acid test "in spades" in this phase of your program or project. Don't forget to keep your Program Manager up to date.

Best Practice: Develop your communication skills. They are critical to your success as a Project Engineer.

Project Team: The first thing you need to do as you initiate the development phase of your project is to establish your Project Team. This usually isn't too difficult because most of the members of your Project Team will be the same individuals who served so admirably on your Proposal Team. You will probably want to add a few additional Engineering "hands-on" personnel. You should also establish a list of "on-call" folks from various organizations to support your Project team as required. Here is a list of functional organizations who should supply candidates for your Project Team (including your "on-call" support personnel):

* Design Engineering (Mechanical, Electrical, Software, & Components)
* Systems Engineering
* Test Engineering (if separate from Systems Engineering)
* Manufacturing Planning & Production Control
* Manufacturing Assembly
* Quality Assurance
* Sourcing or Purchasing (same thing)
* Configuration Management
* Logistics
* Customer or Field Support
* Technical Publications
* Program Engineering

You or your Program Manager will serve as the Project Team chairperson.

You are now ready to begin the development phase of your program. You will rely heavily upon the support of your Engineering lead personnel as well as upon your entire Project Team. Your Program Plan will set the course upon which you and your team will embark.

Best Practice: Your Project Team and your Program Plan are indispensable tools. Treat them with respect and rely upon them for support throughout your Project.

I won't go into great detail at this point as to the specific steps in the detailed design process. This process varies considerably from one business to another. Instead I will describe a design process control methodology which is generic and which can be applied universally to any development activity.

Coordination: You, as the PE, are responsible for coordinating all aspects of the development phase of your project. You will learn about several tools that are available to help you accomplish this task in Part 3 of this book. I strongly urge you to use your Project Schedules, Action Item Lists and Project Management software plus all the other tools described in Part 3 to assist you in your project coordination efforts.

You can't be everywhere at once, so you should depend heavily upon your Project Team to feed you information and to assure that the tasks you assign are executed in a timely manner. Your Project Team Meetings are a good place to start, but this should not be the only means by which you direct and coordinate project activities. Get out of your office. Move about among your "troops". Talk to them. Elicit their suggestions, and help them solve their problems. This should be an on-going activity.

Best Practice: Use every tool at your disposal to assist you in your project coordination and control activities. Spend a good deal of time moving about and talking to your "troops".

Communication: I would like to again emphasize that the name of the game throughout the duration of your project is *communication, communication, communication!* I cannot emphasize this point enough. You may become tired of hearing me dwell on this and a on few other points that I consider vital but please get used to it. These recommendations are time tested, and they are good for you and your project. Therefore, my message to you is this - do everything within your power to communicate well both "up the ladder" and "down the ladder" and to convince your Project Team to do likewise.

Best Practice: Do whatever you have to do to insure a satisfactory level of information flow in all directions.

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Technical Support: Almost every PE thinks that he is technically competent. That's all well and good. However, I believe that we PE's should take most things with a "grain of salt", including our opinions of ourselves (especially our opinions of ourselves regarding our technical competence).

That said, I want to impart a bit a advice of how to deal with your technical folks. They can make or break your project, especially during the design and development phase of your program. You can't drive your project to a successful conclusion without their unconditional support.

You should become as regular a fixture in the offices of your design managers and design lead personnel as their furniture. You are all "eating out of the same bowl". I think I remember some advice along the lines of "Do unto others as you would have them do unto you." This admonition really applies here. You don't want to spend Friday evenings, Saturdays or Sundays or any other day of the week replaying in your mind the things you *wish* you had said to one of these folks instead of what you actually said in a rash moment. They can afford to occasionally get "pissed off". You cannot (at least so that it shows). You need their technical support and their good will. I'm not advocating being "soft" on your technical personnel. Just be sure that you treat them honestly and fairly.

Best Practice: Treat all personnel with respect and patience. Let them know you are "always there for them".

Problem Resolution: I have included in Part 5 of this text a separate discussion on problem resolution. I think that just about everything you need to know about this important topic is discussed in that part of the book. I should point out here, though, that you should expect problems to be identified to you by the designers, builders, users, and maintainers of your product, as well as by your customers, sub-contractors and suppliers. As silly as this sounds, you should be "pleased" when someone advises you of a problem, rather than be annoyed because your motto is: "No Surprises!"

Best Practice: Expect problems. Be happy if you hear about them in a timely manner. Then, do your best to resolve them.

Design Reviews: Design Reviews are the means by which you will measure the success of your development effort at specific points during your design process. You will need to periodically update your Design Review Schedule to assure the currency of your overall Program Plan

because the Design Reviews are major milestone events during the Engineering Development phase of your project.

At each Design Review, you should expect a certain (pre-defined) amount of "goodness" in the design. For the purposes of this book, four Design Reviews will be examined and integrated into the context of the development activity. The following is a brief description of the expectations for the output of each of these Design Reviews.

Best Practice: Design Reviews are events where you will "taste the goodness" of your designs". Make corrections to your design processes, procedures and methodology as appropriate at these events.

In today's business environment, shortened design cycles and an early transition to production require a flexible but controlled approach. Wherever Engineering departments exist, a consistent engineering design methodology must be employed, based upon events which define the transition points plus inputs to and outputs from the Design Review process. People must know their roles and responsibilities and understand what is expected of them at specific points in the evolution of the design. The concept of planning all project milestones by calendar dates doesn't work well because schedules often slip. Of course, certain program-driven dates (start of contract work, first unit delivery, etc) must be employed to satisfy contractual requirements. However, a combination of event-driven milestones and scheduled task completion dates is the most effective control scenario in the day-to day management of your project. These events and program driven dates can be tailored to fit your project.

Figure 5 presents a methodology for the engineering development process which is adaptable to any program or product, regardless of the size of your enterprise. Four Design Reviews and four levels of control (as illustrated by four design "states") are described below:

Design Review #1: The System Specification, which defines the system level requirements for your product, has been completed and signed off by your internal functions and your customer. <u>Your Functional Baseline (system level) and Allocated Baselines (subsystem level) are established at this point.</u>

In the first state, *"Designer Control"*, following Design Review #1, the design is initiated and controlled by the designer. Control of the design data is in the hands of the designer. He can use any means at his disposal or within his range of preferences to manage these design data. Your designers' only constraints are those imposed upon them by the system level specification, i.e., the design requirements documents.

The Project Schedule is again updated at Design Review #1. This document serves as the vehicle for the control of the transition from one design "state" to the next. Formal audits are also scheduled on the Project Schedule, and dates for the capture of baselines are specified.

The timely and accurate maintenance of the Project Schedule will provide the basis for your control of the development phase of your project. A good job here will produce a well designed and reliably built product and will enable you to run a controlled, cost effective project. A sloppy or incomplete job will spawn a free-wheeling design activity, with a production process that is out of control, i.e., a disaster.

Best Practice: Capture your Functional (system level) Baseline and Allocated (subsystem level) Baselines at this point in the development of your project. Update and maintain your Project Schedule diligently.

Design Review #2: Your designers have developed the detailed design to the point where they are confident that the system level requirements have been met, and they are willing to sign the drawings which represents the product or the part or subsystem in question. At this point, fabrication of the prototype is initiated.

In the second state, following Design Review #2, *"Design Internal"*, the level of control (still informal) is increased because at that point, an event has occurred which establishes the expectation of a certain amount of "goodness" in the design, and the design efforts of other people may be impacted by changes to your design as you move into your prototype build phase.

Proposed changes to your design must now be approved by your design lead personnel. It is your lead engineers' responsibility to communicate with other functional areas and personnel proposed changes which may impact their design activities.

As your prototype fabrication evolves and design problems and improvements are identified, the initial drawing and/or design tool database should be updated, i.e., red-lined drawings and new design files or model versions are created. This iterative process continues until Design Review #3 is held and all identified problems are resolved.

Best Practice: Assure proper approval and communication of design changes. Start your prototype build activities.

Design Review #3: Your prototype build has been completed, and your design database has been updated to reflect changes made to your design and/or red-lined changes have been made to

the design drawings. Your Development Baseline is established at this point. NOTE: It is important to state here that the "master" of the design is no longer the physical drawing, as in the past, but the "ones and zeros" in the design database, i.e., the electronic design files.

The two states described above are generally referred to as "Work-In-Progress" (WIP).

At the conclusion of Design Review #3, you should have sufficient confidence in your design to justify the initial procurement of production hardware. This event triggers the transition to the *"Formal Internal"* state.

At this point, your design database is updated again, your design data are loaded into your business' manufacturing inventory and ordering system, and initial (or all) orders are placed for production hardware.

Drawings which represent the Development Baseline are issued by your Documentation Control Center or CM organization (or equivalent), and electronic files generated by design tools which represent the Development Baseline design are inducted into your Product Data Management (PDM) system (or not, if you plan to control your design using paper and/or your CAD tools for the near term). Again, it is important to note that the "master" design documentation is represented by the design tool database *files* and not by mylar or paper drawings, as in the past, except in the case of businesses that, for the time being, rely upon paper drawings and specifications to conduct their operations.

Future proposed changes to your design (including changes to the system level specifications) are documented on your internal "change notices" and are approved or disapproved by your internal Configuration Control Board (CCB). Unless otherwise negotiated, your customer should not participate in the change approval process until the Product Baseline has been established, as defined below.

If your program involves military hardware or critical commercial hardware, your customer may request (or demand) to review and initial the drawings before they are issued and inducted into the internal configuration control system. NOTE: This "initialing" of the documentation is different from the "authentication" process for military designs. That event does not occur until the Product Baseline has been established by the satisfactory completion of the Functional Configuration Audit (FCA) and the Physical Configuration Audit (PCA). See below.

The FCA is conducted on your engineering prototype during the *"Formal Internal"* state. The purpose of the FCA is to assure that tests have been conducted to verify that each requirement specified in the system level specification has been met by your design. If tests cannot be performed to verify a particular requirement, then a 'theoretical error analysis" must be performed

to verify satisfactory compliance to the requirement. These tests are generally referred to as Design Evaluation and Qualification tests. NOTE: The advent of the terminology FCA and PCA is relatively recent. It is mainly driven by Military Standards and used primarily on Defense programs. The purpose of these activities is universal, though and should be an integral part of every development program.

Best Practice: Capture your Development Baseline. Verify your databases. Load your MRP System. Put your design data under formal internal control.

Design Review #4: The Functional Configuration Audit has been successfully completed. This process provides documented proof that the requirements specified in the System Specification have been met, i.e., the design works.

Various names have traditionally been associated with these Design Reviews (#1-Concept, #2-Detailed or Implementation, #3-Critical or Pre-Release, #4-Final or Customer). However, it is more important to identify the specific outputs of the Design Review as the relevant indication of the "goodness" of the design at that point in time, rather than the name associated with the Design Review.

The transition to the *"External"* state occurs at the successful completion of the FCA. This event initiates the conduct of the PCA. During the PCA, your engineering drawings are proofed by comparison to the first production unit. This unit should be built to manufacturing planning that was created from the engineering drawing package. Measurements are verified and all instructions, processes and technical data specified on the engineering drawings are verified against the hardware. Historically, many businesses referred to this activity as the "First Article Inspection (FAI)".

The second major activity of the PCA is the capture of drawing revision and serial number data and comparison to "as-defined" revision levels plus a verification that serial numbers have not been previously used.

The final activity of the PCA is the performance of an Acceptance Test (AT) to assure that the unit examined is physically and functionally the same as the unit that passed the FCA.

Upon resolution of any problems that were observed during the conduct of the FCA and PCA, a FCA/PCA certification form is signed by the customer, and the "Product Baseline" is established.

You can now formally release your updated Technical Data Package to Manufacturing for the continuation of production activities. NOTE: Manufacturing will have been receiving design
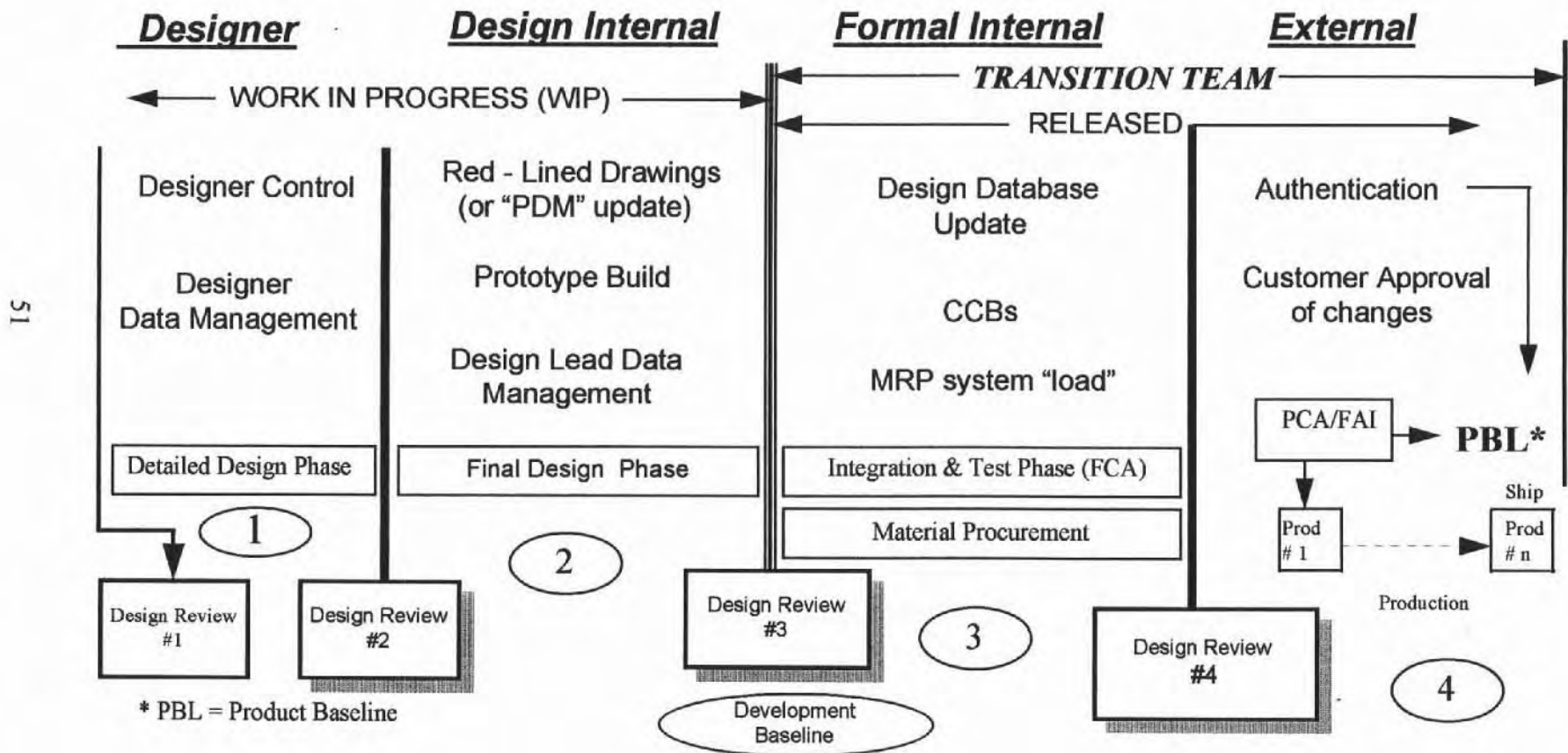
updates as they were processed through your CCB's during the transition to production period. This "release" is a formality which acknowledges that your Product Baseline has been established, and that your Engineering, Configuration Management and Manufacturing design databases are all updated and agree with each other.

Best Practice: Verify that all FCA and PCA discrepancies have been resolved. Capture your Product Baseline. Start building production units.

Figure 5

Design Review State Chart

Project Transition Events

Designer   **_Design Internal_**   **_Formal Internal_**   **_External_**

TRANSITION TEAM

◄── WORK IN PROGRESS (WIP) ──►

RELEASED

Designer Control

Designer
Data Management

Detailed Design Phase

Red - Lined Drawings
(or "PDM" update)

Prototype Build

Design Lead Data
Management

Final Design Phase

Design Database
Update

CCBs

MRP system "load"

Integration & Test Phase (FCA)

Material Procurement

Authentication

Customer Approval
of changes

PCA/FAI → **PBL***

Design Review
#1

Design Review
#2

Design Review
#3

Design Review
#4

Prod
1

Ship

Prod
n

Production

Development
Baseline

* PBL = Product Baseline

① ② ③ ④

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2.3 Transition to Production

The transition to production begins during the Formal Internal state. See Figure 5.

Following the capture of your engineering drawings and your electronic design files (at Design Review #3), your Manufacturing Resource Planning (MRP) system will be loaded with your engineering design data, so that you can place orders for production material.

Best Practice: Make sure your design data are baselined and under formal Configuration Control before you place orders for production materials.

In parallel with this activity, the Functional Configuration Audit (FCA) is initiated on your engineering prototype hardware and software. Admittedly, there is some degree of risk in placing orders for material before you have thoroughly proofed out your design via the FCA; however, due to the cost and schedule constraints present in today's business world, there is often no other way to complete the development activities and deliver the first production units on time.

As it turns out in practice, the engineering development methodology that should be followed allows for that "expectation of goodness" in your design at the specific points we have chosen as transition points from one level of control to the next, i.e., your Design Reviews. Also, the added visibility provided by a PDM system plus its control functionality in the change approval process and faster cut-in of approved changes to production, reduces the risks even further.

The transition to production encompasses the entire third state shown in Figure 5 and continues on through the establishment of the Product Baseline in state four.

Transition Team: The establishment of a transition team is the first step in your preparation for the transition to production. The very terminology "transition to production" screams out the need for such a group of people. After all, what are you really doing during this phase of your program?

You are taking your design, which has been developed according to the requirements articulated in your system level specification, and you are preparing to order the necessary materials to fabricate production units of your engineering prototype.

Different people are going to be utilizing your design data. Different people are going to be building hardware and, maybe, software items. Different people are going to be performing inspections and measurements and conducting tests.

It therefore follows that it might not be such a bad idea to get these people to talk to each other. Let's make them meet regularly. Let's call them the "transition team".

Now, who should you have on your transition team? The following list represents the "best case" scenario for representation on a transition team. You may have all or few of these individuals in your employ . The idea though, is to utilize the expertise of those personnel who have the engineering knowledge and the manufacturing know-how to move the design from its development state to production with a minimum of glitches.

Before I list the functions that will provide your potential transition team members, I should point out that many of the functions shown will look familiar to you. They should. They are, in several cases, the same functions who provided representatives to your Project Team. The interesting thing in this case, though, is that more often than not, there are some different personnel involved.

This is not because the design took so long to develop that the original designers died, retired or were fired for incompetence. It's not because the Project Team members had so many battles during product development that they can't stand the sight of each other's faces any longer. It is merely because a different skill set is required for this task.

The transition team members must be intimately familiar with material procurement, and manufacturing processes. They must know exactly what has to be done and when it has to be done. They must know, in the greatest detail, what they need to do their jobs and when those requirements must be satisfied.

The engineering personnel must have hands-on intimacy with the engineering prototype. They ideally will be the ones who conducted the performance evaluation and qualification tests. They must be familiar with the "lessons-learned" during the test phase of the program. Similar requirements apply to Quality Assurance, Sourcing, and Product Support personnel.

As you can see, the people I am talking about here are the "do-ers" of the detailed tasks. Not that your original Project Team functional representatives are not dedicated, capable people. Some of them just do different "stuff". The development Project Team folks generally have a lot of experience in broad areas, are familiar with company policies and goals, and are the trusted custodians of the designs and the production processes. They are also the Engineering "hands-on" people. The Transition Team must include the Manufacturing and Quality Assurance "hands-on" people. Of course, in any given organization they may be the same folks who are currently serving on your Project Team. I am just recalling for you what I have seen to be the case during my years on the job.

I obviously have let the cat out of the bag as to the identity of most of the transition team members. However, the best practice would be to include a member from each of the following functional areas:

* Design Engineering (Mechanical, Electrical, Software, & Components)
* Systems Engineering
* Test Engineering (if separate from Systems Engineering)
* Manufacturing Planning & Production Control
* Manufacturing Assembly
* Quality Assurance
* Sourcing or Purchasing
* Configuration Management
* Logistics
* Customer or Field Support
* Technical Publications
* Project Engineer
* Program Manager

Some of these members may serve in an "on call" basis. However, you should have a core team that meets regularly to make sure "all bases are covered" as you head into production.

Best Practices: Make your company's "do-ers" members of your Transition Team.

Transition Team Meetings: Transition team meetings should, preferably be held at least once a week following the successful completion of Design Review #3. Additional "splinter" meetings may also be appropriate when items are brought up at the transition team meetings that cannot be readily or immediately dealt with. These meetings don't have to last long - one hour is usually enough.

Meetings should continue to be held weekly until completion of the PCA and resolution of any and all discrepancies and closeout of action items assigned as a result of either the FCA or the PCA. At this point, your Product Baseline is established and your production activity continues with a fully "proofed" build package.

Best Practice: Hold regular Transition Team meetings but keep them short.

Action Item List: As mentioned earlier, it is extremely important to generate, follow up on and maintain current an action item list for all activities addressed, discussed and disposed of at

your Transition Team meetings. Specific individuals should be assigned specific action items to be completed by specific dates. Only when complete ownership is assigned and accepted can there be assurance that tasks will be faithfully executed on time. I will continue to remind you of this "fact of life" often throughout this book.

Remember that you, as the PE, are responsible for the task of following up on action items and assuring that closure is effected on schedule.

Best Practice: Your Action Item list is as important to you as a gunfighter's revolver was to him in the old West. Keep it "well oiled", i.e., up to date.

Technical Support: Your requirements for technical support during your transition to production remain almost as high as during development. However, whereas I said: "You should become as regular a fixture in the offices of your design managers and design lead personnel as their furniture" during design and development, I must modify that statement to some degree for the transition to production phase. You will have to shift some of your attention to the Manufacturing and Quality Assurance folks as well as your Purchasing, Technical Publications, Configuration Management, and Customer Support personnel. Be mindful of the fact that you will still need your Engineers and Technicians to resolve technical problems and to recommend design enhancements.

Problem Resolution: You will establish your formal Problem Resolution Board (PRB) during the transition to production phase of your program. This board will remain in place, with some shifting of member roles and responsibilities, throughout your product's life cycle. Your PRB will expand upon the problem resolution activities you initiated with your Project Team during design and development. Refer to Part 2.5 for a detailed examination of your PRB mission, makeup and processes.

Database Verification: A verification check should be performed on the engineering, manufacturing and sourcing databases to assure that production material orders are placed against the proper revision level of the engineering documentation and your manufacturing planning. This effort will require cooperation between several team members as will most of the transition team's activities.

This "preventive maintenance" step performed at this point in the program can save significant cost and schedule problems down the line. NOTE: This is just one of many tasks that you, as the

PE, must identify and follow up on to assure that it is accomplished properly and in a timely fashion.

Updates to your databases should be implemented immediately upon identification of errors with the corrections communicated to all effected individuals and organizations.

Best Practice: Make sure that your Engineering design personnel and your Manufacturing/Quality Assurance personnel are "singing from the same sheet".

Release to Production: You "release" your designs to your internal manufacturing people or to your suppliers, subcontractors and vendors to procure material for and to fabricate the products. This "release" activity captures the approved baseline, both paper and electronic, based upon successful completion of the specific Design Reviews discussed in Section 2.2. Then your MRP system must be updated with these engineering design data. This allows you to order parts. Future proposed changes will be formally processed through your internal CCBs. Remember that customer involvement in your change approval process will occur only after establishment of your Product Baseline, i.e., at FCA/PCA completion. If you are dealing with a military program, you should obtain customer authentication of your design documentation at that point.

Material Procurement: Major vendors and suppliers should be invited in-house for reviews with your transition team. These "up-front" meetings will serve to identify your company's needs and the resulting actions that must be taken by your suppliers. Schedules can be discussed and agreed upon. Workarounds, where necessary (and there will be some) can be formulated and agreed upon.

These vendor meetings also provide an excellent forum for your purchasing people to meet their suppliers face-to-face. The ensuing relations are usually enhanced when people know each other personally. Occasionally, extraordinary efforts are put forth by vendors and suppliers when needed out of respect for and commitment to your "people", whereas they may not feel the urge to respond in a similar fashion for your "company".

Best Practice: Get to know your outside vendors. Meet them face-to-face. Work at establishing good relationships.

Another benefit provided by your Transition Team is the regular opportunity for the team to discuss current engineering changes and to plan for their timely cut-in during the transition stage.

Of course, you must have documented procedures for the manufacturing cut-in of approved changes during production. This activity should be "cut and dried". However, the process of cutting in changes during the transition to production is often a different matter.

Agreements should be made with your customer to permit your internal CCB to control changes to released drawings/designs at this point in the program. With this in mind, procedures can be put in place to cut in (internal) CCB approved design changes with appropriate controls and improved efficiencies.

Customer Involvement: With few exceptions, your customers should not get involved in your transition activities until the completion of the FCA/PCA, i.e., the establishment of the Product Baseline. At this point, you will present your customer with the drawing package or equivalent for authentication (if a defense product is involved). The authentication process is described below. If your product is commercial, you will simply continue on with production activities and maintain your drawing package in accordance with your Configuration Management Plan.

One of the exceptions to the absence of customer involvement is the "initialing" of the engineering drawings prior to their release to manufacturing. This activity has two purposes: First, to involve your customer in your development process for his own feeling of participation, i.e., the feeling of being "part of the process". The second reason is to allow him to feel that he is performing a "sanity check" on your process before you go off and order production materials which may represent a significant portion of the total program cost.

Admittedly, these intentional allowances of customer intervention, whether forced by the customer or voluntary, take time and may or may not insert added value into the process, they certainly enhance the feeling of good will between both your companies' personnel and the customer. This good will is priceless. You will have made an important investment in the future of your program.

Best Practice: Make your customer feel like he or she is part of your team.

One area that customers almost always participate in is the Final Design Review. Design Review #4 (Figure 5) represents this activity. This is the culmination of the verification of your development process. Your FCA has been completed, and the test results demonstrate that you have met your system level requirements. Your customer will want to participate in this joyous (or maybe not) activity.

That's OK - either way. You must always lay your cards on the table for your customer to examine and, in many cases, chew up, along with some of your personnel, if the circumstances warrant it. That is part of the process. Get used to it because if your designs and test results can't stand the light of day (and your customer's piercing eyes), then you should find a gentler business with which to bring home the bacon.

Generally though, your customer will support you and your employees in every possible way. He too wants your program to succeed. He has as large a stake in your success as do you and your employees. It's surprising how often your customer can help as your program matures and cycles through its production, deployment, and support phases.

Lessons Learned: One of the benefits of gathering experienced, "hands-on" people in a room to discuss the transition to production is that each brings his or her own unique "lessons learned" to the meeting.

The test engineer has recently learned (or is the process of learning) much about the goodness of the design from conducting the design evaluation and qualification tests. The manufacturing representatives know what went right and what went wrong during previous transition periods. As successive programs evolve, mature and decline, additional insight is gained into the pluses and minuses, the good and the bad, the do's and the don'ts, to be applied to the next transition activity.

Best Practice : Document "lessons learned" for future programs.

FCA/PCA: I think that I have adequately described what the FCA & PCA activities are and have provided acceptable guidelines as to best practices for their conduct. The point I shall try to make in this section of the book is that it is important to clarify and reaffirm the roles and responsibilities of the individuals and functional organizations that conduct and support these major transition to production activities.

Once these roles and responsibilities have been "signed up to" by those responsible, the specific actions and processes can be itemized and incorporated into the Transition Team's action item list. From there on, it's a piece of cake.

As I have said before, the FCA is conducted on your engineering prototype. The PCA is conducted on your first production unit. Remember that the purpose of the FCA is demonstrate to yourselves and to your customer that your design works, i.e., it meets your system level specification performance requirements. The purpose of the PCA is to verify that your

manufacturing planning, which was created from the engineering design data and engineering drawings, produced a unit whose physical characteristics match the drawings.

One additional piece of advice on FCA and PCA. Get your customer to sign up to your FCA plan and your PCA plan as early in the transition phase of the program as you can. This will allow both your customer and yourselves to negotiate the "right amount" of FCA and PCA. Overkills in this area can be costly and underachievement can allow important information to drop into the crack, causing additional expense down the line.

Don't forget to conduct an Acceptance Test on your PCA unit to prove that it is the same physical *and* functional configuration as your engineering prototype. After all, you could prove that an artillery piece fires properly (FCA) and that you can build a nice toaster. (PCA). I wouldn't want to go into battle with your toaster as my weapon. This may sound extreme but I think you will get the idea.

An Acceptance Test, a subset of your design evaluation and qualification tests, will preclude this unfortunate turn of events from occurring.

Authentication Authentication is the formal acceptance of your design by a military customer. In earlier times, the customer would wait until all aspects of the development activities were completed and then review the drawings for authentication. As you have learned in this chapter and in earlier chapters, because of shortened development and production cycles, your customer may have become involved at the time of release of your designs. However, it would not be fair for us to request that he authenticate your design disclosure documentation before your FCA/PCA is completed and your Product Baseline is established.

Therefore, this is the way it is done! We complete the FCA and PCA, and then we request authentication. From that point forward, the customer participates in the review of all proposed changes. NOTE: On some contracts, the customer may request to be part of the review process for Major design changes only.

Schedule: Last but not least, is the maintenance of your Project Schedule during your transition to production activities. Your Project Schedule is important during all project phases but so many diverse activities occur during this phase that it is absolutely critical to generate, maintain and be accountable to your Project Schedule during the transition to production phase of your project.

Best Practice: Keep your Project Schedule up-to-date!

The last event in the transition to production schedule is the shipment of the first production unit to your customer. If you did your PE job right, it will be a good one, and he will be happy. That's what we all want.

2.4 Production and Support:

PE activities during production are somewhat different from PE activities during development and during the transition to production.

Coordination: During production you and your Program Manager will coordinate and control several relatively stable processes. You will continue to depend upon your Project Team to provide information and to assure that tasks are executed in a timely manner. You will be spending more time with your Manufacturing, Quality Assurance, Purchasing, Configuration Management, and Product Support personnel than you did during design and development and during the transition to production phases of your program. You will also be meeting on a regular basis with your Configuration Control Boards (CCB), Material Review Board (MRB), and Problem Resolution Board (PRB).

You will probably have to buy new shoes more often because you'll have to do quite a bit more walking as you travel around your facilities in order to maintain the proper level of contact with your widely dispersed functional operations personnel.

Communication: Continue to maintain your high level of communication with all personnel involved in or providing support to your project, both internally and externally. Also, as I have recommended in previous sections, please be sure to utilize _all_ of the communication tools at your disposal. They might make the difference between success and failure as you try to keep tabs on your project personnel as well as on your project tasks, schedules and budgets.

Technical Support: You will still rely heavily upon your Engineers and Technicians for problem resolution technical support, design improvement recommendations and identification of replacement parts and/or vendors. One type of problem resolution could be a design change. The design change approval "vehicle" (in the old world - paper, in our new world - data displayed on computer screens) will be circulated for review and approval or disapproval. The designs (or drawings) will then be updated, and the change cut into production and (possibly) backfitted into previously built and delivered units.

Configuration Management: I think that this is an appropriate place to continue our discussion on the subject of Configuration Management (CM). CM activities are grouped into four categories, i.e., Configuration Identification, Configuration Control,

Configuration Status Accounting, and Configuration Audits. This categorization is not necessarily the order in which these CM activities are conducted during the course of a program. I have endeavored to present the CM activities that fall under these general categories in a sensible and understandable order in a detailed treatment of this subject in "Practical CM".

Configuration Management Plan: Your Configuration Management (CM) Plan is the backbone of your CM program. You should generate a CM Plan, based upon the Templates provided in Appendix B and the guidelines presented in Appendix E. You must secure internal functional ownership for the processes and procedures specified in your CM Plan. When you have also obtained buy-in and approval from your customer, you will have established the basis for a successful CM program.

Best Practice: Document the results of your CM activity planning and negotiations in your CM Plan.

By now you will have captured your Development Baseline and conducted your FCA and PCA. Your Product Baseline has been established. Your internal CCB is in place and has already had several meetings to deal with proposed changes to your system level specifications and detailed designs.

The procedures which you have identified in the Configuration Control section of your CM Plan will guide you through the change process for future proposed design changes. The CSA reporting activities in the Status Accounting section will provide you visibility into and allow you to report upon the progress of those changes. The Configuration Verification Audits described in the Audits section of your CM Plan will determine if your approved Major changes have been cut into your production units at the planned times or on the specific units identified by your internal CCB.

Configuration Control Boards (CCB): As stated in the previous paragraphs, you will have established your internal and external CCBs by now. Your internal CCBs (hardware and software) will review and approve or disapprove proposed changes to your baselined designs. The results will then be forwarded to your external CCB (if applicable, depending upon the scenario you negotiated with your customer at the beginning of your program and documented in your CM Plan) or to your customer's representative for his or her approval. Figure 6 shows the recommended CCB reporting hierarchy.

If your company is fortunate enough to have a PDM system in place, and you have established on-line CCB functionality, the turn-around time for the review and approval process will decrease dramatically.

Best Practice: Implement and integrate a PDM system within your business, if at all possible.

Major and Minor Design Changes: The older Military Standards (MIL STD 480, 483, 973 and EIA 649) allocated many pages and even entire chapters to explanations of what Major (Class 1) and Minor (Class 2) changes are. I will try to cover that same ground in two paragraphs. This is pretty standard stuff, and if you want more detailed information, just pick up a copy of "Practical CM". The "what", "why" and "how to" for all aspects of CM for the 21st Century are in there.

I do not intend to minimize the importance of these change classifications. They are among the most important elements in CM. I do, however, want to keep things simple in this book. After all, if it's worth doing or worth understanding, it ought to be able to be explained in simple terms and in a few sentences. *The truth is always simple* (Lyon's Law).

Definition: A Major (Class 1) change is a design change that is absolutely required for the item in question to function as defined by its requirement specification. All previously built parts must be removed from service and either upgraded to the new design or scrapped. Any adverse impact upon interchangeability is unacceptable. A Major change could also be one that affects cost and/or schedule. The production cut-in of Major changes should be verified by adding the affected part(s) to the list of items to be verified during the conduct of your Configuration Verification audits.

Minor (Class 2) changes are all changes that are not Major changes.

Best Practice: Assure that all personnel working on your project clearly understand the difference between Major and Minor design changes. Never duck your responsibility to classify a change as a "Major" change even though the temptation may exist to do so in order to save time and money.

Material Review Board (MRB): During the course of receiving, fabricating, assembling, testing, delivering, and installing your products, the occasion will occur (not often, we hope) where you encounter materials and or parts and assemblies that do not conform to your Engineering drawings and specifications. This non-conforming material must be dispositioned according the rules and guidelines specified in your CM Plan.

There are five categories of non-conforming material for which specific dispositions have been defined and accepted throughout industry.

The categories of non-conforming material are as follows.

1) Repair (to drawing) in accordance with a standard repair procedure
2) Return to vendor for repair (to drawing) or replacement
3) Scrap
4) Rework to an acceptable condition for specific use
5) Use as is

The first three categories may be dispositioned by a Material Review Team (MRT), i.e., a team of your company's employees who are allocated the responsibility for making the decision as to the appropriate disposition for your non-conforming material, and if your CM Plan so specifies, a customer representative.

However, if after evaluation of the non-conforming material, it appears that category 4 or 5 is appropriate, then review and approval or disapproval by a Material Review Board (MRB) is mandatory.

The MRB should consist of representatives from Engineering, Manufacturing, Quality Assurance, Producibility, Sourcing, and Configuration Management, plus customer representatives as (or if) specified in your CM Plan.

The function of the MRB is not limited to review and approval of recommended categorization but also to determine corrective action to preclude this type of non-conformance from re-occurring in the future. This corrective action is currently documented on Request For Waiver (RFW) and Request For Deviation (RFD) forms for military programs per MIL STD 973. These forms are contained in MIL STD 973. If you implement the functionality of a PDM system, the data that are captured on these forms will be input instead to computer screens and managed along with your design, contractual and procedural data by your PDM.

Suffice it to say, in concluding our discussion on non-conforming material, that once disposition of the material has been approved and appropriate correction recommended and approved by your MRB, then a system for follow-up to assure proper implementation of these corrective actions is needed. Of course, in the future, your PDM system will provide the visibility and control mechanisms necessary to satisfy this requirement. For now, you must rely upon yourself, supported by your Quality Assurance staff, to assure proper closeout of corrective actions. By the way, one possible corrective action is the initiation of a design change. This would trigger an input to your CCB.

Best Practice: Establish a process to assure that the disposition of corrective action for non-conforming material is fed back to the proper team members.

Problem Resolution Board (PRB): Section 2.5 will deal in length with the identification and resolution of problems that occur during all phases of your programs. The point that I wish to make in this chapter on production and support is that, after you establish your Development Baseline, there must be a system in place to identify and resolve problems.

These problems may be identified by designers, builders, users, and maintainers of your products. They may also be identified by your customers. They may occur at any time and at any place. They must be dealt with in a timely manner to minimize risks and costs to your programs.

Best Practice: Establish and maintain a Problem Resolution Board to deal with problems that arise during the conduct of your project.

Configuration Verification Audits (CVA): CVAs are usually conducted on all or selected production units if the product is a military procurement. If not, the option of whether or not to bear the cost involved with the capture and processing of CVA data is a decision which your company must make. You must tradeoff the cost incurred versus the value of obtaining traceability data.

Remember during your deliberations that one of the benefits derived from conducting CVAs is that you will have verification as to whether or not your Major design changes have been properly cut into production.

Automatic CM: It is worth noting again that many of the CM activities which we have identified as occurring during the production and support phases of our programs will be more efficient, some by orders of magnitude, when and if you implement a PDM system into your business operations and environment.

Support: Thus far, I have been directing your attention primarily to the PE activities conducted during the production phase of the program The same PE activities will continue throughout the support phase of your programs, with additional emphasis on the Configuration Management and Problem Identification and Resolution activities.

Actually, there is such a significant overlap between the processes employed during the production and support phases of a program that you will barely notice a change in the way in which you are conducting your PE duties.
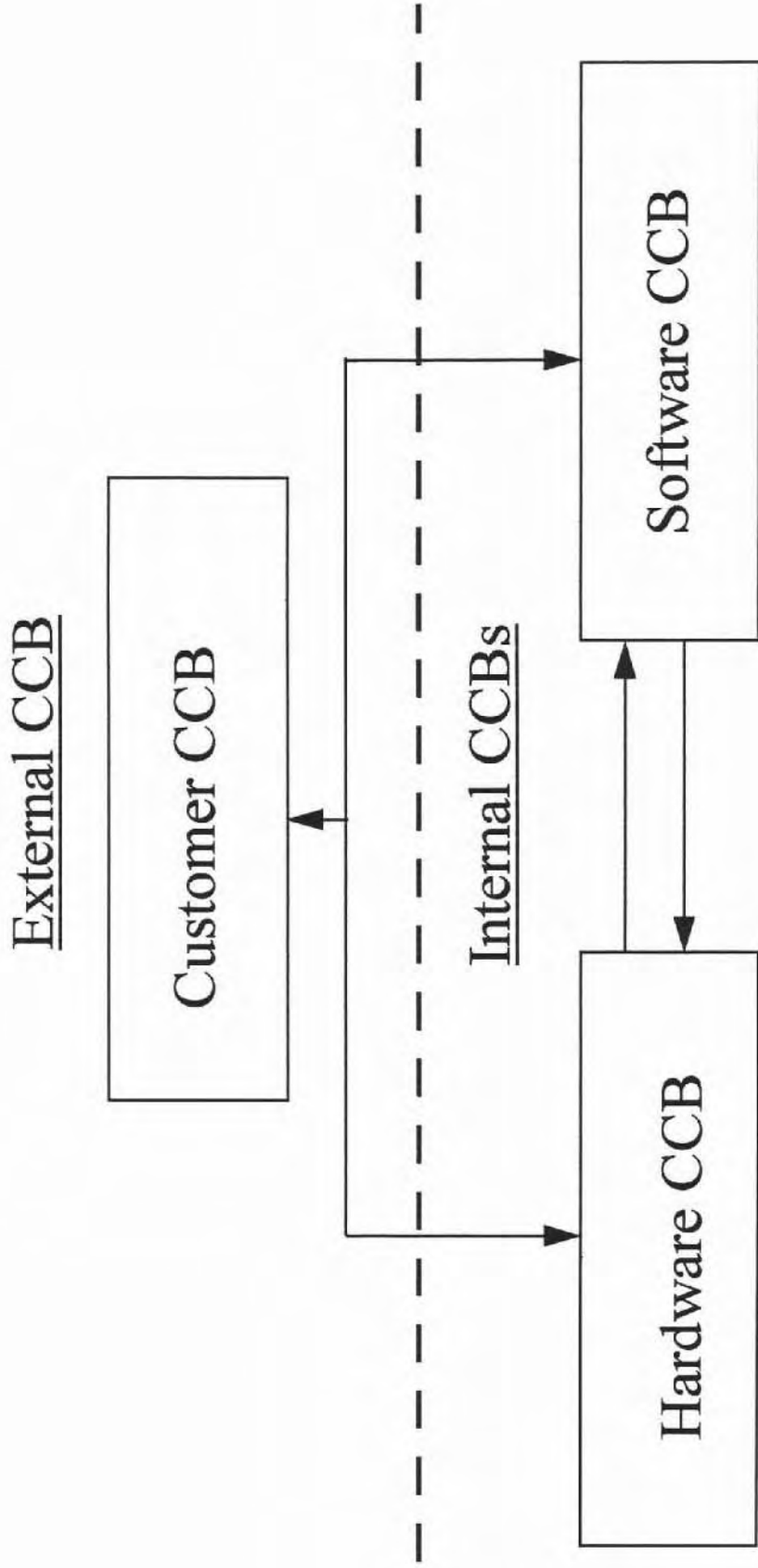
CCB Hierarchy

External CCB

Customer CCB

Internal CCBs

Software CCB

Hardware CCB

Figure 6

2.5 Problem Resolution

As mentioned in the preceding section, you must put a system in place to identify and resolve problems that occur during the production and support phases of your programs. Your Transition Team will identify and resolve problems that occur during the transition to production phase of your program.

These problems may be identified by designers, builders, users, and maintainers of your products. They may also be identified by your customers and suppliers. They can occur at any time and at any place. These problems must be dealt with in a timely manner to minimize risks and costs to your programs.

Figure 7 shows, at a high level, how a typical Problem Resolution Board (PRB) is integrated into a well organized engineering operation. Note that there are no limits as to the sources of the potential problems. Note also the feedback mechanism put in place for verification of corrective actions.

As you can see, a subset of the possible corrective actions is a recommended design change. This recommendation is passed on to the appropriate CCB (hardware or software) for disposition. It is not within the scope of the PRB's responsibilities to approve design changes, only to recommend them to the CCB.

Problem Resolution Board (PRB): A PRB should be established to identify and resolve problems which arise during the production and support phases of your programs. This board will take over the problem resolution responsibilities of your Transition Team as you move into full scale production.

Mission: The mission of your PRB will be to receive, evaluate, investigate, and dispose of problems that are identified to it. Your PRB will recommend design change activity where appropriate. It will solve problems directly if it can. It will document problem inputs and provide status and traceability information throughout the problem resolution process. It will report on the status of the problem resolution process to your management and to your customer as provided for in your company's internal procedures and as documented in your CM Plan.

Your PRB shall assure timely and effective closeout of all problems identified to it. It shall be responsible for the determination and consideration of technical, cost and schedule impacts to your programs.

Membership: Your PRB should be composed of the following membership:

1) Chairman: The chairman shall preside over the PRB meetings. He or she shall assure that the PRB process is conducted as specified in your company's CM Plan. and assure resolution of the issues brought before the PRB.

2) Administrator The administrator shall prepare and distribute the PRB meeting agenda (including a list of current action items and responsible presenters), record action items, generate and publish PRB meeting minutes, and maintain the PRB problem database. The administrator shall also assign an identification number for each reported problem.

3) Project Engineer: The PE shall be responsible for the evaluation of inputs to the PRB and the subsequent resolution and disposition of these problems from a technical perspective. He shall initiate design investigations as appropriate and shall monitor cost and schedule impacts. The PE often assumes the responsibilities of the Chairman.

4) Functional representatives: Representatives from the various functional organizations shall discuss the status of items they have been assigned by the PRB. They shall report on each topic under consideration by the PRB at the PRB meetings.

Process: The PRB process is illustrated in Figure 8.

1) Problems shall be identified to the PCB administrator by the originator, i.e., designers, builders, users, or maintainers of the product or equipment. The problem shall be documented on a Problem Reporting Sheet. See Figure 9.

2) The PRB administrator shall assign a number to the problem and initiate a case file. He or she shall enter the appropriate data (ex: product failure information) into the PRB database.

3) The administrator shall present the problem to the PRB at the meeting. Details shall be provided to the PRB by the individual(s) who identified the problem to the administrator.

4) The PRB shall evaluate the problem to determine that a problem actually exists and, if so, determine the appropriate steps to take to resolve the problem. The PRB shall also categorize the problem for future metrics evaluations.

5) The PRB shall either solve the problem directly at the initial meeting or assign actions to individuals to drive towards a solution of the problem.

6) The individual assigned responsibility for an action shall report on the status of his or her activities at each subsequent meeting of the PRB until the problem is resolved or until his or her part in the solution is completed.

7) When all actions have been completed, and the problem is resolved, the administrator shall document the findings of the PRB in the database and shall issue the results in the meeting minutes.

8) The PE shall follow up on all actions directed by the PRB. If a design change is recommended by the PRB, the PE shall communicate the necessary information to the appropriate CCB.

9) The administrator shall record all assigned action items in the PRB database in a "rolling" action item file, which he shall provide to the PE as a tool to utilize in the follow up on actions taken and closure status.

10) The PE shall provide feedback to the PRB regarding closure to all dispositions or recommendations issued by the PRB

The timely identification, evaluation and resolution of problems during the production and support phase of your programs will reduce costs and improve delivery schedules. Product performance and reliability will be enhanced, and you will maintain a good relationship with your customer.

Best Practice: Consider the problem resolution and disposition activity as the "front end" to your Change Control CM process. This will help you to cover all bases and assure that nothing "drops in the crack".
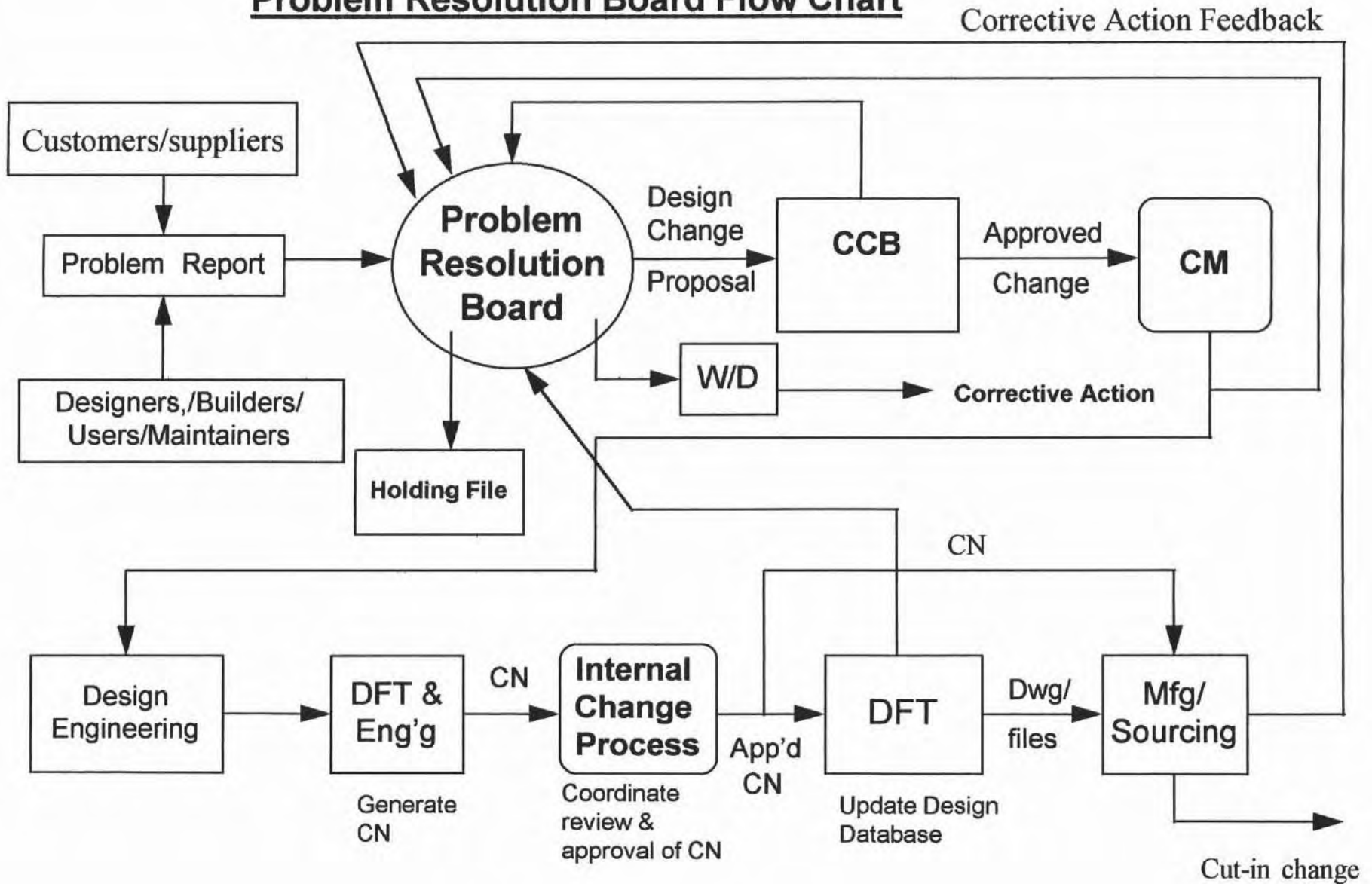
Problem Resolution Board Flow Chart

Corrective Action Feedback

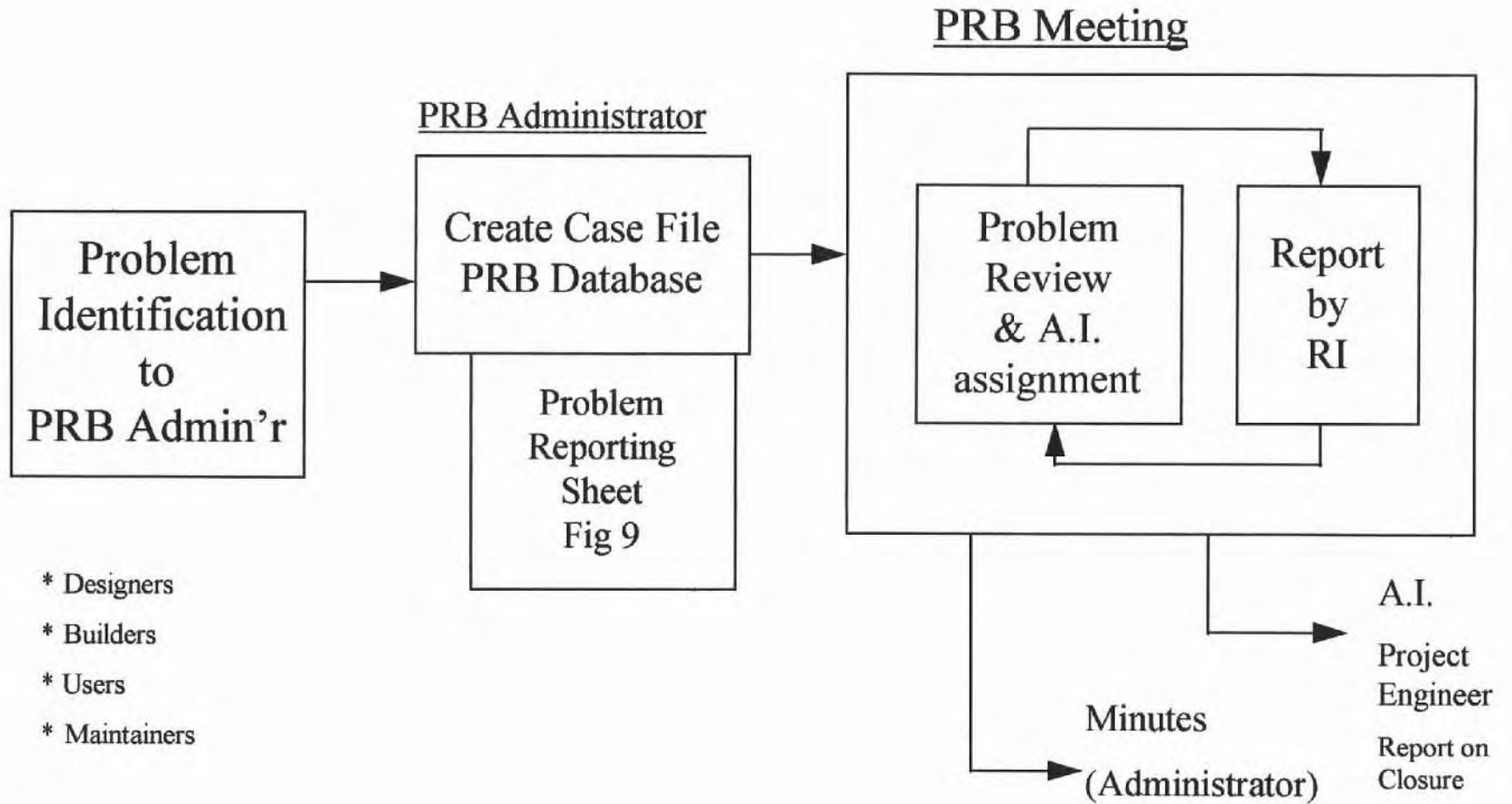Figure 7

PRB PROCESS FLOW CHART

PRB Meeting

PRB Administrator

Problem
Identification
to
PRB Admin'r

Create Case File
PRB Database

Problem
Reporting
Sheet
Fig 9

Problem
Review
& A.I.
assignment

Report
by
RI

* Designers
* Builders
* Users
* Maintainers

A.I.

Project
Engineer

Minutes

Report on
Closure

(Administrator)

Figure 8

Problem Reporting Sheet

PRB # _____   HW/SW/FW _____

Ref. Doc. # _____   Equipment _____

Problem Ident Source _____   Component _____

Presenter _____   Category _____

Problem _____

_____

_____

_____

Status/Action _____

_____

_____

_____

_____

_____

Close Out Action _____   Close Out Date _____

Close Out Approval _____

Figure 9

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2.6 Summary:

The following is a brief summary of the topics and key points presented in the PROCESS section of Practical Project. I am providing this summary to allow the reader to browse through it and decide whether or not he or she has absorbed the details sufficiently or to determine if a review of the detailed explanation for a particular topic is in order.

2.1 - Starting the Project:

* *Project planning:* The PE, with the support of the Program Manager, provides the stimulus and motivation to move the project from the "idea" stage to the "funded work" stage of the program. The PE coordinates the planning process.

* *Concept Design Review:* The desired outcome of the *Concept Design Review* is a firm, documented agreement among the attendees that the proposed product is viable and worth pursuing further.

* *PE Selection:* The PE is the "hub" around which the spokes of your business "wheels" revolve.

* *Project Proposal:* Establish a Proposal Team and conduct Proposal Team meetings.

* *Action Item List:* Assign specific action items to specific individuals and make sure that the action items are completed by a specific date. Drive action items to closure.

* *Project Schedule:* Create a "strawman" Project Schedule as early as possible.

* *Program Plan:* Document the results of your project planning activities in a Program Plan.

* *Negotiations:* Communicate - negotiate - compromise - document.

* *Presentations:* Conduct dry runs.

* *Submit Proposal:* Record and follow through on promises and agreements.

* *Program Plan Update:* Keep your Program Plan current.

* *Buy-In" - Internal:* Make sure that your internal personnel concur with your negotiated tasks, schedules and budgets.

* *Buy-In" - Customer:* Generate a Statement Of Work (SOW) and get your customer to sign it.

* *Preparations for Start of Contract Work:* Update your Project Schedule, Budgets, SOW, and Program Plan.

Orientation Meetings: Communicate - communicate - communicate!

2.2 Development:

Project Team: Put together a Project Team to help you plan and execute your project tasks. Select "hands-on" personnel as your Project Team members.

Design Reviews: Design Reviews are the means by which you will measure the success of your development effort at specific points in your design process.. At each Design Review, you should expect a certain (pre-defined) amount of "goodness" in the design.

Design Review #1: This event is the start of the detailed design process (Designer State). Your Functional Baseline, i.e., system level specification, is established at Design Review #1.

Design Review #2: This event is the start of the final design activity and the prototype build activity, and/or analytical prototyping activity (Design Internal State). These first two states are referred to as the "Work In Process" (WIP) states.

Design Review #3: This event is the start of the design evaluation and material procurement activities (Formal Internal State). You will conduct tests to prove that your design meets your system level functional requirements (FCA), i.e., your design works. Formal configuration control of your design data (via internal CCB) is initiated. The successful completion of Design Review #3 establishes your Development Baseline.

Design Review #4: Design Review #4 is the start of the "External" State where you will prove that you can build production units that comply with your Engineering drawings (PCA). Your Product Baseline is thereby established.

These last two states are known as the "Released" states.

2.3 Transition to Production:

Transition Period: The transition period lasts for the duration of the last two states, i.e., the "Released" states.

Transition Team: Establish a Transition Team, comprised of representatives from your "hands-on" Manufacturing and Quality Assurance personnel in addition to selected members of your Project Team.

Transition Team Meetings: Hold Transition Team meetings on a frequent, regular basis. They should last about one hour, with splinter meetings as required.

* *Action Item List:* Maintain an Action Item list for your Transition Team meetings and tasks utilizing the same methodology you employed for your Project Team meeting Action Item list.

* *Database Verification:* Verify that the data in your Configuration Management, Engineering, Manufacturing, and Sourcing databases are in agreement.

* *Release to Production:* You will formally "release" to your Manufacturing operation your approved Engineering design data.

* *Material Procurement:* Meet with your outside suppliers and vendors. Establish good relationships. Verify acceptance of your design change approval process and non-conforming material disposition process with your customer.

* *Customer Involvement:* Strike a sensible balance between your customer involvement in your design change process and his involvement in your Design Review activities. Make him feel like he is part of your team but don't let him slow down your coordination and control activities.

* *Lessons Learned:* Document "lessons learned" during your Transition to Production period.

* *FCA/PCA:* Conduct as much FCA/PCA as is appropriate to both your pocketbook and your need for traceability information.. Remember that you have to make a tradeoff between the benefits of information gathered and cost.

* *Authentication:* Obtain your customer's signature on a "Certification" form, where he acknowledges satisfactory completion of your FCA/PCA (if applicable).

* *Schedule:* Update your Project Schedule.

2.4 Production and Support:

* *CM Plan:* Generate a CM Plan for your project, based upon the Appendix B Templates and the Appendix E guidelines.

* *Configuration Control Boards (CCB):* Establish hardware and software CCBs.

* *Major Design Changes:* A Major design change is required to make a product comply with its design requirements and/or to maintain interchangeability, i.e., form, fit or function is affected.

* *Material Review Board (MRB):* Your MRB will assure the proper disposition of non-conforming material.

* *Configuration Verification Audits (CVA):* CVAs will capture CM data and serve as a cross-check on the production cut-in of Major design changes.

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Automatic CM: The implementation of a Product Data Management (PDM) system within your business will increase control, visibility, flexibility, and producibility while reducing risk, cost and time required for the development and production of your products.

2.5 Problem Resolution:

Problem Resolution Board (PRB): Your PRB will serve as the vehicle for the identification, investigation and resolution of problems that arise during the transition to production, production and support phases of your program.

Mission: The mission of your PRB is to receive, evaluate, investigate, and dispose of problems that are identified to it.

Membership: The key members of your PRB are the chairperson, an administrator, functional representatives, support personnel, and the PE.

Process: Refer to Figures 7, 8 and 9.

Part 3 - The Tools:

Introduction: In Part 2, we looked at the various processes employed in a typical program or project and discussed the role of the PE in planning, coordinating and controlling these processes. In Part 3, we will examine the tools that you, the PE, have at your disposal to assist you in the accomplishment of your project goals.

I have touched briefly on several of these tools in the course of examining the processes that you will be planning, coordinating and controlling. In the following paragraphs, I will describe these tools in more detail and elaborate upon their use.

Project Teams: The concept of teams has been around for a long time. I believe that there exists both "natural' applications for teaming and "unnatural" forcing of the teaming concept in inappropriate situations. We will look at examples of both cases.

The "natural" and beneficial use of the team concept is exemplified in the following team circumstances, which we have already addressed to some degree:

* Proposal Team
* Project Team
* Transition Team
* Material Review Board and Material Review Team
* Configuration Control Board
* Problem Resolution Board

The value of these teams and boards (same as teams in many respects) may be obvious but I will talk about it, anyway. I believe that some degree of overkill is better than missing an important point altogether.

Each team member brings to the table his or her unique skills and experiences which he shares with the other team members. I once worked for a Program Manager who had a saying that "everyone has their own view of the elephant", i.e., how you see the elephant varies mightily depending on who and what you are. The mouse fears it. The tiger sees it as a potential meal. The eagle has another view. It's all a matter of perspective. During the conduct of team meetings, the value of these different points of view, both for technical and non-technical reasons, is obvious.

You will need to depend upon your teams. They have the unique "how-to" knowledge and the "lessons learned" experience that will prove to be invaluable as you move your project towards a successful conclusion.

It is essential that your team members' roles and responsibilities be clearly articulated, understood and agreed upon. Each team member must accept and express his "ownership" of the process and his place in it. You must demand this "buy-in" from each and every team member, regardless of the overall function of the team. With clearly defined leadership and clearly defined member roles and responsibilities, you will have a smoothly running "team machine". Without it, you will have anarchy and chaos.

Maintain close working relationships with your team members. Don't wait to see them only at team meetings, even if those meetings are held on a daily basis. Visit them in their work areas. As the PE, your best work will be done away from your desk or office.

Move around. Communicate directly with your team members as well as others working on your project. Few things please a dedicated worker more than being visited by the project leader to discuss problems and work plans. It's the little things that count. I don't remember where I heard the following paraphrased quotation but it has always worked for me: "Praise them for a job well done before their sweat dries." I sincerely believe in this admonition. It's not enough to add a nice note to someone's appraisal, assuming that you will be asked for comments by the employee's manager at a later date. People need to hear that their efforts are appreciated, and they need to hear it right away. The payback to you and your project is well worth the time it takes to acknowledge a job well done. I have worked for managers who never took the time to thank me but always found the time to criticize: "How could you have let this happen?" You won't find the names of these bozos on the Acknowledgment page of this or any of my books. I did my job in spite of these small-minded people and thanked God when they (or I) moved on to different pastures. Please keep these thoughts in mind. Even if you aren't paid back in kind, you will be doing the right thing, and that should count for a significant part of the satisfaction you will receive from doing your job as the PE.

It's time now for a few words on the topic of "unnatural" teams. I expect that some of my readers have already been exposed to this type of anomaly - not too many, I hope.

Back in the early 90s, I had the misfortune to work for a manager who thought that the concept of teaming (at that time recently introduced to US businesses by the Japanese), was a great idea for all business functional organizations. One day, this manager gathered our Engineering lead personnel together in a room and gave us a mandate to "go forth and turn your groups and units into teams!" There was no information forthcoming on exactly how to do this, just a vague direction to go off and make it happen. We were instructed to let these new teams decide (by

consensus) how to plan and execute our Engineering tasks. We were also told to report back to management periodically on our progress. NOTE: These "teaming" status meetings later evolved into horror shows from their own negative message momentum.

You can imagine the confusion. As time went by, the confusion increased and was supplemented by despair and frustration. The morale of the truly dedicated folks in the organization plummeted. You see, as it worked out, the individuals in our teams who were the most inappropriate to make business decisions, often had the loudest voices (encouraged by our ambitious manager) and replaced the sound judgment of experienced lead personnel with silly ideas and inappropriate initiatives. A considerable amount of "ax grinding" also took place. This was their chance to "get even".

It took almost two years for upper management (several of whom were replaced as a result of lost contracts and other misfortunes visited upon us by this insanity) to correct the situation. In the meantime, careers were damaged or destroyed, and the business suffered.

You might say: "Why did it take so long to fix this problem?" In hindsight, the answer is simple. It's pretty obvious that there are some situations where "teaming" is inappropriate:

* Surgical Team - Who would want the nurse performing the operation instead of the brain surgeon?

* Orchestra - By the time each musician gets around to learning how to play all the other instruments, he would be too old to find his way to the recital hall.

* Others - many

There are other cases where teaming is not only appropriate, but totally justified:

* Manufacturing operations, i.e., engine assembly, where team members can learn each other's jobs and can support and substitute for each other.

* Service jobs,. i.e., fast food operations.

* Others - many

The task for all of us is to evaluate the various work environments which may be candidates for teaming in order to determine which candidates fall into categories where specialized skills, education and experience make it inappropriate for one person to attempt to do another's work.

You probably won't have to worry about this problem during your career as a PE. The teams described herein will be all you need to do your job in most cases. If additional teams are required for a specific job, just use your common sense and follow the basics presented herein. Also, most US businesses have, by now, learned their lesson about the wonders of "teaming" the hard way.

Best Practice: Rely upon the support of your Project Team members and give them your support. Work closely with them. Trust them. Work on enhancing your credibility with them.

Presentations: You will make many presentations during your career as a PE:

* Internal - orientation meetings, project status meetings, team meetings, demonstrations, person-to person discussions, hands-on training meetings, board meetings.

* External (customers and suppliers) - formal and informal meetings at his or your location

You will most likely utilize slides or vu-graphs during your presentations. During my career in industry and during national seminars which I presented this past year, I relied primarily upon vu-graphs for my presentation material. I have learned the following DO's and DON'Ts over the years through direct experience.

* DO - Keep your vu-graphs simple and un-cluttered. Put only enough information on them to serve as "brain ticklers" for yourself. Provide information to your audience by speaking directly to them.

* DO - Know your material. Don't just make statements. Explain the points you are trying to make. Provide examples. Talk enthusiastically about your topic. Your audience is there to gain the benefits of your knowledge and experience. Give it to them.

* DO - Encourage audience participation Your presentations will be a success if you have a good deal of "back and forth" discussion. Walk among your audience every now and then. Ask attendees if they understand the points you are trying to make.

* DO - Be enthusiastic. No one likes a lukewarm speaker. If you aren't excited about your subject, your audience certainly won't be.

* DO - Be honest and truthful - always. I could go on for several paragraphs about this recommendation. Suffice it to say that your audience will appreciate it, and you won't find yourself in a world of trouble trying to explain your way out of a lie or half-truth.

* DO - Give your audience and yourself frequent breaks. Increased audience attention will result, and you can give your voice a chance to recover.

* DO - Speak often. Take advantage of every opportunity to make a presentation. Speaking will become second nature sooner than you think.

* DON'T - Read your vu-graphs to your audience. If you have to do this, then why does your audience need you to be present at all? They could read the vu-graphs themselves.

* DON'T - Worry about making mistakes. Anyone who does a lot makes mistakes. Those who do nothing makes no mistakes. If, however, you do make a mistake, acknowledge it loud and clear as soon as you are aware of it.

* DON'T - Worry about criticism. You can't satisfy all the people all the time.

* DON'T - Be nervous. If you get upset, find something you can use as a "trick" to re-start your mind on a calm course. I say "OK" out loud or think "re-initiate". It usually settles me down. Slow down your presentation speed for awhile. Speak deliberately. Take pauses. Think of something pleasant. There are many ways to trick your brain into thinking it's relaxed. Experiment! You will find out what works best for you.

*DON'T - Worry about your appearance. Dress neat and be clean. Other than that, your only influence about how you come across is how you act and how well you articulate your subject.

* DON'T worry about any single person's reaction. Remember, you can control yourself but you can't control what anyone else thinks, says or does.

* DON'T drink soda before or during your presentation. It will cause you to become hoarse. Drink water, tea or coffee, instead.

Best Practice: Give your presentations with enthusiasm and confidence. Don't worry!

Action item list: Your action item list is one of your most powerful tools. It provides both visibility and leverage to support you in your goal of *__driving tasks to completion__*. This is extremely important. Your success or failure as a PE is directly related to your ability to get things done.

As mentioned earlier in this book, one of your major duties is to assign a task to a specific individual and get him to accept ownership both for the task and for the due date. You must be

adamant about NOT slipping due dates. Exceptions certainly exist but they must not become the norm.

Absolutely NEVER replace the original due date on your action item list with a revised date. This (common) practice undermines the whole concept of the action item list as a control vehicle. If necessary, you can ADD a new, revised date (on an exception basis) but never delete the original date.

Review your action item list at your Project and Transition Team meetings. Carry it with you when you walk around to personally visit your team members or anyone working on your project. Let your people know that you mean business, and that you will not accept excuses for late task completion unless the conditions are extraordinary.

I know this is not easy to do. "Stuff" happens, and legitimate explanations will be proffered by the people who are working on your project when they are in trouble, either as a result of their own failings or because of some external event. Listen patiently and encourage them to do their best to accomplish their task(s) but don't let them think that they have gotten away with anything. Always make a point of discussing late completion of tasks with the offender in person *and* at your team meetings. Name names. Keep it light but serious. You don't want folks to come to hate you. I believe that a mix of humor and serious discussion works best if you can manage it. I was never too good at this (I can't tell a joke) but I have seen it work very well for others. In either case, you will be OK if you are honest and treat people fairly. Always go out of your way to be fair to people. Your credibility will shoot up to an impressive level and stay there if you are fair, honest and above-board with people. I have never seen an exception to this claim.

If you find that you have an individual who is regularly completing his tasks late, then discuss the problem with him, one-on-one. If that doesn't work, then discuss it with him in the presence of his manager. Remember, you are not being a "bad guy". You are just doing your job!

I must admit that this part of my duties as a PE bothered me for quite some time. I finally got to the point where I would say to myself: "I'm just doing my job" on my way to one of these confrontations. We have to do whatever it takes to "get the job done".

You must build your credibility in the eyes of your project personnel. People will get to know you and how you do your job. They will come to expect the demands you place upon them There is no reason for failure if you dedicate yourself to your task and utilize the processes, tools and approaches presented in this book.

Let's talk a little about the mechanics of your action item list. Please refer back to Figure 1. You can add, modify or delete data (except for the original due date) as you wish, as long as you

capture the basic task, assignee and due date information which we have already discussed. Distribute this list to everyone who is specified on it with a task to complete. I highly recommend electronic distribution (e-mail). However, use paper if necessary. Distribute it also to an appropriate selection of management personnel. They need it to maintain visibility into the status of your project and also, to see how their people are performing. They can, as mentioned above, help you to obtain maximum productivity from personnel for whom they are responsible.

Keep your list up-to-date. You will have to decide for yourself what is reasonable in this area. I used to mark up my action item list on a daily (sometimes hourly) basis, then update my database weekly. I would distribute these weekly updates. You can figure out what's appropriate for your project and your people. This is definitely not a case where "one size fits all".

From the tenor of the above paragraphs you will hopefully have realized by now that it is very important to accurately assess the time required for each task on your action item list. You don't want to hand out impossible assignments, yet you DO want to accomplish theses tasks in an expeditious fashion. Many tasks lie along a critical path, i.e., the successful completion of one task is a prerequisite for the start of another task. Therefore, if action item tasks aren't driven to completion as planned, your project (and you) will bear the heavy burden of failure.

Best Practice: Make your Action Item lists comprehensive and detailed. Follow up on task status diligently. Drive tasks to completion.

Schedules: Whereas your action item list is *one* of your most important tools, your Project Schedule is *your singularly most important tool.* Refer to Figure 3. Your internal and external schedule milestone completion successes are the source of your bread and butter. Meet these milestones within budget with a product that works and is reliable, and you will have a happy customer. He will want to come back with more business for your company.

I recommend that you generate and maintain your Project Schedule using a good computer scheduling tool. Although it may be inappropriate for me to recommend a specific vendor's tool, I don't see any problem in telling you that I use and like the MicroSoft Project application. I have used other scheduling tools in the past but I have found them to be difficult to master and awkward to use. MS Project is easy to learn and use, and it has the capabilities to do everything I have needed to do as a PE. NOTE: A separate topic on Project Management Software tools is provided later in this section.

You should update your Project Schedule at least as frequently as you do your action item list. There will, of course, be some overlap of tasks on each document but your action item list will

tend to contain more of the day-to-day detailed tasks plus the name of the person on the hook for completion of each task.

Distribute your Project Schedule via your e-mail list or post it on your electronic project bulletin board. If you are still operating in the old world of paper, then you should start an initiative to get your antiquated business resources upgraded, so that you can compete in today's marketplace using computerized systems.

Your Project Schedule should contain most of the items shown in Figure 3. It should also clearly indicate the "critical path", i.e., where the successful completion of one task is a prerequisite for the start of another task. Most project scheduler applications will determine the critical path for you automatically. They will also allow you to re-plan your tasks to optimize your resource allocation. Many tasks can and must be run in parallel in order to meet the challenges of today's tight product development and "time-to-market" demands.

Scheduling your project is an iterative process. Keep at it until your schedule "works", and you are able to achieve "buy-in" both from your internal personnel and from your customer. Keep your Project Schedule fine-tuned as your project evolves. As in the case of your action item list, never delete or overwrite your original (approved) schedule dates. The project scheduling tools available today will allow you to show slipped or intentionally modified schedule dates while preserving your original "baselined" schedule. You will also be able to indicate percent completion at any given time.

You can decide for yourself how much of the functionality of your project scheduling tool is appropriate for your project. For simple projects utilizing a limited number of personnel, you may justifiably elect to use only the event scheduling functionality of your scheduling tool. For large, complex project you may decide that you need the resource allocation functionality, lag and lead times, report generation, and dependency functionality. There are several very powerful scheduling tools available. I recommend that you talk to other PEs whom you know and ask them what scheduling tools they use and like.

Best Practice: Plan your schedules carefully with the support of all participating personnel. Make them comprehensive and detailed. Keep your schedules up-to-date.

Budgets: Firm and efficient financial control is a cornerstone of responsible project management. Businesses vary in the degree to which financial responsibility is vested in the Project Engineer. The Program Engineer (if you have one - see Part 5) and the Program Manager usually control financial activities. The Program Manager is, of course, ultimately responsible for all facets of the program. However, some organizations have only one individual responsible for

all aspects of "running the show", i.e., performance, schedule and cost. For the purposes of this discussion, I will assume that financial control of the Engineering organization is the responsibility of the Project Engineer, in addition to his normal responsibilities in the technical coordination and control areas.

You should start capturing budgetary estimates from your functional organizations at the very beginning of the proposal activity. Fine tune and finalize these budgetary estimates as the proposal negotiation process evolves and assure that you have "buy-in" for your numbers by all concerned at the completion of contract negotiations, as discussed in Part 2.

Publish your budget and actual expenditures data to the same folks who normally receive your Project Schedule updates. Establish a computerized database to capture, process and report upon both "planned" budgets and "actual" expenditures.

Discuss your financial performance at your regular Project Team meetings. Also, conduct periodic Project Reviews (monthly is good) during which you discuss financial performance. Invite your Program Manager plus your middle and upper management to these Project Reviews.

Monitor your budget versus actuals data constantly, and "jump all over" anyone who exceeds his or his organization's budgets. Don't forget to praise the folks who do well. There will be exceptions to the adequacy of your original estimated and negotiated numbers but these should be few and far between. Remember that there is only so much water in the well, unless you are working on a cost recovery contract (few of those still exist) or have negotiated a " contingency fund" (lots of luck in getting one of those). When your negotiated funding runs out, you will have to start digging into profits to fund your project, and that situation is "anathema"!

Incidentally, it is wise and appropriate to add a small contingency percentage to each of your individual functional area budgets before you begin your contract negotiations if you think you can do this and still win your contract. Chances are you will lose most, if not all, of your contingency funding during contract negotiations.

Best Practice: Plan your budgets carefully with the support of all project participants. Make your budgets detailed and comprehensive. Keep your "budget versus actuals" data up-to-date.

Meetings: You can utilize the meeting environment for a variety of productive purposes. The team meetings we discussed earlier in this section fall into one category of meetings. You also have Design Reviews, project status meetings (with all levels of personnel - both internal and external), event readiness meetings, disaster recovery meetings, financial planning meetings,

orientation and training meetings, and on and on, ad infinitum. You name it, and someone will find a reason to hold a meeting (or not).

Actually, the last two words of the preceding paragraph are quite important. Don't call a meeting just for the sake of continuing an established activity or if there is a more expeditious way to get the job done. Remember the cost of utilizing the time of project personnel that would normally be spent working on some other facet of your project. This comment may seem obvious and even silly but, I'm sorry to say, this is exactly what often happens unless your PE "guardian angel" is helping you watch over your project. For example:

* Problem Resolution Boards - These meetings may eventually reach the point in your program where the participants are only following events rather than being pro-active, solving problems through early detection, sound analysis, speedy execution, and driving tasks to completion. The old "Corrective Action Committees" (CAC) often became infamous for being typical of this phenomena, i.e., they met on the same day of the month just to gather enough material to generate a report to justify their existence. This is one of the reasons I named my problem solving team a "Problem Resolution Board". It helped to erase the stigma of the dubious "CAC" moniker.

* Configuration Control Boards - The time may (and should) come where, in most cases, actual meetings become unnecessary. Change proposals can be reviewed using virtual on-line CCBs, supported by Product Data Manager (PDM) system automated electronic change package routing techniques.

* Material Review Boards - Same scenario as CCBs.

There are, however, many cases where calling a meeting (other than your regular team or board meetings) may be the best way to get your key personnel together to react to an unprecedented event or to plan a strategy for the solution of a critical problem. The meeting atmosphere is particularly beneficial for inducing spontaneous input by skilled and experienced personnel. For example, say that Joe (Engineer) has an idea for a redesigned part to solve a problem. Mike (Manufacturing) says it can be built for reasonable costs, and Sam (Quality Assurance) sees no problem meeting contractual or internal inspection and test requirements. However, Pete (Field Service) advises everyone that the proposed solution will produce a part that, even though it will work in the tactical hardware, won't fit in the Trainer at San Diego. This spontaneous "back and forth" exchange of specialized information is one of the most important reasons for holding meetings. Please don't underestimate its value.

Best Practice: Hold meetings when necessary and beneficial to the conduct of your project. Don't hold meetings just to continue an established pattern of activity.

Questions: " There is no such thing as a stupid question!" I don't know who originally said that but I do know that he was right on target. Here's another valuable piece of advice: " The only dumb question is the unasked question!" I wish I knew the author's name, so that I could give him proper credit for these insightful statements. The older I get, the more I realize the truth of these sayings. When I was a boy in school (back before there was color in the world), I would rather die than ask a stupid question - in school or out. As children, our fear of rejection, put-down or peer persecution has a pretty effective way of discouraging us from asking questions when we don't already have at least some idea of what the answer is. Dumb! - isn't it? Well that's what happens, and the longer it takes for us to get rid of these childish irrational tendencies towards being shy, the longer our careers and our lives will suffer.

Questions provide the answers that are the life blood of the PE. No one ever knows all the answers but if you constantly ask questions, you are heading in the right direction to find the answers that you need to do your job. Aristotle taught his students by asking questions. This teaching method caused his students to think. In Aristotle's case, the students were the beneficiary of the Question and Answer (Q&A) process. Both you and your business will profit from this process. You will receive the information you need to keep your project moving forward, and your people will be forced to think in order to provide accurate answers.

At some point in my career (about 25 years ago, I think), I started to ask questions fearlessly - both good questions plus lots of not-so-good questions. Sometimes I realized that the question was (in my mind) dumb even before I had fully articulated it. That's OK, though. Even when I thought I had asked a dumb question or if I thought I already knew the answer and was only looking for confirmation, I usually became the recipient of valuable additional information. You never know what information you will receive until you ask the question. Continue to ask questions, and you will come out ahead of the game. Don't do it, and you will inevitably miss out on some bit of information vital to the success of your task or project.

Answers to questions fill in gaps in your knowledge database. The more data you have available, the better prepared you will be to make the decisions that will drive your project down the road to success.

Best Practice: Ask questions. Don't worry about exposing your lack of knowledge in any particular area. Don't worry that your question may appear stupid. The only stupid question is the question not asked.

Businesses Processes: Take advantage of your business processes to aid you in coordinating and managing your project. Your Engineering methodologies, Manufacturing and Quality

Assurance systems and processes, Information Systems capabilities and procedures, Configuration Management systems and processes, Program Management interfaces, and Product Support systems all add up to a mighty resource for you to utilize.

Consider all of these business processes during the planning and execution phases of your project. If you take full advantage of the resources which you have at your command, you will reduce your project risks and enhance your chances of success. Take the time to become familiar with these processes. You should do this during the proposal phase of your project when you are collecting inputs from your functional organization personnel. Talk to the folks who use these processes on a daily basis. Have them explain in excruciating detail the content of the tasks they are quoting and the purpose of each activity. The more you understand about your company's processes, the better will be the Program Plan that you and your Project Team generate, and the greater your chances for a successful project.

I recommend that you take the time to "storyboard" your business processes during the planning phase of your project. First, establish an appropriate working space for your Proposal Team to storyboard your business processes, troubleshoot problems, discuss issues and concerns, and report on progress. I recommend a 20 X 40 foot room, equipped with corkboard walls, vu-graph screen, PCs, workstations, telephones, tables, and chairs. Call it your "Project Center" or some such thing.

You should start by conducting "storyboard" sessions for all of your business processes. Call in the actual "do-ers" for specific tasks. Involve management and functional "lead" personnel as appropriate. Have the "do-ers" write down each step in a process on a card and pin the card on a corkboard in your Project Center. Don't criticize any input. Just pin up all of the cards with activities and actions written on them. You can reorganize and delete individual inputs later, as you discuss among yourselves the steps in the various processes.

Identify and examine each step of each process in excruciating detail. The time you spend doing this up front will preclude many "repairs" to your processes down the line. This is the time to thoroughly understand your current processes and to fix problems as they are identified. You have the opportunity here to "tweak" your processes so that you establish the "best practices" for your business. Please remember that your project will run no better than the basic processes which you put in place. Make sure that you obtain "buy-in" from all participants in this activity.

Best Practice: Understand your business processes and then fine tune them.

Internal Procedures: In order to train your personnel and to enforce a standardized way of conducting your business operations, you must have well documented internal procedures. You

should document the results of your process storyboard sessions on flow charts and include these flowcharts in your internal procedures.

In the "good (?) old days" of the seventies and eighties, when many businesses lived off government contracts which incorporated "cost plus" contracts, a lot of companies had the luxury of employing enough people to assure that "someone" would have enough of the "nitty gritty" information required to get things done during the normal operating scenario plus know enough about business process details (who does what and when) to "cover all the bases" when a critical situation arose.

Times have changed, and most businesses that survived the "merge mania" scythe of the late 80's and early 90's have recognized the value of properly documented procedures as a first line of defense against the loss of key personnel. The documentation of business processes is a time consuming and tedious process. Attention to detail is absolutely necessary. Drafts of business processes must be generated, and then you must verify these draft procedures in a step-by-step fashion until you get it right.

I recommend that you generate a "mini-project plan" for the generation, review, update, and publication of your internal procedures. These documents should be initially drafted by the "do-ers" in your organization. They are the only folks who know firsthand the step-by-step procedures for the accomplishment of any task. Once you have a draft in hand, then you should assign a point of contact (POC) to coordinate the editing, update and secondary review of your internal procedure drafts. This coordination effort is no mean task. It requires time and patience plus attention to detail. Many large businesses have a Technical Publications staff from which you might draw to accomplish this task.

A comprehensive review cycle should be initiated upon receipt of the draft material by your POC. He must assure that comments are not "dropped in the crack" and that the schedule for conducting these reviews is met. You should hold regular meetings with your POC to assure that activities stay on schedule and that discrepancies and disagreements are resolved in an expeditious manner.

I also recommend that your POC assures that an independent verification of the final version of your internal procedures be conducted after all comments have been incorporated and after the final edit operation is completed. Many times, the "do-er" who initially generated the draft procedure is so familiar with a specific task that he may omit simple steps in the procedure since they are second nature to him, i.e., hitting the "return" key after inputting data into a computer. A conscientious step-by-step run through of each procedure will catch these inadvertent omissions.

You will need to establish a system for the capture and control of your internal procedures once they have been approved. Your PDM system (better get one if you don't already have it) is ideal for this purpose. Your procedures will (hopefully) be computer generated. The resulting files must be captured and controlled, i.e., baselined and stored in access controlled electronic vaults.

NOTE: It's important to point out once again that your "master" document is your computer file, not a piece of paper, as in the old world. You can generate or plot paper copies for people to use in the course of performing their jobs but be sure that you and everyone else in your organization is fully aware that your document "master" is the electronic file. It is this file that you must capture and control access to for future updates to your internal procedures.

Don't try to document all of your internal procedures at once. I have mentioned the use of a "mini project plan" for this activity. If you plan this documentation project well and carefully prioritize the generation of your internal procedures, creating the documents that will have the most beneficial use first, you can accomplish your task over time using less resources and allowing sufficient time for adequate checkout of the documentation.

Best Practice: Document your internal procedures if they don't already exist. Use an independent function (person) to thoroughly check out your new procedures. Control changes to your procedures after they are approved.

Computer Systems: We are fortunate during the present era in our business environment that we have at our command a powerful suite of computer hardware and software solutions for almost any project. One of the single greatest time savers is e-mail. You can not only exchange messages faster but you can also post reports, schedules and their updates, meeting notices, plans and procedures, design review comments, and virtually any business information.

Personal contact is still the most vital element of project management, however. You need that eye-to-eye contact to inspire people to perform at their best. Avoid all temptation to utilize the "virtual workplace" concept to de-humanize your business operations. It just won't work.

You should, however, take full advantage of the computer systems and software applications available on the market today and in the future to optimize your job performance and business activities, i.e., project scheduling tools, presentation and publication tools, word processors, spread sheets, databases, and PDM systems. I think it may be appropriate at this point to say a few words about PDM systems.

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I'm using the term PDM to refer to a system used to capture and control product data in an electronic format and to make those data available to all who need to use or observe them. This includes capture and control of design data (native CAD and neutral files), quality assurance data, manufacturing data, and any other data that would be needed to design, test, build, modify, deliver, and maintain a product - either hardware or software.

The heart of this system is a software application which, in conjunction with third party tools (image file view & markup tools, file format conversion tools), provides the functionality required to implement and integrate the PDM system within any given business.

The PDM system can readily be expanded to include the capture and control of other data, such as internal procedures (as mentioned above), contract data, proposals, etc. It would then be referred to as an Enterprise Data Manager (EDM).

In the past, designs were captured on mylar and paper drawings. In the general case, designs being generated now and in the future are and will be generated on Computer Aided Design (CAD) systems. The design master is no longer the paper drawing. It's the actual physical design files, including the models, part and symbol libraries and associations (files), plus the metadata that describes these design files. The need therefore arises to capture and control these physical design files in order to capture and control design baselines and to be in a position to incorporate approved design changes now and in the future. The PDM tool performs these functions.

The use of these computerized tools, in conjunction with your "people skills", will help you to accomplish your PE duties and to assure the success of your project.

Best Practice: Take full advantage of your computer resources and all available design/office tools. Install a PDM system in your business if you don't already have one.

Project Management Software Tools: Project Management software tools have been around for a long time. Back in the 60's and 70's, there was a tool called PERT. The PERT Chart consisted of several rows of "bubbles" (each bubble was a specific task) interlinked by lines (paths) which were either connected in parallel or in series. You tried to identify the "critical path", so you could see the order in which each task had to be accomplished. Sounds pretty good so far, eh?

Well, the problem was that the process for updating the PERT Chart was time consuming and tedious. Usually, a single individual in the Information Services organization of a business was assigned the duty of being the PERT program "czar", and as such was forced to become familiar with the idiosyncrasies of the PERT program and to make changes to that program as necessary.

PERT Chart change requests (forms, markups) were provided to the PERT "czar" who then converted the information into data that the program could understand. He would then run the program at the appropriate time. For our company, I think that time was each Tuesday at 1:00 AM if the moon was full.

Some Program Managers even went to the extent of limiting the use of the computer-generated PERT Charts for inclusion in the initial Contract Proposal only. They then directed that updates to the PERT Chart be made by hand as their programs evolved. I can remember one time back in the late 60's when I spent an entire three day holiday weekend working alone at a drafting board on the complete re-do of our Program level PERT Chart. Our Program Manager had decided that it would be easier to redraw the chart by hand than to update the computer program, which by then had a zillion "patches" in it that only our PERT "czar" understood. I had to draw all those little rectangular boxes, add curves to the corners, and then fill in the words describing the tasks (OOPS - got to erase that box and redraw it - not big enough to contain all the words). Good Grief!

Well we've come a long way since those sad days. Today's offerings in the Project Management software arena are a "giant leap forward for "PE-kind". Now, we can sit down at our PC's and create our Project Schedules by defining goals, specifying detailed tasks (input directly into a table or via a "wizard") and resources (personnel, hours, equipment, etc.) and by then linking the tasks together to form the appropriate interdependencies and relationships with a click of the "mouse". Critical paths are automatically defined. Notes can easily be added for clarification purposes.

Resource leveling is supported by some programs. The functionality for e-mail notification of Project Schedule updates and other information such as task execution direction can also be implemented. Web based interfaces have been directly incorporated into the tool by some vendors. We can now get the "right data to the right people at the right time".

Once your Project Schedule is created, you can easily monitor project progress by tracking task, schedule and resource performance. "Percentage complete" information can be input to the program by either yourself or by the performing functional level personnel.

Training in the use of these Project Management software packages is either provided on-line or is available from separate training materials or courses. The learning curve for these tools is short, and the user interfaces are friendly. There have been drastic improvements in this regard in the past few years.

There are several good Project Management software tools available. I used the "MicroSoft Project" tool to create the Project Schedule example shown in Figure 3. The following is a list of

some currently available Project Management tools as presented in the December, 1998 issue of "Internet Business" magazine:

* MicroSoft Project 98
* Computer Associates SuperProject/Net
* Scitor's Project Scheduler 7
* Time Line Solution's Time Line 6.5
* Primavera System's SureTrak Project Manager 2.0
* IMSI's TurboProject

To summarize, your tasks of planning, documenting and monitoring your project tasks, schedules, action item lists, as well as allocating your resources and managing your budgets can be greatly simplified though the use of these great new Project Management tools. They will only get better in the future. Please use them. If you do, you will have additional time available to spend on your other important PE duties.

Best Practice: Carefully evaluate and select a Project Management software tool and then make full use of it.

The PE Template Set: Appendix B provides the PE Template Set. This series of templates will assure that you cover all the bases as you perform your PE duties if properly utilized.

Please take the time to fill in as much data as you can at the start of your proposal activities. Be excruciatingly truthful in your responses. Only then will you be able to plan effectively for the actions you must take as you embark upon your project.

I also suggest that you update your templates as you complete each of the four states depicted in Figure 5, with your final update occurring at the start of production. NOTE: Do not erase your original data. Save it for future reference. You will be surprised how the lessons learned during each preceding phase will aid you in planning for the next phase of your program.

Best Practices: Use the Templates provided in Appendix B to assure that you have "covered all the bases".

Education: I recommend an Engineering degree (Bachelor of Science or Master of Science) as the formal educational requirement for a PE. There will certainly be exceptions for individuals who have come by an appropriate amount of experience and expertise in other ways. I am just trying to set the bar at some reasonable level for "starters". One of the reasons I say this is that I

hold a BSEE degree. It has helped me understand the technical aspects of the job and, equally important, has taught me how to approach the solution of problems in a methodical manner.

There is, however, more than one way to skin a cat (by the way, have you ever skinned a cat? I don't see why anyone would want to do that). One can become an excellent PE without the benefits of a degree. There are many highly qualified folks out there who don't have a four year degree or even a two year certificate in a technical subject who could conduct themselves quite adequately as a PE. A major requirement is attitude and approach but you still can't get away from the fact that you have to understand the technical intricacies of your product to function properly as a PE.

If you are a young person in high school trying to decide what to do for a living, and you think you want to become a PE (WOW! That's a stretch), then apply to a good technical college or university. If you already work for industry and are "young", then you still might want to consider going to night school for your degree (that's how I got mine - nine years at night) or taking a leave of absence to obtain your degree. If, on the other hand (and the most likely scenario) you have been in the business for some time, and you see a PE position posted on your company's bulletin board, then I recommend that you read this book, cover-to-cover, and then apply for the job if you like what you see here.

Best Practice: Obtain a BS or MS degree, if possible. If this is not possible, read this book and apply its recommendations

Experience: Well, I've already let the cat out of the bag (there I go again with that cat) in the preceding paragraphs. I consider experience the single greatest advantage in the PE's bag of tricks. You will learn various lessons each day you perform your duties as a PE. The more you know from previous experience as you embark on your journey as a PE, the better your chances are for a successful run.

You don't want to do stupid things or make bad decisions. You will have a "leg up" if you've been around the block a few times. In this book I am trying to give you a head start by talking about the processes you will be involved in and by providing you with information about the tools you can (and should) use and advocating an appropriate approach to your tasks as a PE. You will certainly gain a significant amount of experience as you continue your journey throughout your career. If you already are a PE and are reading this book just to see what I have to say, then you certainly know what I'm talking about. You can't buy experience or take classes for it. You have to earn it. The more you have, the better you will be able to do your job.

Best Practice: Take full advantage of whatever experience you have. Seek to learn from others. Learn the lessons of everyday life on the job. If you don't learn from your mistakes, you will probably repeat them.

People: The people you deal with while performing your duties as a PE can be either your most effective asset or your most severe problem. No PE can do his job without the full, unqualified support of his Project Team and the people who report to, work with or support the members of your Project Team. As I mentioned earlier, you will have to establish yourself as a credible, honest and fair person. You have to make folks "want" to work for you and to go out of their way to help you out of the many "binds" that you will inevitably find yourself in.

Good communication is an indispensable part of the continuous effort you will need to expend to maintain the best possible relationships with your functional and management personnel. This communication must be a two way street. Keep them informed, and they will keep you informed. You cannot afford surprises.

If you provide constant encouragement and praise for your people's efforts (while they are still sweating from the effort), you should not have many serious "people problems". If a problem does arise, meet it head on and deal with it immediately. Delays cause the "grudge" mechanism in many personalities to develop as fast as white on snow. You need to face any problem individual in a one-on-one setting, and try your best to understand his problem and to make him understand your position. He may not end up liking you but he has to respect you. If he doesn't assure you that you have his acceptance of the working relationships you have imposed and indicate concurrence with the conditions under which he must perform his duties after you have made a fair attempt to bring him back into the fold, then you may have to remove him from your project.

You can try contacting his manager and having a three way discussion with this fellow and his boss but this may do more harm than good. It usually just delays the inevitable. You can't be constantly running to the chap's manager when he misbehaves. It's a tough decision but that's what you have to be able to deal with in order to be an effective PE. Just make sure that you treat everyone the same. Be fair and consistent in your dealings with people.

Harry Truman had a saying: "When in doubt, do what's right!" I think that most of the time, we know what's right.

Up until now, I have been discussing the use of "people skills" as they apply to your internal organization personnel. Similar rules and guidelines apply to those with whom you will be interfacing who are external to your organization, i.e., your vendors, subcontractors and your customers.

You can't fire your customer if he doesn't agree with you. He can fire you, though. So, with this thought in mind, treat your customers with due respect, fairness and courtesy. The old saying, "the customer is always right" is nonsense. However, you may have to bend a bit every now and then to keep the peace. You should be firm and decisive, not obsequious. You can't let customers or anyone else walk all over you.

You will develop your people skills as you gain experience. Some folks are fragile and sensitive and just need a little "gentle persuasion". Others have more difficult personalities and need a firm hand (figuratively speaking). I sincerely hope that these "people skills" come naturally to you. If they don't, that doesn't mean that you cannot be an effective PE. It just means that you will have to work harder at it.

One final but very important point. Remember people's names and address them by using their names. Few things turn folks on or off so quickly as being addressed by name (or not). This has been a failing of mine over the years. I am just not good at remembering names. I'm getting a little better, now. I play the word association game whenever I can. I wish I were better at this trick, though. If you have a problem in this area, just write down their names on a scrap of paper when you are first introduced. Folks will appreciate your earnest attempt to remember their names. It's much better to do this than to resort to "Hi, there!", as I have done altogether too often.

Best Practice: Treat people fairly and honestly. Be consistent and timely in handing out both praise and punishment. Remember their names.

Summary: You, as the PE, have many tools to help you do you job. The tools include but are not limited to:

* Project Team
* Presentations
* Action Item List
* Schedules
* Budgets
* Meetings
* Questions
* Business Processes
* Internal Procedures
* Computer Systems
* Project Manager Software Tools

* Education
* Experience
* People

In the next part of this book, we will look at various approaches which will make your utilization of these tools as efficient as possible. There may be some overlap of messages but there are certain points I need to stress, so that you can prioritize your actions and do the right thing at the right time.

After all, that is what being a good PE is all about - doing the right thing at the right time!

Part 4 - The Approach:

Introduction: In Parts 2 and 3, we looked at the various processes that you will control and the tools that you will utilize during the evolution of your project. In Part 4, we will examine the approach that you should take to "make things happen". By using this approach, you will assure that you drive your project along the path to a successful conclusion. I will also provide examples of some of my own experiences in the hope that you can benefit from my successes and failures.

Attitude: *"Attitude is everything!"* I don't know who said that but I think he hit the nail on the head - well, almost. There are a few important things besides attitude. We have been talking about them for the last hundred or so pages. However, attitude is very, very important. It sets you up for what you are able to accomplish or it pulls you down to a condition of inaction, resulting in defeat.

You can control your attitude. You cannot control the attitudes of others but you can influence them. The same comment applies to actions - yours and theirs. If you exhibit a winning attitude, then chances are you will inspire that same attitude in others. If your actions are always directed towards the successful accomplishment of your project goals, then so will theirs. I truly believe that. I have seen it happen more often than not during my time in industry.

You will certainly experience defeats during your career as a PE. You must learn from and overcome these defeats. Remember that defeats are temporary unless you persist in dragging them along like unnecessary baggage.

Confidence: How do you achieve confidence? You can't buy it at a store. You can't ask someone to give you a portion of theirs. It's easy to recognize in others but it may seem illusive to obtain for yourself.

There are, however, some things which assure the "capture" of self confidence - success, for one. Sustained, unequivocal success will do the trick. How do you achieve success? Easy. Read this book and understand its principles. Then go out and apply what you've learned, over and over until you get it right. The very action of doing so will assure your success. Just do it! Your confidence will come with time. Yes - time. All good things come with time (if diligently pursued).

Remember that confidence comes from within, so don't worry about what someone else says or thinks. If you do, you will never achieve that confidence from within. You will reach a point where you still care what others think but you will take it "with a grain of salt' in the realization

that you are doing the best you can, and that is all that is required of anyone. You will also find that your confidence is "catching". Your Project Team members' level of confidence will increase in direct proportion to yours. You can believe it. It's true.

NOTE: I realize that some of what I say in this section might sound like preaching. That is not my intent. I am trying to avoid having my readers become uncomfortable with my manner of presentation of this material but I have to articulate my thoughts in a strong enough manner so as not to understate my message. Therefore, between your patience with my terminology and a good deal of my paying attention to comments from my wife (like: "Oh, come on, David. Give it a rest!"), I hope that I can pass on my messages with minimum annoyance to you.

Best Practice: Do your best and follow the advice contained in this book. Your success as a PE will be assured and an increased level of confidence will soon follow.

Ownership: You must possess and exhibit absolute, total ownership for your project. In other words , you must, at all times, accept total responsibility for each and every aspect of your project and for the people working on it. The very reason for the existence of your position as the PE is to provide a "single point of responsibility". Obviously, you must own the bad as well as the good.

Your ability to shoulder this ominous responsibility will derive directly from internal qualities that we will examine in greater detail in the following paragraphs but which I will itemize here:
* Persistence
* Determination
* Stubbornness
* Toughness
* A "do whatever it takes to get the job done!" state of mind

You will not fail if you have or develop these internal qualities and the appropriate state of mind. Everyone has them to varying degrees to start with. The difference between the successful and the unsuccessful individual is the degree to which these characteristics have been developed and utilized. We all need to do both of these things, develop and utilize our internal qualities and the appropriate state of mind. We will talk further about how you can develop and use these characteristics and internal qualities as we proceed through this section.

Best Practice: Epitomize the highest degree of ownership for all your undertakings. Don't wear it like a badge. Instead, be always submersed in it like a fish in a deep well. Others will dive in to join you.

Everyone who works on your project must also possess a strong feeling of ownership for both the entire project and for their part in it. They can't leave you hanging out there on a limb. A chain is only as strong as its weakest link. The success of your chain (project) will be due, in large measure, to the strength (level of ownership) of your links (your people).

Persistence: Persistence is the internally driven mandate to "press on" no matter how bad the circumstances or how big the challenge. "Never say die" and "when Hell freezes over" are familiar exhortations of the demand for a persistent approach to issues and problems. The activity or event in question need not be of a negative nature in order to qualify for the attitude of persistence to be invoked. Persistence is required by yourself as the PE and by your entire organization in every facet of your project as it evolves.

The story of the tortoise and the hare evokes the essence of the quality of persistence. The PE must have the same attitude and approach as the tortoise (hopefully with a touch of speed as well). If you develop an attitude of "keep at it until the job is done", you will win most of your battles and more importantly, you will win the war. Your project and you will be successful

Determination: Determination is a quality or characteristic very much like persistence. They both refer to a mental state which makes the very thought of failure intolerable. The determination to succeed, once developed to the proper level, leaves absolutely no room for thoughts of failure. When the thought of failure has no place to ply its negative trade, then all that is left is room for victory and success.

As may be obvious by now, one of the main objectives of achieving the proper attitude through the development and exercise of ownership, persistence and determination is to make room in your mind for only positive thoughts. This is not easy but it is eminently do-able with practice. Like so many other things, it's a matter of "use it or lose it".

Stubbornness: I think of a mule when I think of the term, "stubborn". I don't own a mule but I do own a pony. His name is Cricket, and he has many of the characteristics of a mule. For example, if I want to lead him someplace, he won't necessarily just come along (like a horse). No, Cricket will just stand there, looking askance at me out of the corner of his eye, with his head held high and his feet firmly planted. In order to get Cricket to move, I either have to explain to him, in a pleasant voice, my reasons for wanting him to move or I have to make believe I'm going to whip him with the tail end of his lead rope. NOTE: We never actually whip our horses or cause physical harm to them in any way. It doesn't work in the first place, and it's just plain stupid in the second. They just get "pissed" at you, and they almost always win the physical battles.

What I want to do now is to put a positive spin on this seemingly negative characteristic. So, if we speak of you, the PE, being stubborn, think of it in terms of your not budging from your goals at

any cost. You have to approach your job with this attitude. Even if you loose heart momentarily, or if you are being besieged by negative thinking individuals, you must be stubborn and remain committed to your cause. Remember that you will frequently be the last line of defense against stupidity, timidity and cowardliness. People will not always make brave decisions when they find themselves in adverse situations. You must remain firm and stubborn when faced with those who wish other than good things for your project or who have lost heart.

Best Practice: Remain true to your project goals. Don't ever cave in!

Toughness: In this topic, I'm not talking about "tough" in terms of the school yard bully picking on a hapless child or the pimp/punk on the street selling sex or drugs. The image I want to portray here is that of the resilient person, i.e., the person who can recover and rebound from adversarily, without delay. Both first and second parts of this statement are important.

Being "tough" means, to a great extent, to be like a sponge - to be able to soak up all that comes your way and to be able to walk away whole or at least not mortally wounded, and to be able to accomplish this feat without delay. For example, the door to your office must always be open. You will not be able to control who walks through that door or the message that they carry. Messages, ideas, words, attitudes, even personal attacks will assail you when you least expect it. One of the recent "quotables" from the Reader's Digest was along the lines of: " It isn't the thing you are prepared to face that will most likely destroy you. It's the unexpected news that arrives at 4:00 PM on a Tuesday afternoon." Think about that for awhile. It has the "ring of truth", doesn't it? So, you must be resilient. You must be "tough".

One other point that I think appropriate for this discussion is the concept of a "thick skin". "You've got to have (or develop) a "thick skin"!" I don't know how many times I've heard that tidy little tidbit of advice. It's bothered me all my life. I've attributed many of the bad things that have happened to me as a Project Engineer to my inability to let things "roll off my back" - in other words, my problem was that I didn't have that good ol' "thick skin"! Well, after a long, long time, I finally came to the realization that NOBODY worth their salt has this miraculous thing called a "thick skin". In reality, those who are intelligent, logical, motivated, and conscientious have just the opposite characteristics, that is to say, they are sensitive. Hurtful words actually hurt them. Does that sound so unreasonable? I don't think so. So, what is the message? Simple - get ready to be hurt, often and badly. But so what? You will survive, and you will go on to do what you have to do to get the job done.

I doesn't hurt to say to yourself: " I'm a good PE". That is what I did for many years before I learned what is contained in the messages I am now recording in this book. It worked for me. It can work for you. If you follow the paths I am laying out for you, then nothing can stop you. Just remember that, no matter how difficult any task may be, you are just doing your job.

If you were able to make it through the preceding parts of this book and still want to become a PE or to improve your performance as a PE, you will have accepted the fact by now that it's not all a bed of roses. If it were, we would have scores of great PE's out there. I don't think that is the case. It is sad but true that "a good PE is hard to find!".

Best Practice: Survive the nonsense and do what you have to do to get the job done! You are a good PE!

Patience: "Patience is a virtue!" That's another old saying. I suppose these sayings wouldn't have lasted for so long if there wasn't a good deal of truth in them. You will certainly need to (or ought to) exhibit a significant amount of patience as you perform your duties as a PE. By the way, when Kathy (my wife) read my "strawman" for this book, she laughed so hard she almost cried when she saw that I was going to recommend and discuss "patience". This is definitely not my strong suit. I can, however, extol its virtues because I have often found myself in the unfortunate position of not having shown the proper amount of patience and of being the recipient of the bad fortune that comes from being too impatient.

Patience comes in several forms: There's the patience that will allow you to listen attentively while someone else is speaking to you. There's the patience that makes it possible for you to "wait and see what happens", sort of like not "watching the pot come to a boil". There's the patience that permits you to accept the failings of others without exploding. There's the patience that allows you to take comfort in the "sure and certain knowledge" that things will turn out for the best in the end versus demanding immediate gratification of your (business-related) desires. The list goes on. It should be obvious that some manifestations of patience may not be in the best interests of your project. You just can't wait to see how things turn out in the end. However, you should have enough patience to listen to others and to keep a cool head in a crisis. You must also be able to provide the appropriate direction to those on your project who have failed to live up to your expectations. You can't just say: "Oh, well. Try again. Maybe things will work out next time." That reaction would invite disaster.

When frustrated by either incompetence or an inadvertent mistake, count to 10 and say: "I understand." This action (and it is an action) will enlist your personnel's maximum support and best level of effort. That is the most you can hope for or demand, and it will generally do the trick

Best Practice: Try to develop an appropriate mix of patience, understanding and prudence.

Re-Initiate: If any section of this book sounds bizarre or crazy, this one will most likely be your choice for that dubious distinction. I have almost deleted it several times but I couldn't quite bring

myself to do it. You see, I am trying to impart to you, my readers, not only sound PE processes, tools and approaches but also "tricks of the trade" that have helped me. If I omit the telling of this story, then I will surely deprive you of a "trick" that has served me well on many occasions, and I will be untrue to myself by permitting the omission. So, at the risk of appearing like a complete idiot, here goes:

"Re-initiate!". I say this to myself during those times when I am mentally overloaded with "whatever", and I just can't focus. I don't understand the mechanism but it works! It's like rebooting your computer or turning a switch off and back on. It puts me at a new starting point where I can discard the rubbish that clouded my mind and allows me to focus anew on the topic or process at hand.

I'll do this during business meetings or when I'm riding one of my horses in a training exercise. The actual situation doesn't matter. I don't recall how I got started doing this in the first place. I only know that it works. It washes away the confusion and "garbage" and gives me a fresh start. Try it. It works! Use whatever term is best for you. I suggest that you experiment with a few different terms.

Here's another, similar trick that can bring you back to a state of harmony when things get out of hand, and you start to "loose your cool":

At night, after I have finished performing all the manual chores related to getting the horses ready for their bedtime, I say "OK" (out loud). I have done this for years without ever really thinking about it. I then give them their treats for the evening (apples, molasses, peppermints - these guys are really spoiled). Sometimes, during presentations and Q&A sessions at my seminars, when I get myself into a "pickle", I will say "OK" out loud (I keep my "re-initiate" comment to myself - I don't like those white jackets with the long sleeves). My audience doesn't have the slightest notion that I am, with a single word, bringing myself back to a scenario where peace and harmony reigns.

You will be surprised at the effectiveness of a couple of simple tricks. I recommend that you use all the tricks that you have at your disposal. It may help to save the moment, and it surely can't hurt.

Risks: "Nothing ventured, nothing gained!" I believe that there is a good deal of truth in this statement. You will have to be willing to take risks (prudent risks, not foolhardy risks) in order to get your project off to a good start, build up momentum and then continue to move it along the path to success. Without risk, inaction rules the day.

Every time you place your trust in another individual, you are taking a risk, and you must trust the people who support your project. You take risks with every schedule you approve, with every budget you authorize and with each technical concept to which you give your "go-ahead".

One might say that the job of PE is, to a great extent, the personification of the business of taking risks. That's OK. There is also something called "risk management". By carefully following the advice presented within the pages of this book, you will automatically be implementing a very effective risk management program. So, when that big old red flag appears in your mind's eye as you are about to decide upon which direction to head off in, remember that risk is always part of the game. If you keep yourself well informed and use the processes, tools and approaches advocated herein, you will minimize your risk and maximize your opportunities for success.

Productivity: It's easy to measure your productivity if you are a bricklayer. Just look at the results of your work at the end of each day. There it is. You can see it. No one can argue. You may have built a ten foot high section of the wall of a church. Or, if you're a mechanical engineer, you will know when you have generated a design which meets the product requirements with which you were presented. You and others can evaluate your design to see whether or not it works.

It's relatively easy, in most jobs, careers and professions to observe the degree of success or failure and the associated degree of personal productivity of the worker. Business productivity can be measured using metrics. It's a matter of defining the right metrics, capturing the necessary data, processing those data and reporting the results.

The task of measuring the productivity of the PE is a much more complex task. You will probably not be able to "see" the effect you've had on your project at the end of each day. You (and everyone else) will know how well your project is doing by how well you meet your scheduled milestones, stay within your budgets, complete your action items, and meet your contractual requirements, including technical, production, delivery, supportability, reliability requirements.

This means that you must have a very high degree of self confidence to get you through each day. That's the way it is. It may be tough but so what?

If you are faithful to your task, you will enjoy significant rewards each time you achieve your goals and make those schedule dates. Your Program Manager (if you have one) and everyone on your team will rejoice in your success if you bring in your project on time and within budget, because your success is their success, also.

So, be tough and hang in there. You will be a good PE and your project will succeed.

Summary: You must know (or learn) how to deal with people. Your success as a PE is dependent upon your ability to inspire people to perform above and beyond their daily obligations. Supported by the proper attitude, a reasonable degree of patience and the willingness to take risks, you will succeed in your career as a PE.

You must be also able to discriminate between the "wheat and the chaff" (or the positive and the negative) and act appropriately. You will sometimes be required to act with the "wisdom of Solomon". Follow the admonitions contained herein and perform your duty as you see fit each day, and you will succeed.

Part 5 - The Obstacles

Introduction: In Parts 2, 3 and 4, we discussed the various processes that you, the PE, will coordinate and control, examined the tools that you will use and studied the approaches that you will take during the evolution of your project. In Part 5, we will talk about some of the obstacles that could get in the way of success for your project if not handled properly. In this section of "Practical Project", I will provide you with information that should help you overcome these obstacles.

5.1 Demands:

Many demands will be made upon you as the PE . They include, but are not limited to, physical, mental and emotional demands upon yourself, plus demands placed upon your family and friends because of the increased time you will be away from them. Remember when I said in the introduction that the project was always "pulling at my mind"? This was a true statement. If I said that there will never be a time when you are not thinking about your project, I would probably be exaggerating, but not by much.

Your project will always be there, if not in the foreground of your mind, then it will be there in the background - in your subconscious mind.

Here are some of the obstacles that you will most likely run across and my suggestions on "best practices" for handling these "challenges".

Stress: Stress, improperly managed, can be your single greatest adversary. How many kinds of stress are there? Before you read further, give yourself a little quiz and try to answer that question. If I try to enumerate all of the sources of stress here, I will surely fail. I think the best plan of action for me to take regarding this subject is to mention just a few job-related "stressors". After all, my remedy for stress is the same, regardless of its source. Here are a few of the stressors that are directly related to the PE profession:

* Missed milestones
* Action items not completed on time
* Budget overruns
* Design changes resulting from design flaws, personnel carelessness or poor design practices

* Unavailability of resources, both personnel and material
* Organizational or personal feuding during design reviews, team meetings and management status meetings
* Hard feelings between project personnel
* Long hours - absence from family
* Lack of enthusiasm exhibited by project personnel

One thing you have to remember is that you can't control who walks through the door to your office. That door must always remain open, and you will have to deal with whomever comes through it and whatever message he or she brings. Many of these messages will contain news which can lead to stressful situations for you.

You cannot avoid stressful situations, especially in your job as a PE. You might just as well stay home from work and hide under your bed. OOPS! That won't work either. You would get stressed out by worrying about how you're going to pay your bills after you're fired. You have to take *action* to beat stress. You cannot maintain a passive attitude about it. You absolutely must take action if you are to survive stressful situations.

There, now that we have established that action (of some kind) is necessary, let's get on with a discussion of a methodology whereby you can turn stressful situations to your advantage as opposed to allowing them to plant an ulcer in your system and encourage you to seek other employment opportunities.

We should, at this point, differentiate between *real* stress and the normal day-to-day condition of worrying about this or that.

REAL STRESS: Real stress (in my opinion) is that condition whereby one's ability to function is impaired, and actual physical or psychological damage to one's body and mind results, either directly or indirectly. We see this all around us, and many of us have experienced this unpleasant phenomenon.

There is only one way to deal with stress, and that is to face it head on. Treat it as a challenge. The concept of "challenge" has a different connotation to our psyches. It is "seen" by your subconscious mind as a positive opportunity rather than negatively as a sinister manifestation of an unbeatable, invisible enemy.

So, now that we have established the proper attitude about this condition we call "stress" and have acknowledged the fact that it can't be avoided, how do we handle it? I believe the answer to this question is simple - just follow the processes and use the tools and approaches presented in

this book. Hold on, now - stop laughing! I really mean what I'm saying. This process has worked for me - *every time*! It can work for you if you give it a chance. By doing as I recommend, you will be taking direct *action*, and that is exactly what it takes to win the "stress wars".

This stress mitigation methodology won't necessarily be easy but it will provide you with a way to face your challenges (stressful situations) in a positive manner and to come out on top instead of being driven to the "funny farm". Once you know *what* to do in any given situation, it's only a matter of execution - simple. *"The truth is always simple!"* (Lyon's Law).

You won't be able to do everything perfectly the first (or second or third) time you try it but keep at it. Practice makes perfect (where did I hear that before?).

WORRY: People worry about many things. "Am I going to be on time?" "Where are my kids?" "What are they doing?" "Will I miss my plane?" Did that cop see me speeding?" "Was that my wife I put on hold?"

These are not truly life or career threatening situations. They certainly don't evoke the "fight or flight" reaction. So, don't "worry" about these "worries". They will always be with you. They are a normal part of life and won't damage your performance as a PE.

Best Practice: Use stressful situations to your advantage by taking action. Use the processes, tools and approaches taught in this book. Don't sweat the small stuff.

Listening: Since we're talking about obstacles, it's essential to put this topic right up near the top of the list because NOT listening can be one of the PE's greatest obstacles.

Actually, listening is one of the last skills that I developed during my career. I don't know why I delayed picking up on this very important item. Maybe I was too busy trying to get my own point across, so I didn't listen to the other guy. Perhaps the more confident I became, the less I thought it necessary to listen to the other guy -WRONG!

You (and I) need to listen for several reasons:

1) You might learn something you need to know, even though you may not want to hear it at the time. Of course, you will hear stories about the other person's family, hobbies and things he is interested in (and you are not) but that is a small price to pay for access to the information you really need to obtain. You may also hear bad news. It's an absolute necessity that you hear bad news as soon as possible. Remember, your motto is: "No Surprises!"

2) You never want the person or group to whom you are speaking to get the idea that you aren't paying attention to them or that you don't care what they have to offer - that their information or opinions are not important. This can cause a credibility gap that may be very difficult or impossible to bridge in the future. Your credibility will be enhanced, and a rapport will be established with your audience if you listen attentively.

3) You can't talk while you're listening. This fact can be important to those who are turned off by someone who "lectures" instead of holding a two way conversation.

4) You may absorb something that may appear to be irrelevant at the time but which may prove to contain valuable information in the future. Often, little "tidbits" of information may not seem important or necessary at the time but they might trigger the opening of a mental doorway in the future when you're searching for information. Be an information packrat and store these little snippets of information away.

5) Listening gives you a chance to collect your thoughts and to be better prepared to articulate them when it's your turn to speak. Pay attention to what the other person is saying but it's generally possible to receive information and think about your reply at the same time.

Of course, a good listener will, by the very nature of the activity, hear many things which truly are irrelevant. However, you should be able to develop your ability to separate the "wheat from the chaff" and retain only the good stuff. Again, practice makes perfect.

Best Practice: Listen to others. Try to hear what they are attempting to convey to you. You will obtain information, and they will feel good about the exchange.

Fighting: Do you have a suicidal wish to get fired on the spot? Or (more likely) do you want to be at the top of someone's "hit list". How about getting one or more of your key personnel so "pissed off" at you that it will be a cold day in Hell before they do anything to help you in the future? I could go on and on but I think you get the idea.

You could accomplish the above objectives very easily and quickly by engaging in verbal fisticuffs or by demonstrating an overly adversarial demeanor. By the way, God help you if you actually do engage in physical combat. The good old days of "teaching someone a lesson" or "let's take it outside" are gone. This may or may not be a good thing but that's the way it is, and we have to learn to live with it (talk about "stressors"!). You'll just have to find a different way to "clear the air" and to resolve difficulties when confrontational situations arise.

My advice is to say something to your antagonist along the lines of: "we're not getting anywhere like this" or " if we keep this up, there's going to be a real problem" or "this is not the time or place to do this". If the confrontation takes place in your office or during a meeting, you cannot leave. Suggest that your opponent "hold that thought" or "we'll discuss this later". If the situation looks like it is not going to improve, then you have no choice but to dismiss the individual. Be sure to set a time and place for your next contact before he leaves, so that you both won't be in limbo. You will definitely need to keep that appointment in order to resolve the problem - one way or another. Usually, given time to think things out, most folks will want to come to a resolution that will allow them to keep both their job and their position on the project team. If your subsequent discussion only makes things worse, then you will have to remove the offending individual from your project, as discussed in Part 4.

Above all, during any confrontation, resist with your whole being the temptation to shout or to lose your "cool". If you can't do anything else, just keep your mouth shut. You will thank yourself later. I always replay these scenes later in my mind and I often end up regretting the fact that I didn't shut my mouth when I should have.

NOTE: Do not mistake what I am saying here to imply that you should not be aggressive in your approach to the people who support your project team. There is a world of difference between being aggressive and being adversarial. You must always convey the impression that your leadership is not to be challenged. Never budge an inch in that regard. Continue to be aggressive, though, and never hold back for fear of an exchange escalating to a confrontation. Just deal with that confrontation when it occurs - and it often will. These unpleasant events come with the territory. You will get used to them.

Best Practice: Be aggressive but not adversarial. Don't shout or lose your temper. You have the most to lose and your project will surely suffer the consequences.

Organizational Structure: The organizational structure in your business can present obstacles to the smooth planning, execution and operation of your project. Much of the cause of this unhappy condition results from inadequate definition of the roles and responsibilities of your project and management personnel.

You, as the PE, need absolute authority over all aspects of your project. If conflicting roles and responsibilities exist, you will have problems. Let me give you a typical example.

Many organizations utilize a position entitled "Program Engineer". This fellow works on proposals, helps the functional managers plan their tasks and budgets, collects actual contract expenditure data and compares it to the budget data, follows up on closure of action items,

interfaces with the customer regarding planning and reporting activities, and provides general support to the Program Manager. Do you see the problem? Many of these activities are either similar or identical to yours as the PE. If you can cooperate with and support each other, then having a Program Engineer to help carry the work load can be a plus. If, however, you have a confident, aggressive Program Engineer who has a strong sense of ownership for his tasks (which everyone should have), and if you and he don't see eye to eye and have an effective method of communication plus a clear definition of who calls the shots and when, then you have a recipe for disaster.

It doesn't take much for hard feelings to develop when either or both of you think the other person is providing double coverage when and where he shouldn't. Situations can arise where you both end up countermanding each other's orders. You don't need this kind of "help", and it's unfair to the Program Engineer to ask him to put forth the kind of effort that is required for him to do his job if it leads to confrontational situations. When this happens, someone has to back down and, by definition, it has to be the Program Engineer.

A much safer organizational setup omits the role of Program Engineer altogether. Actually, many of these fellows have what it takes to be PEs. The skill area in which they may be somewhat lacking is technical competence, and that can sometimes be overcome through sufficient on-the-job experience and/or by taking evening courses at a local college or university. This is an important skill, though, and it's unfair to both the project and the individual to place him in the PE position if there is significant concern about his technical competency.

I strongly recommend that you do not permit the role of Program Engineer to exist on your projects. I have served in both positions, and it just doesn't work out often enough to take the risk. There can only be one boss on a project. If, however, you do have one, you must make sure that both you and he have a clear understanding of "who does what and when". Work especially hard at communications with your Program Engineer if you have one. If you don't, you run the risk of hurting each other and your project.

Many businesses have Assistant Project Engineers (APE) who are really "PE's in training". This situation works out just fine because the APE works directly for the PE and is usually very careful not to do anything to damage that relationship. My advice is to turn your Program Engineer into an APE, if you can. Then you will have a win-win situation.

There are other examples of organizational taboos. You absolutely must maintain the proper relationship with your Program Manager. Roles and responsibilities (both internal and external) will necessarily overlap in this area but are more manageable than in the PE/Program Engineer scenario because of the level of authority vested in each position (the Program Engineer almost never has technical responsibility and usually occupies a lower position on the totem pole than the

PE). If you have a Program Manager, then he is the undisputed boss. You must always be aware of this fact and never do anything to compromise his position.

One of the best ways for you to establish and maintain the proper rapport with your Program Manager involves the manner by you keep him informed of project activities and status. You should always be crisp and precise in your presentations, even though much of this information is delivered in informal meetings. Don't "snow" him with a lot of details unless he asks for them. He should be trusting you to pay attention to the details. However, give him what he wants, to the extent that he needs and requests detailed information. Remember, your Program Manager has the same motto as yourself: "No Surprises!"

Your Program Manager will necessarily have high expectations regarding the way in which you do your job, and the way in which you support him as he does his job. You must, therefore, constantly bring him up to date on project status in order to provide "sanity checks" so as to keep his level of expectation tied to reality. Don't let your Program Manager "lose the bubble"! If this happens, and he learns that he is not as directly in touch with his program as he had thought, his faith in you will vanish like snow in July. It's a lot easier to establish and maintain credibility than it is to re-gain it once it's lost.

There are other organizational situations that can get you and your project in trouble. You must establish and maintain good relationships, credibility and mutual respect with your functional level managers and their lead personnel. These are the folks who will make things happen (or not). The clear definition of roles and responsibilities up front, during the planning phase of your project and documented in your Program Plan, will go a long way towards avoiding conflicts as your project evolves.

Much has been written and spoken regarding "horizontal", "vertical" and "matrix" organizational structures. The primary difference between these management systems is the manner in which company personnel and facility resources are allocated to program and project activities and the resulting reporting scenarios. I have worked in many different incarnations of these organizational scenarios and often rotated through them while at the same company, i.e., the company tried one, then another, then went back to the original, then tried another, etc.

I don't see any significant advantage to one organizational scenario over another as far as the role of PE is concerned, providing that you establish with each member of your project team unquestionable dedication to your project and utilize the processes, tools and approaches recommended herein. If possible, require one hundred percent dedication to your project. If you have to share personnel resources, there is always the risk of competition with another project or program for a particular individual's time. This usually occurs when it is most inconvenient. Remember Murphy's Law.

Best Practice: Start off on the right foot by making sure that there are no organizational situations which could lead to a challenge to your authority. Make sure that everyone on your project knows their roles and responsibilities. Keep your Program Manager well informed. Don't share project personnel unless forced to.

Travel: You will probably be required to do a good deal of traveling in your job to interface with customers and suppliers. Travel has both its up-side and its down-side. You may or may not enjoy traveling but one thing is sure. It places greater demands upon your time (away from your family, friends, leisure activities) plus your availability for planning, coordination and problem resolution activities at your business facilities. This problem is reduced by increased efficiency in our communication systems but it still makes a difference if you aren't there when a problem arises. Remember that you are the "hub" around which your company's business "wheels" rotate.

You can minimize the amount of time you spend on the road through the use of Project Management software tools and computer systems (connected via the Internet). Occasions will arise when your physical presence is required at other locations. My advice is to resign yourself to this fact, and prepared to swallow this bitter (or pleasant) pill when called upon to make those trips away from home.

On the up-side, business trips can serve as opportunities for both yourself and your company. You have a unique opportunity to demonstrate that you're made out of the "right stuff" and that you have established a well planned and well executed project. You should grasp this opportunity with gusto and perform at your best. You are not only satisfying customer or supplier requirements for access to first hand information. You are in the unique (and limited) position of selling future products and services by the very manner in which you deal with your contacts during the course of your business trips.

It's not uncommon for a customer to decide to award future contacts to a specific company based upon the performance of their key personnel on previous contracts. Of course, both sides of this equation are important. I just want you to realize the value which a solid performance during business trips can have on the outcome of future potential contract awards.

Attitudes: In the previous section, we discussed how the "right" attitudes exhibited by your project personnel can benefit your project. Now, we will spend a little time talking about the

reverse situation, i.e., the deleterious effects of "bad" attitudes on the part of one or more of your project team members.

I can remember not too long ago when one of our large corporations (to remain nameless) had the reputation of following what I considered to be rather extreme personnel practices towards anyone who displeased them enough to require removal from their position. My understanding of the story goes like this. As soon as an employee was notified of his termination, he was immediately removed from the local company premises. He was not even allowed to return to his office or desk to pack his personal belongings. Someone else did that for him. The result? For all practical purposes, the offender "vanished".

Why did this company follow this seemingly extreme practice of isolation from one's co-workers? Simple - to keep the employee with the "bad attitude" from infecting his fellow employees.

If and when a negative attitude is exhibited on a regular basis (spurts of bad temper are OK - everyone has them), the risk of this "mental or emotional infection" spreading amongst other project team members is, unfortunately, quite high. I don't know what it is about the human psyche, but it often seems to be attracted towards perverse, negative behavior. This is similar to the practice of "rubber-necking" to see the results of a bad accident on the highway. Folks who are otherwise sensible in nature and emotionally stable start to question things that would seldom come to mind if left alone and allowed to do their jobs without being exposed to the grousing and griping of a dissatisfied or unhappy employee. The "sour grapes" vines seem to be as indestructible as the cockroach.

You should do your best to detect and to weed out any malcontents as soon as possible. You cannot afford to allow the morale of your project team to become victim to one or two employee's bad attitudes, no matter how valuable their skills or experience may be to your project. Talk to them and let them know that if their attitude doesn't change (and fast) they are history. Don't falter on this one. It can undermine your project and be fatal to your career as a PE.

I would like to mention one more thing about attitudes before we finish this topic. That is the subject of *titles*. Titles are often misleading, and I believe that they don't really mean much in the overall scheme of things. Sometimes they create the wrong impression. Titles are necessary, however, in spite of the fact that many well intentioned folks would argue to the contrary. People are people, and they must know who the boss is and understand the "pecking order".

I also feel obligated to point out that, even though it is surely obvious to most of my readers, the true value of an individual is not indicated by his title but rather as proven through his attitude, level of determination, task ownership, accomplishments, and day-to-day behavior. Don't ever be

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intimidated by titles - within or without your company. Remember that most people still put their pants on one leg at a time, and they feel pain when you stick them in the eye with a sharp stick (try to keep this activity to a minimum).

Best Practice: Get rid of complainers before their bad attitude spreads among your project team. Don't be intimidated by titles.

People: As with attitudes, people can be either assets or problems. Treat them well, and they will reciprocate. Treat them badly, and they will retaliate. Simple as that! No need to say more.

Summary: As you can see from the above discussions, there are many potential obstacles both to the successful evolution of your project and to your personal success as a PE. I stress the word "potential" because, with appropriate consideration for others, attention to detail, and conscientious application of the methodologies presented herein, you can overcome these obstacles. In other words, you can get them before they get you. It takes action on your part to make this happen but that's part of your job, i.e., you must "do whatever it takes to get the job done"!

Part 6 - Book Summary

Introduction: We have, at this point, covered in detail the "meat" of this book. I believe that I have, in the preceding five parts, presented the information, methodology and advice that will, if studied thoroughly and applied conscientiously, go a long ways towards making you a successful PE. In this last part of the book, I will summarize the topics covered and highlight certain principles. My purpose in so doing is not to be redundant. Rather, I wish to reconstitute, at a very high level, the key concepts and bits of advice that I hope will stick with you throughout your PE careers.

For example, I can clearly remember what my college freshman physics professor told us over forty years ago during one of his classes. It went like this: "If you remember nothing else from this course, I will be happy if you have learned how to approach the solution of a problem." I will never forget that comment. Although he taught us a great deal about the specifics of physics, the thing that still sticks in my mind is his concern, not about basic physics skills, but about the importance of learning the proper approach to the solution of problems - any kind of problem. I thank him for that. I intend to try to pass some of that kind of information along to you, my readers, in this last part of "Practical Project".

Part 1 - The Project Engineer: Your PE is the *"single point of responsibility"* for the Engineering part of your project or program. As the focal point for your Engineering processes, events and activities, your PE will assure that tasks are properly identified, planned and executed, that everyone knows and executes their roles and responsibilities, that problems are identified and solved, and that all bases are covered - all the time. Your PE must do whatever is required to "get the job done"!

People who are drawn to this profession are self confident, aggressive, conscientious, dedicated, and demonstrate a great sense of ownership. The job of PE rewards the practitioner through the satisfaction of leading a team of competent and dedicated professionals through all phases of a complex program and by surmounting significant obstacles on a daily basis.

Part 2 - The Process: This section of "Practical Project" articulates the role of the PE throughout the entire product life cycle. The following paragraphs summarize major topics discussed in detail in this section of the book.

Before Contract Award: It's important that you enlist the support of your Program Manager and your key design personnel as you form your proposal team and initiate program planning activities. You will need their unequivocal support during this phase of your program in order to submit a competitive, comprehensive and realistic proposal to your customer. Communication with all personnel who will be involved in the execution of project activities is vital.

Create and maintain both a project schedule and an action item list. Create outlines and "strawmen" for a Configuration Management Plan and Hardware and Software Development Plans. Generate a Program Plan, and use it as the basis for your negotiations with your Program Manager and your customer. Be honest and direct with your potential customer so as to assure that his expectations for your performance during contract execution are realistic. Also make sure that you obtain "buy-in" from all key members of your proposal team for any changes to the content of your proposal before you make any commitments to your customer during negotiations. Update your Program Plan as modifications to contract tasks, schedules and budgets occur during these negotiations.

After Contract Award: Update your Program Plan to include all changes made during negotiations, and conduct internal orientation meetings to assure that everyone is up to date and "on board". Finalize your Configuration Management Plan and your Hardware and Software Development Plans.

Development: Establish your Project Team using members of your proposal team plus other functional level personnel as required. Assure that you have systems in place for communication, technical support and problem resolution. Update your Program Plans and Project Schedules to identify your detailed design methodology, including the evolution of design states and a documented process and schedule for design reviews. Keep your Program Manager well informed on all aspects of your project coordination activities.

Transition to Production: Assemble a team of "hands-on" personnel to plan and execute activities during the Transition to Production phase of your program. Utilize your project team members plus manufacturing, quality assurance and purchasing personnel as required. Hold regular (but short) transition team meetings. Maintain your project schedules and your action item lists. Make sure your action items are assigned to specific individuals along with the mandate to complete specific tasks by specific dates. Establish a problem resolution team, using the guidelines in this book. Obtain technical support from your Engineering personnel as required. Meet with your Program Manager plus your vendors and suppliers and solicit their support in your production planning activities.

"lessons learned" from previous programs. Update your program plan, including your program level and detailed project schedules.

Production and Support: Capture your "Product Baseline" and release it to production. Utilize your Configuration Control Board and your Material Review Board to control design changes and to properly dispose of non-conforming materials. Use your Problem Resolution Board to identify and resolve problems identified by your designers, builders, users, customers and suppliers. Conduct internal audits as appropriate to assure compliance with contract requirements and internal procedures.

Part 3 - The Tools: There are several standard business tools supported by numerous mature plus newly developed computer systems and software tools which can and should be utilized in your pursuit of excellence in the field of Project Engineering. Your Project Team meetings will serve as an excellent setting to focus the use of several of these tools, including your project schedule, action item lists, financial performance charts, and vu-graph presentations. Question and answer (Q&A) sessions can utilized during both Project Team meetings and in one-on-one discussions.

Properly documented business processes and procedures can be subjected to documented audits to assure that all bases are covered and that program decisions and operations are executed as directed.

Computer software packages and computer systems play an important job in today's world of project management. User friendly Project Management PC software packages simplify the tasks of planning and monitoring program events and activities as well as controlling schedules and personnel resources. Other PC software "office tools" simplify database generation and maintenance, enhance the efficiency of electronic messaging systems and document creation, modification and maintenance activities. Product Data Management systems support the capture and control of engineering design data plus subsequent change proposal and incorporation process data, configuration status accounting data, manufacturing inventory, material procurement, product fabrication, assembly and test data plus other "enterprise" data, such as internal procedures, financial data and proposal data. Communications software packages can reduce travel time and create virtual workplaces for your project team members, your suppliers and your customers.

Finally, your "personal" capabilities and skills will provide the foundation from which you build your expertise as a PE. I daresay that you will use every facet of your education and experience as you execute your PE duties. I heartily advocate that you utilize every tool at your disposal. You will need all the help you can get!

Part 4 - The Approach: A winning attitude on your part and on the part of your project team members is essential to your success as a PE and to the success of your project. Self confidence, a strong sense of ownership, persistence, determination, stubbornness, plus mental and emotional toughness are vital elements of a winning attitude. Patience is a personal characteristic which you must develop if you don't already possess great gobs of it. There are also mental "tricks" which you can learn to help get you through difficult situations and to help you keep your "cool".

You must be ready and willing to take risks but with proper consideration. Haphazard risk taking is, of course, inappropriate and downright irresponsible. Above all, treat the people with whom you work with respect and a good deal of patience and they will reciprocate by performing in accordance with or above your expectations. You will need this level of performance by your project team members and by those supporting your project team in order to assure the success of your program or project.

Part 5 - Obstacles: You will necessarily encounter obstacles in many forms as your project evolves. These demons will raise their ugly little heads from all corners of the compass. They will usually appear when you least expect them. Someone once said that the career or life threatening problem isn't the one you anticipated at some major event. Instead, it emerges quietly at 5:00 PM on a Tuesday afternoon as you are starting to plan your evening's affairs. In other words, these potentially problematic situations often sneak up on you at unlikely moments. So, like a good Boy Scout, the PE must always "be prepared" (for just about anything).

One obstacle that can be harmful to both you and your project is the inability to deal with the stress that you will encounter on a daily basis. The only effective way to combat stress is through direct action. Follow the processes recommended in this book, use the tools provided and the approaches identified and you will defeat the insidious enemy - stress.

Another obstacle is the natural human tendency to not listen attentively to what others are trying to say to you. Many of the reasons for paying proper attention are identified and discussed in the text. Suffice it to say here that you will be rewarded if you take the time to listen. It's a skill that practice will improve upon. Work at it and you will thank yourself.

The inability to properly handle confrontational situations can also be an obstacle. Don't try to avoid confrontational situations. You just can't. Always maintain your "cool" and never shout or lose your temper. It's OK and even necessary to be aggressive but try not to be adversarial. Always deal with those who contribute to confrontational situations in a timely manner. Don't allow hard feelings to develop. Resolve conflicts as soon as possible.

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Organizational problems can escalate to severe obstacles if insufficient attention is paid, during the early project or program planning phase, to the careful definition and communication of project team member roles and responsibilities. You must assure that no duplication of or competition with your duties as PE occur. Work with your Human Relations personnel and your company's management to establish proper roles and responsibilities and to assure that all team personnel are aware of and agree with the established roles and responsibilities.

Maintain a good relationship with your Program Manager. Don't let him be put into a position where he questions your credibility. Keep him well informed with up-to-date information.

Some people like to travel. Others do not. If you are one of the latter, then the travel that is an integral part of a PE's duties may appear as an obstacle to you. You can turn this apparent obstacle into a challenge and an opportunity to build upon your own credibility plus your company's reputation by performing at your peak ability during trips to your customer or supplier sites. Modern methods of communication (computer systems/Internet) can also alleviate travel related problems.

The attitudes of the folks who work on your project as well as management, customers and suppliers can be either beneficial to your project or disastrous to both your project and your career if you allow misunderstandings or hard feelings to develop and go unchecked. Work diligently to keep your people aware of what's going on, solicit their opinions and support, be fair and honest in your dealings with them, and they will prove to be your greatest asset. Ignore this advice, and they may cause serious damage both to your career and to your project.

I truly believe that, in all cases, the appropriate action on your part can either prohibit or resolve any obstacles that appear in your path. Take action immediately. Use the processes, tools and approaches advocated in this book, and you will successfully overcome these obstacles.

Lessons Learned: I have devoted an entire appendix to the subject of "lessons learned" - Appendix C. I suggest that you read this appendix in order to obtain the greatest value regarding this topic. I will, however mention here a few recommendations stemming from my lessons learned which have been particularly beneficial to me during my career as a PE.

Pay attention to details. The old saying, "the devil is in the details", is particularly true if you are a PE. If you had ten times the information gathering skills and ten times the capability to analyze this information and act upon it, it still wouldn't be sufficient to cover absolutely every situation that will arise during the evolution of your project. Having said that, I must implore you to pay attention to detail to the greatest extent possible, given your limitations as a human being. The risk of missing something important is too great to be superficial in anything you do as a PE. It's

always better to err by paying too much attention than by paying too little attention. Remember that your motto is: "No Surprises!".

Develop the traits and work methodology recommended in Part 4 - The Approach. If you sincerely approach your duties in the manner advocated, your chances of success will be optimized.

Treat people with honesty, openness and fairness at all times but always demand their best efforts. Be relentless in this regard. You will be succeed if you do not waiver from this approach.

In the field of Real Estate, they say the value of a piece of property is measured by *"location, location, location"*. In the field of Project Engineering, the measure of your success will, in large part, be determined by your ability to: *"communicate, communicate, communicate"*! Ronald Reagan was known as the "Great Communicator". His popularity and ability to get things done were due in large measure this trait. I recommend that you put this requirement at the very top of your list of "things to do".

Best Practices: The *Best Practices* for each major section of this book have been presented in italics at the end of each relevant paragraph. They are also repeated for rapid review in Appendix A. These *Best Practices* are specific in nature, and I feel it would be inappropriate and misleading to attempt to summarize them at this point. I suggest that your review them by reading Appendix A.

Expectations: Everyone involved with your project should have a very clear understanding as to what is expected of them. They certainly know what they expect of you, their peers and your company's management. It is your job to assure that these expectations are both realistic and in concert with your Program Plan. This is another example of the importance of the requirement that everyone, both internal and external to your business, fully understanding their roles and responsibilities.

If expectations are not met, then you will have lost some degree of control over your project, and the final results will not be satisfactory to those with false expectations. You should make it a regular practice to reaffirm each individual's role(s) and responsibilities and to make adjustments and corrections as appropriate as time goes by.

Credibility: You are a "dead duck" if you don't establish your credibility right up front and maintain it throughout the life of your project. Everything you do and say must have "the ring of truth". If your project team members, your management personnel or your customers and suppliers doubt your credibility, your career as a PE is doomed. Remember that your basic job is to serve as the *single point of responsibility* and to *do everything it takes to get the job done.* You can't accomplish either of the above if your credibility is in question.

Even the very appearance of a loss of credibility can be just as damaging. You must be like "Caesar's wife" and avoid even the appearance of impropriety. You can do this. Follow the advice provided herein and your conscience. You'll do just fine. If you do screw up, admit it loudly and immediately. Folks will forgive you. God help you if you try to hide something. It never works - never!

Finally, remember to keep things simple. Analyze problems carefully. Always try to determine the basic facts of any situation. *The truth is always simple* (Lyon's Law).

Templates and Illustrations: The PE Template set is provided in Appendix B. These Templates are checklists which should be filled in for each phase of your project or program and maintained in an up-to-date condition. The more use you make of this Template set, the less risk you will invite into your project. They are one of your most effective tools for planning and executing your project tasks.

Several illustrations are provided as Figures in Part 2 - The Process. You should use these illustrations as guidelines when generating your Program Plan, program schedules and action item lists. They are generic in nature and can be applied to any project or program, whether hardware or software oriented. You can tailor these figures to suit the specifics of your project.

Good PE: My idea of a good PE is one with whom I would want to work on the next project. I say this not only because he brought the current project to a successful conclusion on time and within budget and provided the products and services specified in the contract but because he was a pleasure to work with. I would be very pleased if the people working on my projects could say that of me.

Bad PE: It's easy to spot a bad PE. They have one or more of the following characteristics. I once had the misfortune of working for a PE who had all of these characteristics. I believe that this PE's only redeeming feature was that he was able to provide first hand experience of what *not* to do. Here's a list of "bad PE" conduct, practices and characteristics:

* Abusive vs cordial
* Back-stabber vs forthright
* Shouter vs persuasive
* Overbearing vs supportive
* Adversarial vs cooperative
* Pushy vs receptive
* Obnoxious vs pleasant
* Tense vs relaxed
* Climbs over bodies vs helping people develop
* Counter productive demands vs productive and positive actions
* Offloads pressure to peers and team members
* Accepts praise for successes and passes the buck for failures

Would you want to works for this moron on your next project or invite him home to meet your family? Of course not. Individuals like this are deserving only of contempt, in my humble opinion. Fortunately, there aren't too many poor excuses for a PE still in the business. Reality dictates that these misfits can't survive in today's business environment. Unfortunately, some businesses in the past were run like medieval castles by a cast of "good old boys" who covered for each other. These operations usually fail, as did the one in my example. Enough said about negative people and bad PE's. Their only redeeming value is to provide a lesson in what *not* to do.

Conclusions: You have read a lot of material to get to this point in "Practical Project". That shows dedication and determination - qualities which will help sustain you throughout your career as a PE.

I've written several drafts for this last section of the book but none really "did the job" as I intended. As a result, I have finally decided on the following words in my final effort to impart a few important thoughts.

One day you will retire from your chosen profession. Hopefully, there will have been many happy and productive years between now and then. But that day will come. When it does, you will look back upon the intervening years and wonder if you did all that you could have done for yourself, your business, your co-workers, your family, and your friends (not necessarily in that order).

If you really want to be a PE (and I believe it is one of the most useful and satisfying professions in the world), or if you are already a PE and wish to improve your performance, I sincerely believe that you can do so by applying the advice provided in this book.

Appendix A

This Appendix summarizes the "Best Practices" for the Project Engineer. The format for this presentation is the book section title, followed by the "Best Practices" as presented in the text of this book. My purpose in creating an appendix for this material is to allow the reader to scan these "Best Practices" and to decide, as in the Summary section, whether or not it is appropriate to re-read specific parts of the book. This summarization of "Best Practices" can also serve as a refresher for periodic review of the material presented herein.

Part 2 - The Process:

Assure that you have "buy-in" from all key personnel in your organization for your proposed project. This will help to guarantee that you have their full support as the project evolves. This support will be indispensable to the success of your project

Project Engineer Selection

Select the PE who is going to be responsible for your new project at this time. Your PE will be the "single point of responsibility" for the successful completion of all project tasks and events.

Proposal Kickoff Meeting

Make sure that you "beat the bushes" to identify all tasks and to ferret out all related costs. It's better to find out about these items now, when you are in a position to negotiate them with your customer than to find out about them later when you will have to pay for them out of profits. Your motto should be: "NO SURPRISES!"

Action Item List

Create an Action Item List, and assure that responsibility for each action item is assigned to a specific individual. Require that individual to report upon the status of his action item at the regularly scheduled Proposal Team meetings. Demand action item closure per scheduled dates.

Project Schedule

Generate a Project Schedule as the first task in your proposal activities. This is one of your most important PE tools. Update your Project Schedule on a regular basis.

Configuration Management

Establish a sound CM program by tailoring your CM "Best Practices" to fit your customer's needs and your program's requirements for baseline capture and control, status accounting and audits. Also, transition your business from a paper-based CM system to an electronic based CM system utilizing a Product Data Management (PDM) system.

Program Plan

Plan your plans, now - early in the process, i.e., determine, with the support of your Proposal Team members, the plans required for your project. Don't forget to include the cost of generating these plans in your budgetary calculations.

Document everything you can get your hands on. You will be surprised at the kinds of information you will need to support your project as time goes by. Record as much information as possible via electronic media, i.e., computer databases, text files, graphics files, etc. This methodology will make it easier to retrieve data in the future.

Negotiations

Be assertive but not argumentative. Keep your promises.

Demonstrations and Presentations

Conduct dry runs. Flush out errors and redundancy, improve the wording and put more "punch" in your proposal at your dry runs.

Submit Proposal to Customer

Don't promise anything you can't follow through on. Never assume anything. Communicate! Communicate! Communicate!

Part 2.1.2 - After Contract Award

Document your project planning agreements and require your internal organization personnel to acknowledge ownership for these tasks plus the Project Schedule and budgets in your Program Plan. These documents will help you later on in case someone "forgets" what they agreed to do.

Preparations for the Start of Contract Work

Make sure that you are always "on top" of your project. Capture all internal procedures and processes via Internal Procedure documents.

Part 2.2 - Development

Develop your communication skills. They are critical to your success as a Project Engineer.

Project Team

Your Project Team and your Program Plan are indispensable tools. Treat them with respect and rely upon them for support throughout your project.

Coordination

Use every tool at your disposal to assist you in your project coordination activities. Spend a good deal of time moving about and talking to your "troops".

Communication

Do whatever you have to do to insure a satisfactory level of information flow in all directions.

Technical Support

Treat all personnel with respect and patience. Let them know you are "always there for them".

Problem Resolution

Expect problems. Be happy if you hear about them in a timely manner. Then, do your best to resolve them.

Design Reviews

Design Reviews are events where you will "taste the goodness" of your designs". Make corrections as appropriate at these events.

Design Review #1

Capture your Functional (system level) Baseline and Allocated (subsystem level) Baselines at this point in the development of your project. Update and maintain your Project Schedule diligently.

Design Review #2

Assure proper approval and communication of design changes. Start your prototype build activities.

Design Review #3

Capture your Development Baseline. Verify your databases. Load your MRP System. Put your design data under formal internal control.

Design Review #4

Verify that all FCA and PCA discrepancies have been resolved. Capture your Product Baseline. Start building production units.

Part 2.3 - Transition to Production

Make sure your design data are baselined and under formal Configuration Control before you place orders for production materials

Transition Team

Make your company's "do-ers" members of your Transition Team.

Transition Team Meetings

Hold regular Transition Team meetings. Keep them short.

Action Item List

Your Action Item list is as important to you as a gunfighter's revolver was to him in the old West. Keep it "well oiled", i.e., up to date

Database Verification

Make sure that your Engineering, Manufacturing and Quality Assurance personnel are all "singing from the same sheet".

Material Procurement

Get to know your outside vendors. Meet them face-to-face. Work at establishing good relationships.

Customer Involvement

Make your customer feel like he is part of your team.

Lessons Learned

Document "lessons learned" for future programs.

Schedule

Keep your Project Schedule up-to-date!

Part 2.4 - Production and Support

Configuration Management Plan

Document the results of your CM activity planning and negotiations in your CM Plan.

Configuration Control Boards

Implement and integrate a PDM system within your business.

Major and Minor Design Changes

Assure that all personnel working on your project clearly understand the difference between Major and Minor design changes. Never duck your responsibility to classify a change as a "Major" change even though the temptation may exist to do so in order to save time and money.

Material Review Board

Establish a process to assure that the disposition of corrective action for non-conforming material is fed back to the proper team members.

Problem Resolution Board

Establish and maintain a Problem Resolution Board to deal with problems that arise during the conduct of your project.

Part 2.5 - Problem Resolution

Process

Consider the problem resolution and disposition activity as the "front end" to your Change Control CM process. This will help you to cover all bases and assure that nothing "drops in the crack".

Part 3 - The Tools:

Project Team

Rely upon the support of your team members and give them your support. Work closely with them. Trust them. Work on enhancing your credibility with them.

Presentations

Give your presentations with enthusiasm and confidence. Don't worry!

Action item list

Make your Action Item lists comprehensive and detailed. Follow up on task status diligently. Drive tasks to completion.

Schedules

Plan your schedules carefully with the support of all participating personnel. Make them comprehensive and detailed. Keep your schedules up-to-date

Budgets

Plan your budgets carefully with the support of all project participants. Make your budgets detailed and comprehensive. Keep your "budget versus actuals" data up-to-date.

Meetings

Hold meetings when necessary and beneficial to the conduct of your project. Don't hold meetings just to continue an established pattern of activity.

Questions

Ask questions. Don't worry about exposing your lack of knowledge in any particular area. Don't worry that your question may appear stupid. The only stupid question is the question not asked.

Business Processes

Understand your business processes and then fine tune them.

Internal Procedures

Document your internal procedures if they are not already documented. Use an independent function (person) to thoroughly check out your new procedures.

Computer Systems

Take full advantage of your computer resources and available design tools and office tools. Install a PDM system in your business if you don't already have one.

Project Management Software Tools

Carefully evaluate and select a Project Management software tool and then make full use of it.

Part 5 - The Obstacles:

<u>Stress</u>

Use stressful situations to your advantage by taking action. Use the processes, tools and approaches taught in this book. Don't sweat the small stuff.

<u>Listening</u>

Listen to others. Try to hear what they are attempting to convey to you. You will obtain information, and they will feel good about the exchange.

<u>Fighting</u>

Be aggressive but not adversarial. Don't shout or lose your temper. You have the most to lose and your project will suffer the consequences.

<u>Organizational Structure</u>

Start off on the right foot by making sure that there are no organizational situations which could lead to a challenge to your authority. Make sure that everyone on your project knows their roles and responsibilities. Keep your Program Manager well informed. Don't share project personnel unless forced to.

<u>Attitudes</u>

Get rid of complainers before their bad attitude spreads among your project team.

<u>Summary</u>

Now that you have reviewed the "Best Practices" presented in this appendix and throughout this book, I recommend that you take a "highlighter" pen and go though this summary of "Best Practices" one more time. Highlight those "Best Practices" that are most applicable to your business situation. Then go back into the text and re-read the detailed sections that lead up to and

PE Template Set

Use the Templates provided in Appendix B to assure that you have "covered all the bases".

Education

Obtain a BS or MS degree, if possible. If this is not possible, read this book and apply its recommendations

Experience

Take full advantage of whatever experience you have. Seek to learn from others. Learn the lessons of everyday life on the job. If you don't learn from your mistakes, you will repeat them.

People

Treat people fairly and honestly. Be consistent and timely in handing out both praise and punishment. Remember their names.

Part 4 - The Approach:

Attitude

Do your best and follow the advice contained in this book. Your success as a PE will be assured, and an increased level of confidence will soon follow.

Epitomize the highest degree of ownership for all your undertakings. Don't wear it like a badge, though. Instead, be always submersed in it like a fish in a deep well. Others will dive in to join you.

Remain true to your project goals. Don't ever cave in!

Survive the nonsense and do what you have to do to get the job done!

Patience

Try to develop an appropriate mix of patience, understanding and prudence

amplify the processes, tools and approaches that should be applied to gain the most advantage from these "Best Practices".

We all remember better with a little repetition. You will be rewarded manyfold for the time that you spend reviewing this material.

Finally, please don't put this book on a shelf to gather dust over the coming years. Keep it close at hand so that you can pick it up and refresh your memory as to the best processes, tools and approaches to put into practice as you move forward in your career as a PE. A good time to go through this "refresher" is at the beginning of each new project. Over the near term, I recommend that you re-read the specific project "process" sections of the book as you enter the various stages of your current project.

There is a lot of information in these pages. Use it to your advantage.

Good Luck!

Appendix B

The PE Template Set

This appendix provides the following series of templates which, when filled in, will form the overall template set for your PE activities:

PE Template Set

Title	Figure Number
Program Milestones - Starting the Project Template	B1
Proposal Team Activities Template	B2
Program Milestones - Starting the Project (Cont'd) Template	B3
Program Milestones - Starting the Project (Cont'd) Template	B4
Program Milestones - Starting the Project (Cont'd) Template	B5
Program Milestones - Starting the Project (Cont'd) Template	B6
Engineering Tasks - System Design Template	B7
Engineering Tasks - System Design Template (Cont'd) Template	B8
Engineering Tasks - System Design Template (Cont'd) Template	B9
Engineering Tasks - System Design Template (Cont'd) Template	B10
Engineering Tasks - Hardware Design Template	B11
Engineering Tasks - Hardware Design (Cont'd) Template	B12

The PE Template Set (Cont'd)

The PE Template Set (Cont'd)

These templates address the PE activities covered in this book. They provide you with the opportunity to assure that you have "covered all the bases" as you perform your PE duties. You can expand upon or modify these Templates as appropriate to fit the specific details of your business processes.

The intended meaning for the heading categories for each template element is as follows:

"PLANNING" - Have you planned this template element? Does your Project Team agree with your planning? Has ownership been assigned? Are you sure you have "buy-in"?

"ACTION" - What is the next action that must be taken to drive this template element toward a satisfactory conclusion?

"STATUS" - Has this template element been started? Has it been clearly communicated to all participating organizations? Have any problems been identified? Has this template element been completed?

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Please take the time to evaluate your true business condition before you start your project. Be excruciatingly truthful in your responses. Only then will you be able to plan effectively for the actions you must take as you begin your journey to excellence as a PE.

I recommend that you make copies of these templates and update them periodically as your project evolves. I also suggest that you create a new set of templates as you complete each of the four states shown in Figure 5. You will be surprised how the lessons learned during each state will aid your planning for the next state.

Good luck!

PROJECT ENGINEER TEMPLATE SET
Program Milestones - Starting the Project

TASK	PLANNED	ACTION	STATUS
IR&D PROGRAM	——	——	——
CONCEPT DESIGN REVIEW	——	——	——
PROJECT "GO-AHEAD"	——	——	——
PE SELECTION	——	——	——
PROPOSAL TEAM	——	——	——

Figure B-1

PROJECT ENGINEER TEMPLATE SET
Proposal Team Activities

TASK	PLANNED	ACTION	STATUS
PROPOSAL TEAM:	_____	_____	_____
* ACTION ITEM LIST	_____	_____	_____
* PROJECT SCHEDULE	_____	_____	_____
* BUDGET ESTIMATES	_____	_____	_____
* PROGRAM PLAN	_____	_____	_____

Figure B-2

PROJECT ENGINEER TEMPLATE SET
Program Milestones - Starting the Project (Cont'd)

TASK	PLANNED	ACTION	STATUS
PROPOSAL SUBMISSION			
CONTRACT NEGOTIATIONS			
CONTRACT AWARD			
PROGRAM PLAN UPDATE			
PROJECT TEAM ESTABLISHED			

Figure B-3

PROJECT ENGINEER TEMPLATE SET
Program Milestones - Starting the Project (Cont'd)

TASK	PLANNED	ACTION	STATUS
ORIENTATION MEETINGS	_____	_____	_____
* ENGINEERING	_____	_____	_____
* MANUFACTURING	_____	_____	_____
* QUALITY ASSURANCE	_____	_____	_____
* CONFIGURATION MANAGEMENT	_____	_____	_____

Figure B-4

PROJECT ENGINEER TEMPLATE SET
Program Milestones - Starting the Project (Cont'd)

TASK	PLANNED	ACTION	STATUS
ORIENTATION MEETINGS	____	____	____
* PRODUCT SUPPORT	____	____	____
* SOURCING/FINANCIAL	____	____	____
* TECHNICAL PUBLICATIONS	____	____	____
* INFORMATION SERVICES	____	____	____

Figure B-5

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PROJECT ENGINEER TEMPLATE SET
Program Milestones - Starting the Project (Cont'd)

TASK	PLANNED	ACTION	STATUS
ORIENTATION MEETINGS	___	___	___
* PROGRAM MANAGERS	___	___	___
* UNIT MANAGERS	___	___	___
* TOP MANAGEMENT	___	___	___
* SUPPLIERS & VENDORS	___	___	___

Figure B-6

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Systems Design

TASK	PLANNED	ACTION	STATUS
SPECIFICATIONS	_____	_____	_____
* SYSTEM LEVEL REQT S	_____	_____	_____
* ALLOCATED REQTS	_____	_____	_____
* HARDWARE REQTS	_____	_____	_____
* SOFTWARE REQTS	_____	_____	_____

Figure B-7

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Systems Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
SPECIFICATIONS (Cont'd)	_____	_____	_____
* FIRMWARE REQT S	_____	_____	_____
DESIGN STATE DEFINITION	_____	_____	_____
* TRANSITION EVENTS	_____	_____	_____
* LEVELS OF CONTROL	_____	_____	_____

Figure B-8

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Systems Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
PROTOTYPE BUILD SUPPORT	_____	_____	_____
HARDWARE/SOFTWARE INTEGRATION - PROTOTYPE	_____	_____	_____
PROTOTYPE HW/SW DESIGN UPDATES	_____	_____	_____
PROTOTYPE CONFIGURATION VALIDATION	_____	_____	_____

Figure B-9

PROJECT ENGINEER TEMPLATE SET

Engineering Tasks - Systems Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
DESIGN EVALUATION TESTS			
QUALIFICATION TESTS			
ACCEPTANCE TESTS			
DESIGN REVIEW PLAN			
DESIGN REVIEW SCHEDULE			

Figure B-10

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Hardware Design

TASK	PLANNED	ACTION	STATUS
DESIGN TASK SCHEDULE	_____	_____	_____
DESIGN REVIEW SCHEDULE	_____	_____	_____
DESIGN REVIEW #1*	_____	_____	_____
DETAILED DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #2	_____	_____	_____

* See Design Review Detailed Task
  Template (Figure B13)

Figure B-11

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Hardware Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
FINAL DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #3	_____	_____	_____
INTEGRATION & TEST	_____	_____	_____
DESIGN REVIEW #4	_____	_____	_____
FCA/PCA SUPPORT	_____	_____	_____

* See Design Review Detailed Task
   Template (Figure B13)

Figure B-12

PROJECT ENGINEER TEMPLATE SET
Design Review Process Tasks

TASK	PLANNED	ACTION	STATUS
DR PACKAGE TO REVIEWERS	_____	_____	_____
DR PACKAGE COMMENTS RECEIVED	_____	_____	_____
DR COMMENTS RESOLVED	_____	_____	_____
DR PACKAGE UPDATED	_____	_____	_____
DR MEETING ANNOUNCED	_____	_____	_____

Figure B-13

PROJECT ENGINEER TEMPLATE SET
Design Review Process Tasks (Cont'd)

TASK	PLANNED	ACTION	STATUS
DR MEETING	_____	_____	_____
DR MEETING ACTION ITEMS RESOLVED	_____	_____	_____
DR APPROVED OR DISAPPROVED	_____	_____	_____
DR REPORT PREPARED	_____	_____	_____
DR REPORT ISSUED	_____	_____	_____

Figure B-14

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Software Design

TASK	PLANNED	ACTION	STATUS
DESIGN TASK SCHEDULE	_____	_____	_____
DESIGN REVIEW SCHEDULE	_____	_____	_____
DESIGN REVIEW #1*	_____	_____	_____
DETAILED DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #2	_____	_____	_____

* See Design Review Detailed Task
  Template (Figure B13)

Figure B-15

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Software Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
FINAL DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #3	_____	_____	_____
INTEGRATION & TEST	_____	_____	_____
DESIGN REVIEW #4	_____	_____	_____
FCA/PCA SUPPORT	_____	_____	_____

* See Design Review Detailed Task

  Template (Figure B13)

Figure B-16

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Firmware Design

TASK	PLANNED	ACTION	STATUS
DESIGN TASK SCHEDULE	_____	_____	_____
DESIGN REVIEW SCHEDULE	_____	_____	_____
DESIGN REVIEW #1*	_____	_____	_____
DETAILED DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #2	_____	_____	_____

* See Design Review Detailed Task
  Template (Figure B13)

Figure B-17

PROJECT ENGINEER TEMPLATE SET
Engineering Tasks - Firmware Design (Cont'd)

TASK	PLANNED	ACTION	STATUS
FINAL DESIGN TASKS	_____	_____	_____
DESIGN REVIEW #3	_____	_____	_____
INTEGRATION & TEST	_____	_____	_____
DESIGN REVIEW #4	_____	_____	_____
FCA/PCA SUPPORT	_____	_____	_____

* See Design Review Detailed Task

Template (Figure B13)

Figure B-18

PROJECT ENGINEER TEMPLATE SET
Prototype Build and Test Activities

TASK	PLANNED	ACTION	STATUS
MATERIAL PROCUREMENT	_____	_____	_____
PROTOTYPE FABRICATION	_____	_____	_____
DESIGN CHANGES INCORPORATED	_____	_____	_____
HARDWARE/SOFTWARE INTEGRATION	_____	_____	_____

Figure B-19

PROJECT ENGINEER TEMPLATE SET
Prototype Build and Test Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
SIMULATIONS	_____	_____	_____
DESIGN EVALUATION TESTS	_____	_____	_____
QUALIFICATION TESTS	_____	_____	_____
FUNCTIONAL CONFIGURATION AUDIT	_____	_____	_____
PROTOTYPE UPDATED TO PRODUCT BASELINE CONFIGURATION	_____	_____	_____

Figure B-20

PROJECT ENGINEER TEMPLATE SET
Transition Team Activities

TASK	PLANNED	ACTION	STATUS
TRANSITION TEAM ESTABLISHED	_____	_____	_____
DEVELOPMENT BASELINE CAPTURED	_____	_____	_____
CCBs* ESTABLISHED	_____	_____	_____
PRB* ESTABLISHED	_____	_____	_____
FCA/PCA PLANS APPROVED	_____	_____	_____

* See Detailed Task Templates

  (Figures B26 & B28)

Figure B-21

PROJECT ENGINEER TEMPLATE SET
Transition Team Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
MRB* ESTABLISHED	_____	_____	_____
MRP SYSTEM DATA LOAD	_____	_____	_____
PROJECT SCHEDULE UPDATE	_____	_____	_____
CM PLAN UPDATE	_____	_____	_____
ACTION ITEM LIST	_____	_____	_____

* See Detailed Task Template

(Figure B27)

Figure B-22

PROJECT ENGINEER TEMPLATE SET
Transition Team Activities (Cont'd)

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TASK	PLANNED	ACTION	STATUS
ELECTRONIC DATA CONTROL STRATEGY VERIFIED	_____	_____	_____
VENDOR/SUPPLIER MEETINGS	_____	_____	_____
DESIGN RELEASE TO MANUFACTURING	_____	_____	_____
LONG LEAD MATERIAL ORDERS	_____	_____	_____

Figure B-23

PROJECT ENGINEER TEMPLATE SET
Transition Team Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
DATABASES VERIFIED	_____	_____	_____
PRODUCTION SCHEDULE	_____	_____	_____
FCA* CONDUCTED	_____	_____	_____
FCA DISCREPANCIES RESOLVED	_____	_____	_____
FIRST PRODUCTION UNIT COMPLETED	_____	_____	_____

See detailed tasks, Figures B29 & B30

Figure B-24

PROJECT ENGINEER TEMPLATE SET
Transition Team Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
FIRST ARTICLE INSPECTION	_____	_____	_____
PCA*	_____	_____	_____
PCA DISCREPANCIES RESOLVED	_____	_____	_____
PRODUCTION BASELINE ESTABLISHED	_____	_____	_____
DESIGN AUTHENTICATED	_____	_____	_____

* See Detailed Task Templates

(Figures B31 & B32)

Figure B-25

PROJECT ENGINEER TEMPLATE SET
Configuration Control Boards (CCB)

TASK	PLANNED	ACTION	STATUS
MEMBERS SELECTED	_____	_____	_____
CHAIRPERSON SELECTED	_____	_____	_____
FACILITIES IN PLACE	_____	_____	_____
CCB PROCESS VERIFIED	_____	_____	_____
ON-LINE CCB* TESTED & VERIFIED	_____	_____	_____

* If PDM system is installed

Figure B-26

PROJECT ENGINEER TEMPLATE SET
Material Review Board (MRB)

TASK	PLANNED	ACTION	STATUS
MEMBERS SELECTED	_____	_____	_____
CHAIRPERSON SELECTED	_____	_____	_____
FACILITIES IN PLACE	_____	_____	_____
MRB PROCESS VERIFIED	_____	_____	_____
ON-LINE MRB* TESTED & VERIFIED	_____	_____	_____

* If PDM system is installed

Figure B-27

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PROJECT ENGINEER TEMPLATE SET

Problem Resolution Board (PRB)

TASK	PLANNED	ACTION	STATUS
MEMBERS SELECTED			
CHAIRPERSON SELECTED			
FACILITIES IN PLACE			
PRB PROCESS VERIFIED			
ON-LINE PRB* TESTED & VERIFIED			

* If PDM system is installed

Figure B-28

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PROJECT ENGINEER TEMPLATE SET
Functional Configuration Audit (FCA)

TASK	PLANNED	ACTION	STATUS
FCA PLAN	_____	_____	_____
DESIGN EVALUATION TEST PLAN	_____	_____	_____
DESIGN EVALUATION TESTS	_____	_____	_____
DESIGN QUALIFICATION TEST PLAN	_____	_____	_____
DESIGN QUALIFICATION TESTS	_____	_____	_____

Figure B-29

PROJECT ENGINEER TEMPLATE SET
Functional Configuration Audit (Cont'd)

TASK	PLANNED	ACTION	STATUS
FCA PROBLEM RESOLUTION	_____	_____	_____
DESIGN EVALUATION & QUALIFICATION TEST RPTS	_____	_____	_____
FCA REPORT	_____	_____	_____
CUSTOMER WITNESS OR VERIFICATION	_____	_____	_____

Figure B-30

PROJECT ENGINEER TEMPLATE SET
Physical Configuration Audit (PCA)

TASK	PLANNED	ACTION	STATUS
PCA PLAN	_____	_____	_____
FIRST ARTICLE INSPECTION	_____	_____	_____
PCA REV/SER# DATA CAPTURE	_____	_____	_____
ACCEPTANCE TEST	_____	_____	_____
PCA DATA PROCESSING	_____	_____	_____

Figure B-31

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PROJECT ENGINEER TEMPLATE SET
Physical Configuration Audit (Cont'd)

TASK	PLANNED	ACTION	STATUS
PCA PROBLEM RESOLUTION			
PCA REPORT			
CUSTOMER WITNESS OR VERIFICATION			
PRODUCT DESIGN CERTIFICATION			

Figure B-32

PROJECT ENGINEER TEMPLATE SET
Production Activities

TASK	PLANNED	ACTION	STATUS
PRODUCTION SCHEDULES:			
* LONG LEAD ITEMS	_____	_____	_____
* PRODUCTION MATERIAL	_____	_____	_____
* PRODUCTION UNITS	_____	_____	_____
PRODUCTION TEST & INSPECTION PLAN (PTIP)	_____	_____	_____
TRANSITION TEAM ACTION ITEMS	_____	_____	_____

Figure B-33

PROJECT ENGINEER TEMPLATE SET
Production Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
VENDOR PROBLEMS	_____	_____	_____
DISCREPANT MATERIAL	_____	_____	_____
MAJOR DESIGN CHANGE INCORPORATION	_____	_____	_____
MINOR DESIGN CHANGE INCORPORATION	_____	_____	_____
CONFIGURATION VERIFICATION AUDITS	_____	_____	_____

Figure B-34

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PROJECT ENGINEER TEMPLATE SET
Quality Assurance (QA) Activities

TASK	PLANNED	ACTION	STATUS
PRODUCTION TEST & INSPECTION PLAN (PTIP)	_____	_____	_____
INTERNAL QA PROCEDURES	_____	_____	_____
CCB ACTION ITEMS	_____	_____	_____
MRB ACTION ITEMS	_____	_____	_____
PRB ACTION ITEMS	_____	_____	_____

Figure B-35

PROJECT ENGINEER TEMPLATE SET
Quality Assurance (QA) Activities (Cont'd)

TASK	PLANNED	ACTION	STATUS
INTERNAL QA AUDITS:			
* AUDIT SCHEDULES	_____	_____	_____
* AUDIT PLANS	_____	_____	_____
* CORRECTIVE ACTIONS	_____	_____	_____
* AUDIT REPORTS	_____	_____	_____
CCB ACTION ITEMS	_____	_____	_____
MRB ACTION ITEMS	_____	_____	_____
PRB ACTION ITEMS	_____	_____	_____

Figure B-36

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PROJECT ENGINEER TEMPLATE SET
Configuration Management (CM)

TASK	PLANNED	ACTION	STATUS
REQTS TAILORED & NEGOTIATED	————	————	————
BASELINE CAPTURE PLAN	————	————	————
ELECTRONIC DATA CONTROL STRATEGY	————	————	————
CM PLAN	————	————	————
CCB's ESTABLISHED	————	————	————

Figure B-37

PROJECT ENGINEER TEMPLATE SET
Configuration Management (Cont'd)

TASK	PLANNED	ACTION	STATUS
DEVELOPMENT BASELINE CAPTURED	_____	_____	_____
CSA DATABASE	_____	_____	_____
FCA PLAN	_____	_____	_____
PCA PLAN	_____	_____	_____
PRODUCT BASELINE ESTABLISHED	_____	_____	_____

Figure B-38

PROJECT ENGINEER TEMPLATE SET
Product Documentation

TASK	PLANNED	ACTION	STATUS
USER MANUALS	_____	_____	_____
TECHNICAL MANUALS	_____	_____	_____
DRAWINGS (PAPER/ELECT)	_____	_____	_____
RETURN & REPAIR PROCEDURES	_____	_____	_____
TROUBLESHOOTING DOCUMENTATION	_____	_____	_____

Figure B-39

PROJECT ENGINEER TEMPLATE SET
Contract Documentation Requirements

TASK	PLANNED	ACTION	STATUS
TECHNICAL DATA PACKAGE	_____	_____	_____
PROGRAM STATUS REPORTS	_____	_____	_____
DESIGN CHANGE ACTIVITY REPORTS	_____	_____	_____
MRB CORRECTIVE ACTION REPORTS	_____	_____	_____
CONFIGURATION VERIFICATION AUDIT REPORTS	_____	_____	_____

Figure B-40

Appendix C

Lessons Learned

This appendix provides examples of lessons that I have learned during my career as a Project Engineer and which I am passing on to you, my reader, in the hope that you will not make these same mistakes. I will present these *Lessons Learned* as follows:

Lessons Learned are the basis for the development of several of the *Best Practices* presented in this book. In other words, over the years I (and other PE's) have done several misguided, stupid or hasty things or have taken actions which weren't properly thought out ahead of time. These "goofs" subsequently proved to be deleterious both to our careers and to the projects on which we were working. As a result of a careful review of these "screwups", I have been able to present you with advice as to how you can improve on our past performance by utilizing the "derived" *Best Practice* for the specific task at hand. These *"Best Practices"* (derived from *Lessons Learned*) are a subset of the overall set of *"Best Practices"* that is presented throughout the text of this book and which is provided in summary format in Appendix A. In order to present you with a set of *Lessons Learned* which has the "ring of truth", I shall reiterate this specific subset of *"Best Practices"* in the following paragraphs and then identify the *"Lesson Learned"* from which that specific *"Best Practice"* was developed so that you can easily see where we went wrong and learn from our mistakes.

"LESSONS LEARNED" which led to "BEST PRACTICES"

Best Practice: *Assure that you have "buy-in" from all key personnel in your organization for your proposed project and for any changes to your project plan. This will help to guarantee that you have their full support as the project evolves. This support will be indispensable to the success of your project.*

Lesson Learned: On a few occasions, I have gone ahead with "buy-in", i.e., unconditional expression of support, from the majority of those whom I considered the "key individuals". There were some folks who I thought at the time would be nice to have on board for a particular decision but whom I did not contact because I wanted to save time. I learned the hard way that I

should have contacted these folks. The time ultimately came when I needed their support, and they (rightfully) informed me that, had they known about my revised plan at the appropriate time, they would have either disagreed with my proposal or increased their quotation for their portion of the effort. In these cases I was forced to "eat crow" in front of the Program Manager when I went to him to obtain the required additional funding. Don't let this happen to you.

Best Practice: *Make sure that you "beat the bushes" to identify all tasks and to ferret out all related costs. It's better to find out about these items early during the proposal phase of your program, when you are in a position to negotiate them with your customer than to find out about them later when you will have to pay for them out of profits. Your motto should be: "NO SURPRISES!"*

Lesson Learned: On occasion, I have (mistakenly) relied upon the in-house quotation system to capture functional unit cost estimates in response to instructions provided at the proposal "kickoff" meeting. I have learned the hard way that not everyone who may ultimately participate in contract activities always attends these kickoff meetings, no matter how hard I try to make that happen. As a result, these "missing" individuals do not get their quotes in on time or at all. In some cases, they hear second hand about the quotation effort but do not receive complete and accurate task definitions, so that their quotations, when submitted, are not truly representative of the actual tasks they will be called upon to perform. You need to combat this situation by pro-actively getting out there and making sure that everyone who will be contributing to the contract effort receives proper quoting instructions. You should generate a list of potential performing organizations, check it our with your proposal team and make sure that you receive an input from everyone on your list.

Best Practice: *Create an Action Item List, and assure that responsibility for each action item is assigned to a specific individual. Require that individual to report upon the status of his action item at the regularly scheduled Proposal Team meetings. Demand action item closure per scheduled dates.*

Lesson Learned: During my career, I have been assigned to organizations that did not do business by using action item lists. The first thing I did in these cases was to learn what the outstanding program tasks consisted of and then proceed to establish an action item list for these tasks. I always made sure that I obtained "buy-in" for both task content and the due date from the specific individual assigned to the task. The improvement in task performance was astonishing in every case. Without an action item list process in place, you are bound to have a free-wheeling, out-of-control mess on your hands.

Best Practice: *Document everything you can get your hands on. You will be surprised at the kinds of information you will need to support your project as time goes by. Record as much information as possible via electronic media, i.e., computer databases, text files, graphics files, etc. This methodology will make it easier to retrieve data in the future.*

Lesson Learned: Situations have occurred where I found it necessary to search my records and the company's records for information surrounding the circumstances of specific events. This scenario often occurred during internal or external audits when the auditor found something which seemed to him to be a violation of requirements or procedures but which, in fact, was acceptable at the time it occurred. I have been able to demonstrate the appropriateness of our actions when and if I had sufficient backup data. However, in many cases, I could not find what I was looking for. It had, in most cases, seemed unimportant at the time to save some scrap of information. The lack of that information proved embarrassing more often than not. The realization in hindsight of, "if I had only saved that" is a very unpleasant one. Try not to let it happen to you.

Best Practice: *Don't promise anything you can't follow through on. Never assume anything. Communicate! Communicate! Communicate!*

Lesson Learned: Frequently, in the heat of negotiations, it became necessary for me to make decisions on the spot and promise something or other to the potential customer. My record has been pretty good as far as acceptance of my commitments to the customer by my management personnel but I can tell you, that on a few occasions, I felt mighty uncomfortable as I was trying to justify some of these commitments. I urge you to keep open and use your channels of communication with both management personnel and your functional contributors as you negotiate either new contracts or modifications to existing contracts.

Best Practice: *Document your project planning agreements and require your internal organization personnel to acknowledge ownership for these tasks plus the project schedule and budgets in your Program Plan. These documents will help you later on down the road just in case someone "forgets" what they agreed to do.*

Lesson Learned: There is generally a "honeymoon" period immediately after contract award when everyone feels generous as he looks forward to the execution of a profitable contract. Things change, however, when the realities of business life force many folks into the unenviable realization of not having quoted enough for a particular task or of becoming exposed to unanticipated technical or production problems. When the going gets tough, people generally are not open to performing what they may consider to be unnecessary or avoidable tasks. Having documentary proof they had accepted ownership for a particular task during the proposal period will make your life much easier.

Best Practice: *Use every tool and aid at your command to assist you in your project coordination activities. Spend a good deal of time moving about and talking to your "troops".*

Lesson Learned: In the past, I have been forced to rely upon notes jotted down on scraps of paper, update schedules and action item lists by hand, generate report drafts to be later typed by my secretary, place phone calls, and hold frequent meetings in order to perform my duties as a PE. Today we have e-mail, PC office tools, PDM systems, and the Internet (to mention a few) to save time and provide a higher level of control and communication. However, you still need to get out of your office and move about among the "troops" to speak to project team members and supporting personnel in order to maintain the necessary level of personal contact..

Best Practice: *Make sure your design data are baselined and under formal Configuration Control before you place orders for production materials.*

Lesson Learned: Many businesses that do not have a solid Configuration Management program in place have made the mistake of ordering production materials before capturing their product's design data, baselining it and putting it under formal Configuration Control. The risk in not capturing and controlling your design data at a specified time or event is simply to permit a free-wheeling, out-of-control design process to take place. In this situation, no one has any idea of the state of the design at any given time. This is anathema! Parts can be delivered which won't fit or work. Future design changes can't be proposed or evaluated because you have lost track of your starting point. I could go on and on but the idea is basic and simple. Capturing and controlling a known baseline at a previously agreed upon time or event is absolutely essential in order to conduct a responsible program or project.

Best Practice: *Make sure that your Engineering, Manufacturing and Quality Assurance personnel are "singing from the same sheet".*

Lesson Learned: In the "bad old days", invisible walls seemed to exist between Engineering and Manufacturing operations. On the other hand, Quality Assurance and Manufacturing operations typically have worked quite closely together. Once the design was completed and "blessed" by Engineering, it was "tossed over the wall" (released) to Manufacturing to build. When Manufacturing found that they could not build the product as designed, they tossed back red-line markups of the design drawings, and Engineering redesigned the product as required. This was a time consuming, iterative process, as you can imagine. This topic is covered in detail in the text. The point I wish to make here is that today, with the concept of "concurrent engineering" in full swing, it is mandatory that everyone on your Project Team be part of and party to all decisions, whether they be Engineering, Manufacturing, Quality Assurance, or other in nature. It shouldn't

take much imagination to see the problems that can (and will) develop if any operation or key individual is left "out in the cold".

Best Practice: *Make your customer feel like he or she is part of the team.*

Lesson Learned: Customers can and do run the gamut from being technically capable to being design dummies. They can, therefore, contribute meaningfully or not at all to your business decision making processes. They can also be downright deleterious to your decisions. I have seen examples of a whole range of situations. The point that my experience admonishes me to make here is that, if at all possible, make your customers part of your decision processes *where it is appropriate.* If you can do this without slowing down your processes, they will feel like they are an integral part of your team, and they will tend to do whatever is asked of them (within reason) when and if you need their cooperation on some issue. Think of the effort this takes as an investment in the future of your project. It's a win-win situation for you.

Best Practice: *Document the results of your CM activity planning and negotiations in your CM Plan.*

Lesson Learned: There were many times when I had to go around to my designers looking for the product design files or paper drawings to induct into our PDM system, electronic vaults or document control center as part of the Baseline capture process. Often, these designers or their lead personnel did not remember that they had signed up to deliver ALL design files as of a certain date or event such as prior to or immediately following a design review. I had to pry these designs away from each designer. It was like trying to squeeze water from a rock. If it were up to these engineers, they would work on their designs until they were thoroughly tested, updated and proofed out before they presented them to their CM folks for baselining and subsequent formal Configuration Control. After that event, each change presented to their peers and to your management clearly points out the inadequacies of their design (from their perspective).

It makes life much easier and adds a significant degree of control to your CM process if you document the agreements made between yourself, your designers, your CM folks, and your customer up front during the proposal and negotiation process so that you don't have a battle on your hands further on down the line.

NOTE: I have only given you one example here of possible conflicts in the CM area. There are many other potential trouble spots, such as your CCBs, design data control during development, FCA/PCA/CVA, and prototype hardware and software configuration control. Do yourself and your project a favor and document your entire CM scenario in a CM Plan.

Best Practice: *Consider the problem resolution and disposition activity as the "front end" to your Change Control CM process. This will help you to cover all bases and assure that nothing "drops in the crack".*

Lesson Learned: This is a relatively new concept, one which I developed and implemented at the General Electric and Lockheed Martin business units where I worked. Once you capture your baselines, you would seldom have to make any design changes (other than to replace parts if one or more of your suppliers goes out of business) unless problems developed and were identified to you by your designers, builders, maintainers, or customers.

Therefore, the problem resolution process, as discussed in detail in the text of this book, is the front end of your design change process. I have experienced considerable difficulty in the past trying to convince other PE's and my managers that the CM folks had a legitimate right to serve as core members on their problem resolution boards or corrective action committees. Once this arrangement was put in place, the transition from problem identification and resolution to design change proposal, approval and implementation was made in a much more effective and efficient manner.

Best Practice: *Plan your schedules and budgets carefully with the support of all participating personnel. Make them comprehensive and detailed. Keep your schedules up-to-date.*

Lesson Learned: The key words here are "with the support of all participating personnel". I have, on occasion, proceeded to generate and publish my project schedules and/or budgets without the input and "buy-in" of ALL participating personnel. Sometimes, I made estimates for folks who were either not available at the time or who did not submit the requested information. I can truthfully state that, in almost all cases, I got into trouble for doing this. Not only is it a risk to input information for another individual or function as far as accuracy of the estimate (dates or $) is concerned, it also "pisses them off". You don't want to do that, believe me. Take the extra time, go out of your way and even be late (if necessary) but make sure that you get inputs from all of the appropriate folks for your schedules and budgets. You will have much more accurate information to use, and more importantly, you will have proper ownership for the tasks involved.

Best Practice: *Hold meetings when necessary and beneficial to the conduct of your project. Don't hold meetings just to continue an established pattern of activity.*

Lesson Learned: Sometimes, it just seems the "right thing to do" to call a meeting. Sometimes, however, I have found myself wishing that I hadn't done this, because some meetings I've called have turned out to be disasters. Folks whom I asked to attend gave me advice that was either not

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welcome or was just plain inappropriate for one reason or another. Arguments ensued over which course of action to pursue. I would have been better off to have limited the attendance to a few key individuals or not to have called a meeting at all. My message is this: be judicious when making the decision as to whether or not to call a meeting. You should always involve the key players when making important business decisions; however, think twice about who these people should be for a specific meeting topic. Perhaps it might be wiser, in some cases, to walk around to discuss the matter personally with members of your project team before you decide to call a meeting. The more organized you are at the beginning of any meeting, the better your chances for success.

NOTE: This admonition does not apply to your regular periodic meetings, i.e., CCB, MRB, PRB, Project Team, Transition Team, etc.

Best Practice: *Ask questions. Don't worry about exposing your lack of knowledge in any particular area. Don't worry that your question may appear stupid. The only stupid question is the question not asked.*

Lesson Learned: Earlier in this book, I mentioned my aversion to asking questions as a youth and during my formative years as a PE. I realize now how foolish that was. I would have done more, faster if I had not been reticent about asking questions. Think back in your own life and think about the most recent time you held back when considering whether or not to ask a question. I'll bet it wasn't that long ago. We still all have this natural fear of exposing our ignorance. However, the more often you just go ahead and ask those questions, the easier it will get and the faster you will obtain the information you need to do your job. This is a "learned" trait, not a naturally occurring phenomenon.

Best Practice: *Document your internal procedures if they don't already exist. Use an independent function (person) to thoroughly check out your new procedures.*

Lesson Learned: The first several times my manager asked me whether or not I had documented this or that procedure, I was not only offended at his seeming mistrust in my ability to do my job (he was, in effect, checking me out), but I was also concerned about his increased ability to hand my job over to someone else once he thought he had a "cookbook" that anyone could follow. Well, after years went by, and I found myself in the position of having suddenly lost a few key individuals, I wished that I had pulled that old "document your job" trick myself. In the highly competitive business environment of today and tomorrow, we don't have the luxury of having too many individuals around who know how to cover "all the bases". Therefore the next best thing is to generate, check out and maintain current your internal business procedures.

Best Practice: *Take full advantage of whatever experience you have. Seek to learn from others. Learn the lessons of everyday life on the job. If you don't learn from your mistakes, you will repeat them.*

Lesson Learned: Experience, like love or friendship, cannot be bought. It can't be studied. It only comes with time, and that only happens when you do something with your time. The more you do, the more valuable your experience. I'm not trying to say that you won't be a good PE until your hair falls out and your arthritis starts to act up. On the contrary, each additional day that you put in on the job will increase your experience and, therefore, your performance. Be patient , and that invaluable experience will pile up, making you a better PE, and allowing you to enjoy your profession all the more.

Best Practice: *Treat people fairly and honestly. Be consistent and timely in handing out both praise and punishment. Remember their names. Epitomize the highest degree of ownership possible for all of your undertakings. Don't wear it like a badge, though. Instead, be always submersed in it like a fish in a deep well. Others will dive in to join you.*

Lesson Learned: The message provided by this "best practice" is, obviously, an admonition to treat people right to the best of your ability. I think that we all know what this means, and we all have a pretty good idea as to the reasons for and the benefits of this practice. I would like to be able to say that I practice this "way of life" every day, in everything I do. However, that would be a gross overstatement of the truth. I don't believe that there would be much added value to this "lesson learned" topic if I tried to tell you about all the negative things that have happened to me as a result of my past failings in this area. You can look back upon your own lives, both business and personal, and clearly see the advantages of complying with this admonition.

Life is a two way street. We reap what we sow. As a PE, your business is people. They must, in order to keep their jobs, comply with your directions and try to meet your expectations of them. They will, however, put forth that extra bit of effort when the time comes that it's needed, whether or not your ask for it if you treat them right. There is nothing hypothetical in this statement. It's just the way things are. So, I'm offering this message here as a word to the wise.

Remember also that the way you treat folks should not be affected by whatever the situation is at the time. Ethics are independent of circumstances.

Best Practice: *Remain true to your project goals. Don't ever cave in!*

Lesson Learned: On occasion, I have become momentarily discouraged with the way things were going. Remember my problem in the introduction to this book? Well, looking back, I've gone through many difficult times. I think we all have. I will not wax philosophical here and get into

any broad conceptualizations about this phenomena but I would like to say at this point that things always get better. That said, it's extremely important to note that you must always remain true to your principles and to your project goals. No matter how unlikely the accomplishment of a single action item or the success of your entire project may seem at any given time, you must never give up, even for a moment. Keep forging ahead. There is always light at the end of the tunnel if you persist.

Best Practice: *Try to develop an appropriate mix of patience, understanding and prudence*

Lesson Learned: I could really get carried away on this topic. My lack of patience has reached epic proportions over the years. However, I think it would bore my readers to death if I tried to recall specific examples. Suffice it to say that many times I have "blown up". In retrospect, I can't recall one time where I did not wish afterward that I had demonstrated more patience. This is another "learned" skill. I only wish I that had learned this lesson much earlier in life.

Best Practice: *Use stressful situations to your advantage by taking action. Use the processes, tools and approaches taught in this book. Don't sweat the small stuff.*

Lesson Learned: I think we often get so engrossed in and overcome by stress that it is difficult to realize that the only way to overcome it is by taking action. That fact has not always been obvious to me. It is true, however, that once I was able to plan a course of action - ANY course of action and then start to execute it, things got better. *This works every time.* That cloudy curtain that stress draws over our faces and our minds disappears like water on a hot tin roof as soon as we initiate action. So, even if you are not sure that you have defined the absolutely best plan of action, move ahead with it anyway. You can always modify your approach as time goes by. Immediate action is the name of the game when stress rears its ugly head.

Best Practice: *Listen to others. Try to hear what they are attempting to convey to you. You will obtain information, and they will feel good about the exchange.*

Lesson Learned: It has always been difficult for me to keep my mouth shut and listen to others talk. I have had to consciously tell myself (mentally) to shut up and listen. On those occasions when I listened to this advice, I usually learned something. It wasn't always what I wanted to know or what I expected, but I picked up information, and that is not a bad thing. If I had a dollar for every time someone has told me to "shut up and listen", I'd have enough to take my wife out to dine at the best restaurant in town for at least a week.

Best Practice: *Be aggressive but not adversarial. Don't shout or lose your temper. You have the most to lose and your project will surely suffer the consequences.*

Lesson Learned: This is a very important "best practice". There is a world of difference between being aggressive and being adversarial. This fact was made evident to me on a daily basis when I worked as a Program Engineer for a Program Manager who was always battling our Engineering personnel. During private meetings with this individual, he usually referred to "them" or "they" as if they were the enemy. This attitude on his part manifested itself in such a forceful way that the Engineering folks came to think of him as the enemy, and he lost all credibility. He became ineffective because he could no longer negotiate or discuss issues objectively.

A similar situation developed during a time when I worked for a senior PE who acted as though he were the only one in the organization who was capable of doing anything right. Everything was adversarial with this guy. Oh, he had a few buddies in our Engineering organization but everyone else was a "jerk" as far as he was concerned, and he treated them accordingly. Needless to say, he was hated by many and lost the respect of almost everyone with whom he came in contact. He kissed up to the customer and the Program Manager and, as a result, was able to keep his job for awhile. Ultimately, however, when the time was right, he was given a relatively unimportant assignment to keep him busy until it was time for him to retire. I've lost track of this fellow since my days at the company where we were both employed. When I meet my old working companions around town, no one brings up his name. Better to let sleeping dogs (and miserable old PE's) lie.

Don't mistake this with being aggressive, though. You must be very aggressive in all your actions as you plan your activities, coordinate your operations and drive your tasks to completion.

Best Practice: *Make sure that there are no organizational situations which could lead to a challenge to your authority. Also make sure that everyone on your project knows their roles and responsibilities. Keep your Program Manager well informed. Don't share project personnel unless forced.*

Lesson Learned: I have worked many years as both a Project Engineer and as a Program Engineer. Often, my duties were the same or very similar for both positions. On those occasions when my counterpart (Project Engineer or Program Engineer) was intelligent, sensitive and "with it", things went OK. However, on those unfortunate occasions when my counterpart was less capable and a little dense, I experienced many miserable times because of the overlap of responsibilities and the ensuing friction which developed between us.

It's a much more desirable situation when roles and responsibilities are clearly identified and understood by all concerned.

Appendix D

Multiple Projects

A Project Engineer is usually assigned responsibility for one project at any given time. There are, however, exceptions to this rule. The subject of how one deals with the coordination and control of multiple projects is addressed in this appendix.

The idealistic or academic solution to the dilemma of managing two or more projects simultaneously is the multiple application of the same processes, tools and approaches recommended in the main parts of this text for the management of a single project. In the real world, however, this will not work - at least as a simplistic approach.

The problem is time. We have only so much of it to spend. If the duties of a PE consume as much time as I have indicated throughout this book, then how could one ever hope to manage more than a single project?

Well, there is a way to approach this daunting task. We have to deal with what's real, and multiple task management is a reality in today's business environment. There are ways to focus coordination and control activities so as to make the best use of your time and to minimize the risks inherent in this type of business scenario.

Project Schedules: The first and most important activity which you must undertake is the generation of a Project Schedule for each of your projects. Create "strawman" Project Schedules and discuss them with your key personnel. Seek their counsel and listen carefully as they describe potential conflicts. Many of these folks have "been there, done that", and you need to absorb as much of their wisdom as you can. Use their tips to augment your decisions as you flesh out your Project Schedules. This is necessarily an iterative process, so don't worry about the time you will be spending as you develop these Project Schedules. They will pay you back manyfold as your projects evolve.

NOTE: It is critical to constantly update, revise and add more detail to your Project Schedules as time passes. The conscientious utilization of these project management tools will be a major factor in your being able to "pull off" the challenge of multiple project management.

The new Project Management software tools available on the market today can not only add to your efficiency as you perform your PE duties, they can make the difference between success and

failure, simply because of the time that they can save for you to use in carrying out other PE activities which demand your personal presence or attention. Again, I must stress that time (or the lack of it) is the enemy as you struggle to manage multiple projects. Any process, tool or approach that can save time is your ally.

Assistant Project Engineer: Another strategy you can undertake is the deployment of one or more Assistant Project Engineers (APE) to support your overall planning, coordination and control of multiple projects. You can delegate limited responsibilities to your APE's, with the provision that they report back to you on a daily or more frequent basis. Of course, you won't let them make any major decisions without your blessing.

Your APE's can assume much of the load of maintaining your project schedules and budgets plus follow up on action items and conduct many of the more routine meetings. Again, your main objective is the overreaching goal of winning your war against time as you move your projects forward towards a successful conclusion.

This methodology is a win-win situation for your company. Not only is the risk of a severe problem developing on any given project mitigated to a significant extent but your APE's will be provided with invaluable experience, thereby increasing their value to your organization. The only drawback is the cost of their labor but this is minimal when compared to the damage that inadequate project oversight can cause.

Summary: This is the shortest section in this book. However, I think it appropriate to end it at this point because I have simply said all that I have to say on the subject of multiple project management. If you are able to employ the suggestions given above in the manner prescribed in the basic text of this book, you should be able to avoid any major problems.

Whether managing one or more projects, the tips provided above plus the processes, tools and approaches described and advocated in this text can, if conscientiously utilized, save you that extra bit of time which might make the difference between success and failure as your projects evolve.

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APPENDIX E

CM Plan Preparation Guidelines

INTRODUCTION:

Roadmap: Your Configuration Management Plan (CMP) will serve as the roadmap for your configuration management program. From the time you embark on your initial proposal activities to the time you initiate development activities, you will be planning the configuration management processes that you will put into place, and you will be negotiating these processes with both your internal functions and your customer(s). The results of these planning activities and negotiations will be documented in your CMP. Then, from the time you start your requirements analysis and design definition throughout development, test, transition to production, production, deployment, delivery, on to the end of your maintenance and support activities, your CMP will guide you, your employees and your customers along the way.

Your CMP should tell the story, in clear and simple language, about how you have agreed to control your design data during development, capture and control your development and

production baselines, conduct your FCA (prove that your design works) and PCA (prove that you can build your product), control the ordering of your materials, provide status information (internally and externally), control the fabrication and build of your hardware and software, run your CCBs, MRBs, PRBs, Design Reviews, Transition Team meetings, plus perform periodic audits to assure compliance to your documented concurrent engineering and production processes.

Your CMP will also serve as a reminder of those agreements made early on in the program, just in case someone forgets.

As you progress through this Appendix, you will notice that I have created three separate categories. These categories provide different options and guidelines for different sized businesses:

Small Business   *Medium Size Business*   *Large Corporation*

The purpose of this categorization is to make it easy for you to focus on the information you need to know to generate a meaningful and useful CM Plan appropriate for the size of your business and the specific program involved.

Whether you operate a small, medium or large business, your single most important CM tool is your CMP. Even if you don't design the products you are building, you need a CMP to control the design provided to you by your customer or engineering subcontractor.

Generic CMP vs. Program-Unique CMP: I wish I had a dollar for every time I've been asked to write a "generic" CMP. You would think a CMP was the same as a procedure for changing the tire on a bicycle, i.e., pretty much the same for all bikes. By the way, this is a good time to emphasize the difference between plans and procedures. I will do that as soon as I complete this section on generic CMPs.

A generic plan is just that - generic: a plan for all occasions! That is not possible with CMPs!

Your CMP documents the merging of your "best CM practices" and the customer's requirements for a given program. The CM processes negotiated for your program represents tradeoffs between levels of control and cost. These processes are documented in your program CMP. If

Military Standards are invoked for a program, your CMP must document how the requirements specified therein are to be satisfied.

Therefore, you must bite the bullet and be prepared address the specific CM requirements of each new program as it comes along. You may, by all means, have standardized CM "best practices" documented in your internal, step-by-step procedures. You will use these "best practices" plus the templates provided in Appendix B to plan and negotiate your CM program.

CM Plans vs. CM Procedures: I don't want to belabor this point but it deserves coverage here. Plans document relatively high level decisions, provide schedules to identify milestones and establish completion criteria, reference requirements and related documents, and describe, in general terms, how you plan to conduct business for a given program. Enough information should be provided in a plan to allow the reader to understand, to a reasonable degree, the interrelationships between processes and program driven events, including a substantive description of roles and responsibilities of those individuals and functional areas performing on the program.

Procedures, on the other hand, provide detailed, step-by-step, instructions as to how you are going to implement these processes. You should be able to use identical or similar procedures from one program to the next. Your procedures should represent your "best CM practices".

CM Template Set: I have provided a description of the "best CM Practices" plus a detailed, comprehensive CM template set in another text, "Practical CM: Best Configuration Management Practices for the 21st Century". This book can guide you through your CM planning, coordination and implementation activities for current and future programs:

CMP Length: Your CMPs should not be voluminous documents. Nobody will read them if they are. The length will vary from program to program but a good rule of thumb is no more than fifty pages (thirty pages is good), not including appendices which contain definitions, acronyms, special topics and forms.

Be concise but don't skimp on the necessary information. A few well designed flow charts such as your process for design baseline capture and change control (from beginning to end) will go a long way to convey the information you need to communicate. Use the flow charts in "Practical CM" to get yourself started. You should also include your organizational reporting chart. Your customers will want to know who's the boss and who's responsible for the various aspects of your business.

Remember that, whenever a question arises during any phase of your program, you want your people to automatically go first to their best source of reliable information - their CMP. If you do a poor job in writing your CMP, they will come to you, instead, every time!

TAILORING AND PLANNING:

Communication With Engineering: In this section, we will first discuss the importance of communicating the details of the job to be done with those who are going to help you do it. You should tell them about the customer's requirements and discuss how you will propose your "best CM practices" to your customer, tailored to meet his needs, yet not cause too much damage to his wallet.

You must then make sure that all of your key personnel understand the content of the work, the interrelationship of CM and the engineering, quality assurance and production processes and agree to the roles and responsibilities of all involved during the various stages of the program. You will then proceed to document the results of your planning and tailoring in your CMP. Place this information right up front in your CMP. It is very important that your customer knows that you have done a good job in the planning and tailoring area. He can help you iron out details later but you must first demonstrate that you have planned a solid foundation for your (and his) program.

Start with your Engineering personnel because it is they who are involved most during the early stages of the program. Understand that you need to involve other functions, such as Producibility Engineering, Components Engineering, Quality Assurance, Manufacturing, Product Support, and Sourcing in both primary and supporting roles.

If you operate a small business and your engineering department consists of one individual, get him or her involved at this time.

Obtaining "Buy-In": The key to success for a smoothly running CM operation is the "buy-in" of your CM/DM/PDM system users and, especially, of those key individuals who will help you integrate your PDM system into your Engineering, Quality Assurance, Manufacturing and CM disciplines and methodologies.

Without their buy-in, you don't have a prayer for success. Actually, today it is much easier to garner that cooperation than it would have been two or three years ago. Engineers and draftspersons know that they need help in managing their design data files. Quality Assurance and Production personnel want to get rid of all that paper. Fortunately, you are operating today on the winning side of the curve.

In order to assure buy-in of these important elements in your operation, you have to be "up-front" with your people and let them know, as early as possible, what is going on.

I recommend a series of "CM/DM/PDM overview" discussions where you describe in sufficient detail for thorough understanding just what your CM requirements are and how you plan to achieve them. Then you should describe where you are going with your PDM system and tell your people how you plan to get there.

Open yourself up to their questions and ask for their help. You will need it, and they will be glad to provide it. After all, they have a stake in your program's success, too.

Don't forget to document the results of these discussion and planning sessions in your CMP.

Roles and Responsibilities: As you and the representatives of your functional areas discuss and complete the planning checklists provided herein, the roles and responsibilities of your personnel will become obvious. Document these roles and responsibilities in your CMP.

Checklists and Templates: The checklists and templates presented in "Practical CM" provide the basis for what you and your organization need to generate a good CMP. The Design

Review Checklist (Figure 2), the CM Planning Schedule (Figure 3), the CM Planning Checklist (Figure 4), and the ten CM Planning Templates provided in Chapter 10 comprise the checklist and template set that you will need to plan and execute your CM program and generate your CMP.

The order in which you fill out the checklists and planning sheets doesn't matter. I advise you to read them all once, then fill out what you can. You should then search out information you don't have at your fingertips. This activity will provide you with the opportunity to talk to those individuals in your organization that I have spoken of earlier in this Appendix.

Once you have completed your first draft of the template set, pass it out for review. Then call a meeting and discuss each entry on every sheet. You will be amazed at the amount of good information that will result from this meeting. It may be tedious but it is worth it. This time invested up front will reward you manyfold as your program progresses.

After you have secured agreements and revised your set of checklists and templates, you should edit them at least one more time and include them in an Appendix to your CMP. You will see that these checklists and templates describe not only your best CM practices but document the unique processes that you intend to apply to the program being planned.

You should periodically update these checklists and templates. They will provide an excellent source of "lessons learned" for future programs and projects.

Military Standards and Commercial Standards: The Procurement Reform initiative, i.e., the Perry Initiative, undertaken by the DoD is, in part, designed to reduce the number of MIL-STDs utilized by the DoD to procure products. Some MIL STDs, though, such as the Interface Specification, MIL STD 2549, will be a mandatory requirement for most DoD suppliers and contractors.

Commercial Standards and Guidelines may, on the other hand, be recommended by DoD suppliers as the way in which they propose to run programs for either the DoD or for commercial customers. The government can then decide whether or not it can live with the processes described in these commercial standards.

Some companies are in the process of generating their own internal "best practice" procedures, based upon Commercial Standards and Guidelines, Military Standards, ISO Guidelines and requirements, where applicable, and just plain good sense. You need to become aware of the "playing field" on which you will be conducting your programs. Make sure you maintain compliance to those standards which your customer requires and generate your CM plan accordingly, using the "best CM practice" techniques taught in "Practical CM".

Risk Management: As a final note in this section about tailoring and planning in preparation for the documentation of your CM processes in your CMP, we should introduce the concept of risk management. After all, that is what CM is all about.

CM is a tradeoff between control and cost. The amount of CM you can afford depends upon the level of risk you are prepared to take and the size of your customer's wallet. We still have to deal with what's real! More control and traceability costs more money up front but pays off in costs saved down the line. I don't believe it is appropriate to try to sell you on the idea of putting lots of CM procedures in place at this time. If you haven't gotten the idea of the value of a solid CM program by now, then I've done a pretty poor job of writing this book.

On the other hand, you should be aware that there is, indeed, a point where you must decide upon the appropriate amount of CM for each of your programs.

This is particularly true for small and medium size businesses. You can start with a good CMP

and continue to run your CM program in a controlled environment without installing a sophisticated PDM system and still reduce your risks and enjoy the resulting savings.

Use the "best CM practices" defined herein and integrate them into your program as appropriate to meet your customer's requirements within his budget. Some decisions may be hard but you have to make those decisions in as well informed a position as possible. By now, you should be very well informed about the values of CM and the methods required to implement an efficient and effective CM program*.

CONFIGURATION CONTROL BOARDS:

One of the subjects that is always covered in CMPs is the topic of Configuration Control Boards (CCB). The reason for this is simple. CCBs are the vehicles by which we control changes to our designs after we have captured our design baselines.

The reason we convene CCBs is to tap the resources that know the most about the fundamental ways in which we conduct business. It is imperative that the appropriate people review proposed changes to our designs.

* This appendix originally appeared in "Practical CM". It was excerpted from that book and modified for inclusion in "Practical Project". For a full treatment of CM "best practices", the reader is referred to "Practical CM".

Small and medium size businesses may have limited functions and personnel to draw from for their CCB membership. This is OK. The important thing is to involve those individuals whom you can trust to carefully evaluate proposed changes and make wise business decisions.

With such a significant amount of responsibility riding upon the shoulders of the CCB members, it is prudent to define roles and responsibilities of the various CCBs as early in your programs as possible. Actually, in most DoD programs, the CMP is a deliverable item, and this fact forces the CCB architecture and composition decisions to be made in a timely manner.

Internal CCBs: Internal CCBs should be organized by the categories of Hardware CCBs and Software CCBs. Sometimes you will see Integrated Product Development "Team" (or worker level) CCBs plus internal Program level CCBs. The latter is the exception rather than the rule, though. The Program level CCBs generally encompass your customer representatives and are usually put into place after the Product Baseline is established.

Your CMP should provide an illustration to show the organizational hierarchy of your internal CCBs. It should also show the relationship between your internal and external CCBs.

You should identify the roles and responsibilities of your required and supporting CCB members. You should also define in sufficient detail the process by which proposed changes to your designs are presented to your CCBs, the manner in which they are reviewed and approved or disapproved, the process by which your designs are updated and the mechanisms you have instituted to assure proper cut-in of design changes to your hardware and software products.

It is perfectly acceptable to point to other internal procedures for detailed descriptions of exactly how these processes are performed. Your CMP should, however, provide a roadmap that the careful reader can follow to understand the overall process.

You will need to discuss how information and action items are communicated between your internal CCBs. This communication line is essential in assuring that important items do not get dropped in the crack. My purpose here is chiefly to advise you as to the proper content of your CMP and to drive home the fact that you must show, in your CMP, how you communicate, internally.

External CCBs: Following the establishment of your Product Baseline, your customer will probably want to sit in on your CCB to review and approve changes (at least Major changes), or to conduct a Program level CCB of his own, especially if your contract is with the DoD. I do

believe, however, from my observations over the past few years, that even our Military customers are leaning towards control of our designs by controlling our design specifications and leaving the control of our individual detailed designs to ourselves, i.e., the contractors.

In any case, you should negotiate this facet of the change review and approval scenario with your customer and try to come to an agreement that will provide the most "bang for the buck" when it comes to the level of activity assigned to your external CCB. Your customer must understand that here, as in other areas of CM, it is primarily a matter of cost versus control. You and he must answer the question, " How much CM do I need"? If you can convince your customer that your CM methodology is properly integrated into your internal design and development processes and that you have a solid CM process in place during production, you may be blessed with minimal customer participation and intervention during the latter stages of your contract. This is one area where your planning activities with your customer early in the program will pay off as demonstrated by the amount of trust he is prepared to place in you and your processes at this stage of your program.

Small businesses may never see the need for an external CCB. Your process will be more streamlined if you aren't required to obtain customer approval for proposed changes.

Small businesses may never see the need for an external CCB. Your process will be more streamlined if you aren't required to obtain customer approval for proposed changes.

CM PROCESSES: Now that you have the planning, tailoring and organizational matters thoroughly covered in your CMP, it is time to get down to the specifics as to exactly how you are going to run your CM program for this contract. You should present and document your CM processes in the major categories of:

        * Configuration Identification

        * Configuration Control

        * Configuration Status Accounting

        * Configuration Audits

Your task in generating your CMP is to describe, in plain language, how you intend to address these areas of activity - simple as that! Remember, if it's true, it has to be simple!

You also need to document the answers to the following questions as to why you will be performing the CM job for each category described above:

        * What are the reasons why I should perform this activity?

* What are the "red flags" that will tell me if I am doing something wrong?

* What is the corrective action that I can take to remedy a bad situation if it occurs?

These questions were posed by the Willoughby templates. I have borrowed them to pass on to you because they are the right questions to ask. I do, however, want to make sure that Mr. Willoughby receives the proper credit for them. He certainly has the right thinking in this area.

Automatic CM: You will have achieved fully Automatic CM when your new PDM system becomes tightly integrated into your CM and Engineering development tools and processes. You will need to cover this topic in your CM plan.

 Small businesses who do not plan to implement the functionality of a PDM system can, of course, skip this section.

Small and medium size businesses that are considering implementing a limited scope PDM such as a Local Area Network (LAN) should discuss this activity in their CMP, even if the program is going to be initiated via a paper-based scenario.

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Large corporations, however, should cover this topic with a comprehensive section in the CMP. Your customer will want to know the extent to which you are automated, and your personnel will need the roadmap to follow in performing their CM tasks.

You should be very careful to explain, in simple terminology, your "end condition" of Automatic CM, i.e., paint a picture of where your are now and articulate how you are going to reach that blissful final state by increasing your PDM functionality a step at a time and by simultaneously integrating your new PDM functionality into your programs and processes. Of course, by the time you need to generate your next CMP, you may already be at or beyond the final phase of the customization and integration of your PDM system.

"Practical CM" provides the information you will need to both implement your new PDM system and to document its functionality in your CMP. You may use the Figures contained in "Practical CM", Chapter 9, as well as those provided throughout this book, as the basis for similar illustrations for your own CMP.

You should provide in an appendix to your CMP , or incorporate into a separate internal procedure, the screens to be used by your PDM system and the procedures required to operate the system. Don't forget to negotiate up front the resources required for the use of your system

(hardware, software and network hookups). Also, plan for training PDM system users, including your customers and suppliers.

Finally, document it all in your CMP.

Good luck on your projects!