# 9

# RCM LESSONS LEARNED

It is very likely that most of the people involved in your company maintenance program, especially those charged with its improvement, have heard the term "RCM." However, the number of people who actually have some reasonable understanding of RCM is, in our experience, quite limited. Given that such an uninformed state exists, it is extremely difficult to gain wide acceptance of an RCM program and the value that can be realized from it. The necessity for such familiarization is important at both the management level and the system engineer and craft personnel level. Familiarization at the craft level is especially important, a point that is not always fully recognized or appreciated.

Throughout this book, we have endeavored to demonstrate how RCM can and should be an integral part of any maintenance organization, especially those wishing to be known as *World Class*. In Chapter 8, we have just dealt with how to successfully carry an RCM program to the shop floor and make it the backbone of any PM improvement philosophy. The authors, having been involved with RCM from its first introduction to the U.S. commercial and industrial world in the early 1980s, have experienced virtually every characteristic that contributes to successful and likewise not-so-successful RCM programs. In this chapter, we will attempt to give you the benefits of our 35-plus combined years of RCM experience and the lessons we and others have had to learn along the way. It is our hope that, by knowing where the more significant potholes lurk, you may avoid them.

We will begin our discussion on RCM lessons learned by more fully developing the organizational factors that have an influence on beginning a *World Class* journey in maintenance. From there, we'll touch on what we feel is the proper composition of the RCM team, present some thoughts on how to effectively

schedule your RCM activities, touch on the importance of training everyone and not just the RCM team, how to know what systems are the best candidates for RCM and which are not, and how to make the most use of those IOIs. We will then end our presentation of Lessons Learned with winning strategies on gaining acceptance from your peers, program management considerations, and finishing with what we feel are the key factors in the successful and not-so successful RCM programs.

## 9.1 Organizational Factors

### *9.1.1 The Structure Factor*

There is an old adage that it is the dispositions, personalities, and motivations of the people, not the structure of the organization in which they work, which ultimately determine project or product success or failure. Experience bears this out, in the authors' view. But, by the same token, this experience also says that the particular version of organizational structure that is employed can be a significant factor in making success easy or difficult to achieve. For example, organizational structures usually determine lines of communication, which can be short and simple or lengthy and complex; they also establish boundaries on areas of responsibility which can be either very broad, highly partitioned and restrictive, or even deliberately overlapping and competitive, to encourage the "best ideas" to emerge victorious. (We have worked in the latter organizational philosophy on occasion, and have frankly found it to be quite counterproductive to ultimate product success, and sometimes even destructive of highly competent people who were inadvertently caught in its web.) In the maintenance world, in particular, there is a continuing debate over organizational structure at both the corporate and the plant level that never seems to reach a satisfactory resolution. We refer here to a structure where maintenance and production are separate and equal organizations versus a structure where maintenance reports to production. We have been involved with clients in both camps, and have even worked with clients who have switched from one to the other in midstream of a successful RCM program.

Here is our view on this issue. We see two important factors that should influence the choice:

a. Externally, meeting customer requirements (delivery, quality, cost).
b. Internally, achieving team play and efficient use of resources.

We believe that this can best be achieved when maintenance and production are peers—i.e., separate organizations. When maintenance reports to production, team play tends to take a back seat to production's authoritative approach. More bluntly, production loses sight of the vital role that maintenance plays in

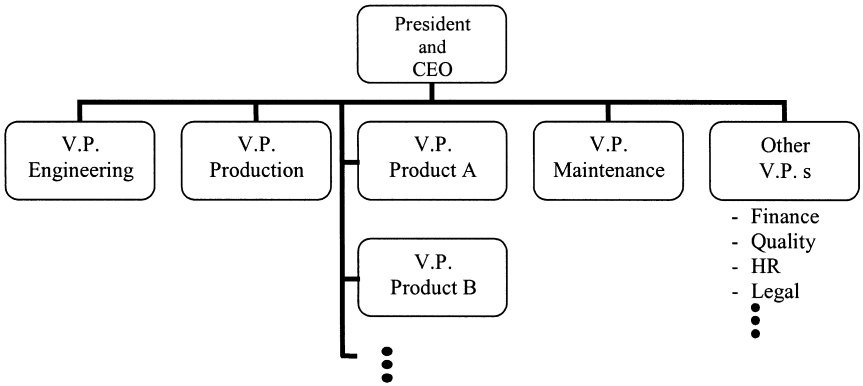


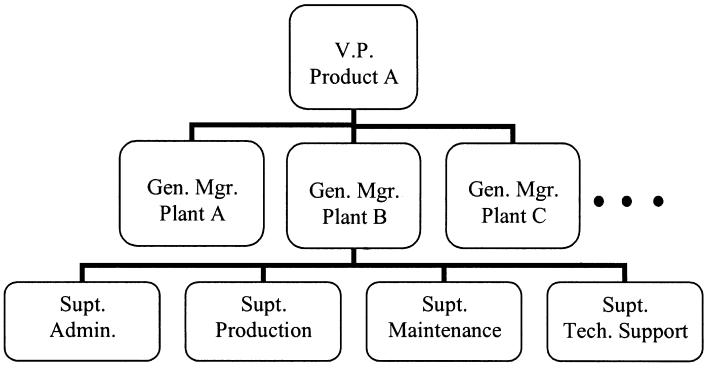

*Figure 9.1 Typical corporate organization.*

its success; egos and turf battles tend to replace team play. And from an RCM point of view, initiating and implementing an RCM program is easier to accomplish when the two organizations are separate since the decision chain is shorter, straightforward, and more willing to undertake innovations that make the job more efficient. Ultimately, reduction in team play and efficiency will detrimentally impact one or more of the parameters that affect customer satisfaction.

To keep it simple, we will now look at two tiers of a typical company structure that is composed of separate maintenance and production organizations. The corporate level is shown in Figure 9.1 and the plant level in Figure 9.2. How should we deal with them to initiate and implement an RCM program?

### *9.1.2 The Decision Factor*

In the corporate structure (Figure 9.1), our interests usually reside with the Vice President of Maintenance, and also possibly a key technical director who oversees process improvement. And even though the organizations are separate, it is prudent to include the Production Vice President in some of the "selling" discussions because the RCM process ultimately requires the cooperation of Production's equipment operators in optimizing the PM tasks. The important thing is to understand just who the essential decision makers may be; failure to include all of the right people in the selling process could doom your efforts before you even reach first base. One simple example will illustrate this latter point. You manage to do a first-class job convincing the VP–Maintenance that RCM is needed. But nothing ever happens because, unbeknownst to you, the VP had to then sell it to VP–Production who controls approval rights to any production line modification, and your VP flunked the course. You might well have succeeded had you made the pitch to Production, but you never knew about the control that production exercised on new maintenance ideas.




Note: In a typical matrix organization, the plant personnel are drawn from the parent Functional organization.

***Figure 9.2 Typical plant-level organization.***

In the plant-level structure shown in Figure 9.2, our interests deal with the plant general manager as well as the superintendents of operations, maintenance, and technical support. Of course, even to get the plant's attention, we might have first required a positive endorsement from corporate management. Without this endorsement, we may get nothing more than a polite hearing from plant personnel, if that. Notice also, that when dealing with the plant, operations and technical support will play a role that could be just as important as the maintenance role in initiating and achieving a successful RCM program (see Sec.9.2—RCM Teams). If the plant manager happens to be a "power center" on the organization chart, it could be that your sales job begins and ends there. We have seen such cases, but they are infrequent. A good plant manager, however, can be a very strong ally for your cause if he introduces and endorses your idea at the corporate level. In either event, it may sometimes be prudent to start at the plant level even though the real decision authority probably resides at the corporate level.

### *9.1.3 The Financial Factor*

Our corporate focus in the previous discussion on the decision factor is directly related to the financial factor. Funding for new initiatives like an RCM program either comes from a corporate budget, or at the very least may require a corporate-level approval of development expenditures that are resident in a plant budget. You may also find that everyone is apparently positive about the introduction of RCM, but no one is willing to pay for it. We have all too often heard responses to the effect that "we can't afford it." The job then becomes one of convincing the decision makers that they "can't afford not to have it." How is this done?

There are several parameters that influence a credible answer to this question, but the answer in a nutshell is ROI—Return On Investment. What will it cost, and what will be the payback? Let's examine these two questions more closely.

On the cost side, we need to put away one RCM myth that is frequently encountered—namely, a belief that RCM must be applied to every system in a plant in order for its benefits to be realized. And this myth is frequently what is behind the "we can't afford it" response. So let's put this myth to bed right now. You do not want to apply RCM to every system in a plant! Sec. 9.5 will explain in more detail that you usually choose about 20% of the plant systems for an RCM program using the classical process, and maybe another 20% (if any at all) using the abbreviated classical process. Using these percentages, we can suggest the following guidelines for costs (assuming use of "RCM WorkSaver" software—see Chapter 11):

Classical process, using a 3-man team (see Sec. 9.2):

- Pilot (1st) system—about 6 weeks applied time, including training time, or 18 man-weeks of total effort.
- Subsequent systems—using those personnel trained on the pilot system, there is a rapid learning curve to about 4 weeks applied time, or 12 man-weeks of total effort.

Abbreviated classical process—about 75% of the effort required on the full classical process.

The cost of RCM WorkSaver software and use of a consultant for training and pilot project facilitation can add a one-time cost of about $40,000 to $50,000. For a rather simple plant with about 30 systems (e.g., a fossil power generation plant), the RCM program would cost $200,000 to $300,000 over a 1- to 2-year period. If the plant is complex with, say, 100 systems (e.g., a nuclear power generation plant), the cost is in the $900,000 range over 3 to 5 years.* Of course, there are many variables that influence these cost and schedule figures, such as learning curves, personnel experience, salary levels, number of teams employed, and team size. (It is important to note that, when multiple plants or facilities are involved, a new RCM analysis for each system is usually not required; rather, the existing systems analysis can be "replicated" at the other plants at a considerably reduced cost. The replication process is a particularly useful concept where a number of similar plants/facilities are involved.) But at these levels of expenditure, it is safe to say that the approval requirements are at the corporate level where the Vice President of Maintenance, together with key members of his or her staff, must formally concur in order to establish a line item in the budget for the

*These cost estimates are given in 2002 dollars, and assume an 80/20 rule using the Classical RCM process.

RCM program. Thus, the initial sell occurs at the corporate vice-presidential level, and this may or may not occur with visible support from the Plant General Manager. If you are fortunate, it is the Plant General Manager who initiated the request for RCM program funding because the selling job is then already halfway done at the outset. We have occasionally experienced this, and it has simplified the entire process immeasurably. In one rather extreme case, the board of directors became the approval authority, but the more general rule is that you must go to the corporate vice presidents to get the ball rolling. If two vice presidents are involved, your selling job may be more than twice as difficult—simply because these people may have different agendas and priorities which tend to compete for available funding. Thus, you may have to gain a very comprehensive understanding of these two agendas, and then find a way to couch your sales pitch to fit both agendas. If a single vice president is the initiating sponsor, funding approval becomes less involved since he or she usually will not hesitate to act unilaterally if you present a convincing case that success is highly probable.

But are the above costs worth it? Again, what will be the payback? Let's start by recalling Figure 1.1 in Chapter 1. Our point there was the need to focus our PM resources (costs) on decreasing the CM incidents (costs) and increasing output (profit) by reducing forced outages (i.e., downtime). This latter factor is by far the big swinger in this financial picture. A brief downtime analysis, based on a very conservative estimate, will place ROI quickly into perspective. We find that all of our clients measure a one-day loss of output in the $100,000 per day range and up—a nuclear plant, for example, must purchase about $800,000 of replacement electricity when it goes unexpectedly off-line for one day. We suggest that a saving of just one day of downtime essentially represents the breakeven point for implementing a comprehensive RCM-based PM program. More realistically, our clients have measured the following benefits (ROI):

- Downtime reductions of 40 percent and up.
- CM cost reductions of 30–50 percent.
- Items of Interest (IOI) paybacks of $100,000 and up.

All of these benefits are annual paybacks. If you agree with these values (or if you wish, only one-half of these values), how can you afford not to implement an RCM program!?

One final thought here. Be sure to check Sec. 12.2 which presents seven case studies that our clients have graciously agreed to contribute to this book. And listen carefully, please, to what they have to say. Also, in Appendix C of this book the reader will find a discussion on ProCost©, a financially based reliability improvement model that can calculate an estimated ROI for commencing and implementing RCM PM program recommendations. A financial model like ProCost© can take the "trust me" out of PM improvement justifications. This model is currently being used by a large Midwestern manufacturing company. Also, we should mention that

using financial models like ProCost© adds additional but minimal front-end costs to any project.

### 9.1.4 The Buy-In Factor

Buy-in is the process whereby an individual or a group, responsible for carrying out some new procedures or actions, has been a party to the development and planning for those actions, and has agreed that this new modus operandi is good for all concerned, and therefore will support its use. When buy-in is successfully accomplished, the people involved have usually made a direct or supporting contribution to the action plan and, implicitly, have accepted the plan as well as assumed some level of ownership in the plan. With RCM, this process occurs almost entirely at the plant level of the organization. Without the essential ingredients of *acceptance and ownership* it is highly improbable that a plant staff will feel motivated and compelled to implement anything—and that especially includes the recommended PM tasks from an RCM program.

Achieving an appropriate level of buy-in to an RCM program is dependent upon several factors that deal with how the plant staff is integrated into the RCM systems analysis process and the expected benefits to be realized. First of all, there must be a clear and visible endorsement for the RCM program from top management—usually at the Maintenance Vice Presidential level. However, do not be lulled into believing that the sales and education job stops there; it does not! If you succeed in obtaining top management endorsement, your job has really just begun because you now must do the same job, only better, with the plant staff. This, in particular, includes the craft technicians who may never be members of an RCM team. This latter process is not a one-stop job, and chances are excellent that the sales and education process will continue over a long period of time—say, two years or more—to capture everyone in the plant organization who is germane to a completely successful RCM program. The approach to buy-in from the plant staff is multifaceted, and requires not only training seminars and one-on-one tutorials but, more importantly, the involvement of experienced and respected craft personnel in the systems analysis process who can explain the methodology and benefits to their peers, and motivate a broad base of acceptance.

For sustained success, an RCM "champion" must emerge who can provide leadership to the buy-in process.

Another important point to consider is the need to include the operations and technical support personnel in the acceptance and ownership issue. The reasons for this are imbedded directly in the RCM process itself, when CD and FF tasks take on equal importance to the more traditional TD (overhaul and intrusive-type) tasks. And who "owns" a share of responsibility for the CD and FF tasks? You've got it—operations and technical support. If you should fail to recognize this facet of the plant organization, successful implementation of the RCM program may never occur.

Our experience is that some organizations do not fully comprehend the significance of the buy-in issue. These organizations typically have serious difficulties when introducing anything new to an operating plant. This problem is compounded when the direction comes from "outside of the fence." While difficult to quantify, we believe that the success achieved with RCM is directly proportional to the degree of buy-in achieved with the plant operations, maintenance, and support technicians.

## 9.2 RCM Teams

### *9.2.1 Resource Allocation*

Where will the personnel to staff the Systems Analysis Process and Task Packaging efforts come from? This has all too frequently been a monumental issue which has led to delays in initiating an approved RCM program—delays that in a few instances have literally spanned several years. The nature of the difficulty with this issue involves the unfortunate fact that the most logical place to staff and conduct the RCM program, the plant itself, usually does not have sufficient availability of experienced personnel to do the job. The issue of plant on-site staffing is, however, a realistic issue since most plants have had or continue to conduct staff reductions to make them "lean and mean." The plant, without doubt, is the logical first choice for the selection of team members when we consider both the role that buy-in plays in assuring a successful program and the absolute necessity to establish a knowledgeable equipment and operations "database" for the systems analysis process. There are four possible solutions to this issue, each of which has been employed at one time or another to overcome the staffing dilemma.

1. Bite the bullet and assign appropriate on-site plant personnel to the RCM team by giving it top priority over other activities. The problem with this solution is that the top-priority assignment frequently goes by the wayside when there is any sort of hiccup in the plant availability status. Personnel are continually pulled away from their RCM team assignments "for just a few days to handle the crisis" with the net effect that a smooth and continuous RCM program is difficult to maintain. Everyone gets frustrated in the process and, in the worst case, the program may never be completed while, at best, the schedule for the program can be extended far beyond the original target dates for implementation. If you can eliminate, or at least consciously minimize, the RCM team disruptions due to emerging crises, this can be a very effective solution.
2. A variation on this theme is to authorize an increase in plant staffing specifically to assume the normal workload of the RCM team members. With this approach, some (one or two) key personnel from the existing staff might be placed in lead positions to help orient and integrate the new personnel into the plant community. The use of "retirees" has

proven quite effective in performing this "fill-in" assignment since they already are familiar with the plant and its equipment. There have been cases where this approach has worked exceedingly well, and has ultimately produced some of the best implementation results while avoiding any disruption to the daily work routines.

3. A third possibility is to staff and conduct the RCM program through the technical support group at corporate headquarters. This is often considered to be the best solution from a staffing point of view, but it also turns out to be a poor solution in terms of the required buy-in at the plant. This latter point can be mitigated to a large degree if the corporate-staffed RCM team plays a continuing and highly visible role with involvement from and integration with the plant personnel. Success with this approach is totally dependent upon how well this "if" is handled, but it still retains some of the disruptive problem inherent to #1 above.
4. A fourth approach is to bring in an outside contractor to execute the entire RCM program. In this case there is usually some degree of plant management assigned to oversee the contractor, with the net result that a very minor participatory role is played by the plant staff. This condition not only creates a major buy-in problem at the plant, but it may also create some technical deficiencies in the systems analysis process, since the contractor personnel will not have the in-depth systems and equipment knowledge required to thoroughly perform this process. The results of this approach have been mixed. We hear claims of successful programs, but more often we have known of partial to total wipeouts (i.e., the contractor's product was partially or totally unusable). This approach is usually the most expensive one, and has the lowest probability of yielding completely satisfactory results.

A variation of the contractor theme has been employed by several companies with whom the authors have worked. The examples presented in Chapter 12 are illustrative of this theme, where the company has used one of the first three approaches just described, and has employed a single consultant to work with the RCM teams until they become RCM process experts in their own right and can then complete the program using in-house personnel exclusively.

In summary, it is the authors' view that approach #1, augmented during the early program phases by an expert outside consultant, offers the highest probability of RCM program success. We would discourage any consideration of approach 3 or 4—both of which have a high probability that a successful and comprehensive RCM program will never be achieved.

### *9.2.2 Team Makeup*

The team should comprise no more than 4 to 5 people plus a facilitator. Larger numbers definitely fulfill the old adage that "too many cooks spoil the soup."

At a minimum, the team must contain an operator, a mechanical technician (machinist), and an electrical/I&C technician. The well-balanced RCM team is mostly composed of craft personnel representing both operations and maintenance. The maintenance technicians know the equipment inside and out and how the equipment degrades and even fails, while the operators know how the plant systems interact and functionally behave. Most engineer types are only vaguely familiar with these details. Occasionally, a maintenance and/or system engineer is also a team member if this person knows the plant. Historically, however, teams that do not have craft personnel as members have not achieved a successful RCM analysis. We feel so strongly about this latter point that we will not facilitate any team that does not meet this criterion.

### *9.2.3 Personnel Selection*

Not everyone has the temperament and motivation to participate directly in an RCM process. Thus, in selecting team members, it is advisable to choose people who are capable of contributing new ideas, can accept change from the "old ways," and have a desire (thus the motivation) to play a role in improving how business is conducted. Frankly, if people have little creativity in their daily activities and responsibilities, they will not have a positive influence in a "team" environment. This particular team makeup is considered necessary for both the Classical and the Abbreviated Classical RCM™ process as well as for the ECM process (as described in Chapter 7).

RCM team assignments, especially for pilot RCM projects, should not be seen solely as a training exercise. Success is very dependent upon the knowledge of the individuals who comprise the RCM team. However, the assigning of an additional person to "experience and learn" can be an effective training scenario—just do not overdo it.

### *9.2.4 Facilitator Role*

Ideally, a positive team environment greatly helps any new process to be a success. Thus, some degree of a prior team Buy-In to the RCM process will help to create a conducive environment where each member has no reluctance to share his or her experience, knowledge, and opinions with others. In reality, this Buy-In may not always exist at the start of the project, and the Facilitator needs to provide the necessary guidance to help in achieving Buy-In during the early stages of the project. In an extreme case, where a team member consistently takes a negative posture, it might be best to replace him or her. (While this is not the norm, it has occurred.)

A successful RCM project depends on the capture of the team's past operations and maintenance knowledge and experience into the structured format used in the RCM and ECM process (see Chapters 5 and 7). However, the Facilitator

must be on guard to assure that this experience does not dominate the process to the extent that few, if any, "new" ideas are introduced. This is especially crucial in Step 7-1 where the team is required to specify candidate Applicable PM tasks for the critical failure modes. Promote innovation and new ideas, even if they go against the traditional way of doing things. In fact, a good Facilitator will go out of his or her way to encourage the introduction of new and innovative methods and techniques. RCM recommendations present strong and defensible *Business Cases* for new or improved cost-effective PM tasks, especially CD tasks.

On occasion, a team member is reluctant to speak out—especially if the team discussion revolves about some controversial issue. It is important that the Facilitator recognizes this, and tries to use his influence to persuade this member to "open up" and contribute his or her expertise more fully.

## 9.3 Scheduling Considerations

Successful RCM teams are always composed of personnel who are known to be among the "best" from the available candidate list. For the RCM team, that is the good news. The bad news is that these very same people are in demand, and represent key resources to management with limited availability for peripheral assignments. This has been a common problem with all RCM projects.

The solution that has worked successfully involves the use of a staggered calendar schedule for the RCM team—generally one week of effort on the RCM project and then a two- or three-week interval where the team personnel return to their normal job duties. This arrangement satisfies most concerns about conflicting priorities, allowing plant management to effectively schedule these "key" personnel. But it is imperative to secure a firm management and team commitment to the one-week intervals when the team personnel will, in fact, be available without interruption for the RCM project. Intervals shorter than one week at a time make it very difficult to complete the analysis work with a reasonable degree of continuity.

When first introduced to management and those responsible for getting the work done, the idea of releasing their best people for one week without interruption appears to be at best somewhat unrealistic and at worst a nightmare. But consider this scenario:

> *Your improvement team has finally found an opportunity to meet for one or two days. By the time you get everyone's attention and redirect them to the purpose of this meeting, you are out of time and little if anything has been accomplished. What a waste of valuable time and talent! Now imagine how much more productive and how much better the results would be if you*

*could keep your team assembled for five straight days and concentrate all of your resources on the assigned task.*

As we have shown, RCM is a paradigm shift in attitude and philosophy and it takes time to get the ball rolling—especially with people who may not be used to sitting in a meeting all day—so anything that affects their effectiveness will just short-circuit the results. The team, especially the craft members, need to be assured that they will be left alone so they can concentrate on their valuable task—improving the profitability of your maintenance program.

Going hand-in-hand with making effective use of your resources, another reason for the one-week schedule is the cost-effective use of consultants. It makes for better use of their time and expense, especially with today's rising travel costs.

Facility "scheduled outages" tend to play havoc with the scheduling of the RCM team. Consideration of these scheduled events should be taken into account when the RCM team meetings are planned. Far more disruptive are the unplanned and therefore unanticipated outages. These events drain available manpower to get the plant back up, and those individuals most valuable to plant restoration are the same people who were felt to have the "right stuff" and were assigned to the RCM team. From a practical point of view, these interruptions cannot altogether be avoided. It is hoped that the importance of completing the RCM assignments, thus improving the bottom line and decreasing the occurrence of these unanticipated outages, will be recognized. Hopefully, management will become sensitive to this problem, and take action to accommodate at least some of these perturbations in order to keep the RCM project schedule on track.

We have come to learn that the successful completion of the first (pilot) RCM project tends to reduce, if not eliminate, the concerns that first arose over the assignment of key plant technicians to the RCM team.

## 9.4 TRAINING

Not everyone needs to become an RCM expert in order to realize its benefits and support its introduction. However, it is critical that everyone, from the corporate level VP of Maintenance (or equivalent) down through all levels of plant management, and on to the craft technicians who will be asked to utilize the RCM recommendations, becomes aware of what RCM is and is not. Specifically, focused indoctrination training, about 4 to 8 hours, should be provided to all corporate and plant personnel who may be affected by or have an impact on the program.

It goes without saying that all RCM team members, and especially any new or replacement members, must be trained in the details of doing RCM. It is imperative

that all team members have knowledge of the RCM process and how it is employed. This training includes:

- Understanding that the current maintenance situation can be improved upon.
- What RCM is.
- How RCM will help plant management and craft alike to achieve a more cost-effective PM program, and ultimately lead to more personal satisfaction in their job.
- A detailed explanation of the 7-step RCM process, i.e., how to do RCM.
- What the team's roles will be during the analysis and implementation processes.

This extensive training for an RCM team is most effectively accomplished in a 2-step program: (1) classroom-type instruction for a 3- to 4-day period at the outset of each new RCM project, and (2) hands-on involvement in an actual RCM project under the guidance of a skilled RCM facilitator. This 2-step program should be continued whenever a "new" team is formulated to conduct an RCM analysis. Historically, classroom training alone has been tried, and has not worked. Hands-on experience under a skilled facilitator is needed to realistically qualify an individual as an RCM "expert."

If the RCM philosophy is to be institutionalized in the plant, Facilitators must be developed and must have specialized training on reliability and failure concepts, RCM processes, running a team, and efficient use of RCM-oriented software (see Chapter 11). It is very important that an RCM Facilitator be included on as many teams as possible before letting them act autonomously; even then, from time to time the RCM Facilitator should sit-in with all teams. Several of our clients have used consultants who will first train the Facilitators and then counsel/tutor them as they direct a team.

Thus, the issue of training ranges from a broad-based indoctrination program to a focused and intensified program for those personnel directly participating on the RCM teams. Hands-on training via project participation (versus classroom-only training) is clearly the best, if not only, way to conduct a successful RCM program.

## 9.5 System Selection

We believe that one of the five ingredients required to bring your maintenance program to World Class status is to "focus resources for the best Return-On-Investment." In order to do just that, it is necessary to apply a credible method that will provide this focus. That method, in our view, is the 80/20 rule previously discussed in Sec. 5.2. We reiterate the 80/20 rule here to again emphasize its importance in any maintenance optimization program.

Hard (and embarrassing) early-on experience has taught us the need to use the 80/20 rule. In two of our early RCM efforts, the clients elected to employ qualitative (i.e., judgmental) decisions on where to focus resources (i.e., RCM projects) to improve their maintenance program. In both situations, the decisions initially led to the selection of systems for RCM evaluation that were "well-behaved" systems with no ROI potential.

So, if you wish to improve your maintenance program—by whatever process—we believe you must use the 80/20 principle as the starting point.

Our use of the 80/20 rule has consistently provided a credible basis for use of the Classical RCM process, and has been a very effective tool for defending the specific system selections that were made. By requiring the use of quantitative data and Pareto diagrams, we have also avoided system selections that gave the appearance of valid 80/20 systems but were totally ill-suited for the RCM process. Two examples in this regard will illustrate this latter point. In the first instance, the system was a high-cost maintenance system during the 18-month period that was selected for evaluation—but the maintenance problem resided almost totally in a single assembly which had been recently replaced with a new design. The maintenance problem vanished, and the discovery of this situation was revealed during a presentation to system engineering management who were responsible for approval of system selections for the RCM program. In the second instance, a high-maintenance system was correctly selected per the Pareto analysis—but a closer review of the system revealed that it was almost entirely digital electronic equipment. In case you haven't already noticed, preventive maintenance on digital electronics is virtually non-existent (do you perform PM on your TV set?). In both of these examples, we would have eventually discovered the problems described above, but some careful review of the selections made in Step 1 of the system analysis process can avoid some costly wasted effort (and perhaps some unwanted embarrassment).

As a reminder, we have found that there are three primary sources of historical system data that are suitable for the 80/20 analysis:

1. Total (PM & CM) maintenance cost.
2. Forced Outage Rates or Downtimes.
3. Number of CM events.

These items should be evaluated for the most recent 12–18 month interval for which data are available. We have also had situations where all three items were available, and each provided essentially the same list of 80/20 systems but in a slightly different order. We have also found that most organizations have records on all three items, but a simple count of CM events is usually the easiest and quickest data set to retrieve and evaluate.

## 9.6 Using IOIs (Items of Interest)

The introduction of IOIs to the system analysis process was an innovative addition that we first employed very early in our RCM work. When we learned to use RCM teams that were composed of O&M craft technicians, it was quickly recognized that the depth of practical talent gathered about the table, in conjunction with the depth of discussions triggered by the 7-step systems analysis process, exposed large amounts of valuable information above and beyond just maintenance data. So we instituted the IOI list in order to capture these pearls of wisdom.

The IOIs represent an invaluable "free" source of potentially large cash paybacks. For that reason, it is wise to selectively recommend some IOIs for immediate evaluation and action. Our experience is that these early IOI actions frequently produce cost savings that literally pay for the entire RCM program even before the first pilot RCM project is completed and implemented. This early payback feature has always led to a very positive response from management.

## 9.7 O&M Peer Acceptance

A special sub-category of buy-in deals with the issue of peer acceptance. Every organization structure places each individual in a position where there are peers—i.e., people with virtually the same level of responsibility, salary and, to some degree, influence on how people of "equal rank" might respond to new ideas and changes to the status quo.

Your peers, however, are not always in your part of the organization structure. The maintenance people are, for example, in this situation with respect to their peers in operations. Historically, in fact, maintenance and operation technicians have been at odds for as long as we can remember—with each blaming the other for almost every plant problem that occurs. In a *World Class* scenario, this hostility must cease. Understanding and cooperation between operations and maintenance must be a way of life.

RCM, because of its focus on the necessity to maintain function and its unique approach to the team makeup, will break down many of these barriers by exposing both parties to the everyday trials, tribulations, and responsibilities of each other. Our experience is that RCM has been the major influencing factor in those organizations where the traditional roles of O&M have been successfully melded together. The message here, then, is that O&M personnel need to learn and appreciate the mutual dependence that they share in achieving a *World Class* status.

## 9.8 Program Management Considerations

### *9.8.1 Feedback to Management*

Management has a large and constantly changing agenda with which to deal. Their nature is to move on and focus on emerging topics and/or the crises of the moment. It's not that they have forsaken you, but that you may have dropped below their radar screen. (In this instance, absence does not make the heart grow fonder!) It is incumbent upon the RCM team leader to keep RCM in front of management. How best to do this?

Feedback, more specifically feedback in person, is the key to success. Get on management's agenda on a pre-set and continuing basis. Right from the outset, establish a rapport with the member or members of the management team who are ultimately responsible for your project, and convince them that you should present a status report on this very important project at each regular project review meeting. As much as possible, you need to control your destiny and that of the project's. Keep the reporting short and focused on progress towards the goal, not on details. Be as positive as possible—this is a good place to bring up the IOIs which surfaced during the week and what their potential seems to be. All of this is aimed at keeping management's interest and attention; if you are seen as saving and not costing money, you will have a sympathetic ear. Gaining management's awareness will ease the few times when things may have gone astray and you may need their understanding and help to achieve a mid-course correction. Speaking of requesting action from management, be sure to have a suggested solution in mind when you ask for their assistance. You are there to gain their concurrence rather than to ask directly for a solution. Remember, you are dealing with somebody who always reports to somebody else. So give them something to carry up the corporate ladder that speaks well on how RCM is leading the way towards achieving *World Class* distinction and recognition.

We have discussed in the previous paragraph the importance of maintaining an open feedback to management. Just as important are feed-forward comments from management to the troops in the trenches. Management's comments need to be often, positive, and visible. They need to assure those doing RCM that the program is supported and recognized for its contribution to the bottom line and the company's progress towards achieving *World Class* status. The most successful RCM programs are those where management, at all levels from the top to the bottom, makes a concerted effort to have a keen interest, awareness, and presence in the activities being undertaken on the company's behalf.

On two occasions, we encountered management feedback situations that were totally beyond control by the RCM project—situations that ultimately led to failure (i.e., the successful pilot project was abandoned and the entire RCM program was dropped). Both failures had the same root cause—change of key top managers. In both instances, we had originally achieved key management Buy-In and

support, and in one instance the pilot project had identified and implemented two IOIs which saved some $300,000 during a major scheduled outage. Basically, the new top managers, who brought in their own people to key plant staff positions, arrived on the scene just as pilot project implementation (Step 8—Task Packaging) was to begin. We instantly lost our hard-won Buy-In and ownership. Despite repeated attempts, we were unable to regain program recognition. With the arrival of the new managers, RCM was a dead issue. It was not their idea, and they had their own agenda to promote. We do not have any useful advice on how to cope with such a situation. Just be aware, however, that this can happen to you should fate dictate management changes in strategic locations in the organization structure. Again, Buy-In and ownership is so important. You can't win without it.

### *9.8.2 Using Quantitative Reliability Data*

You may have noticed that we have not used any quantitative reliability data in the RCM systems analysis process (Secs. 5.2 to 5.8). In particular, we have not directly introduced any quantitative failure rate ($\lambda$) or reliability modeling data anywhere in the seven-step evaluation or prioritizing process. This is a very deliberate decision for the following reasons:

1. The ultimate decisions on PM task need and selection occur at the *failure-mode level*. With the current data-reporting systems at operating plants and facilities, there is rarely any credible quantitative reliability data collected at the failure-mode level; what quantitative data is collected is found at the component level, where PM task selections are not made (or should not be made). Thus, usable quantitative reliability history (for example, failure rate) is usually lacking where it might be helpful to the RCM process. This could change in the future, and perhaps should be reconsidered if such occurs.
2. In fact, however, there is no pressing need to introduce quantitative reliability data into the RCM systems analysis process. Realistic evaluations and decisions, from a maintenance point of view, can be made from the qualitative engineering and logic tree information that is systematically developed in the systems analysis process.
3. In addition, without quantitative data, the credibility of the results cannot be questioned on some abstract discussion of "numbers" validity. Only engineering know-how and related judgments are subject to challenge, and these areas can be more readily resolved.
4. Many people simply do not understand quantitative reliability values; thus their absence avoids unnecessary confusion and misunderstanding. (For example, did you read and understand App. B?)

While some RCM practitioners may feel differently about the preceding points, it is the authors' experience that any introduction of quantitative reliability data or models into the RCM process only clouds the PM issue and raises credibility

questions that are of no constructive value. Quantitative reliability data is not required in the selection of functions, the conduct of the FMEA, or the ordering of priorities in the LTA. It is useful, however, in decisions on the PM task frequency if the age–reliability relationship is known. In the majority of cases, however, the age–reliability relationship is not known with any degree of precision, even at the component level (see discussion in Sec. 5.9).

### *9.8.3 Information Traceability and Coding*

It is a practical administrative consideration to address the question of information traceability. When RCM is applied to several systems in a plant, we find that the systems analysis information from Steps 4 to 7 tends to pyramid, with the apex representing the system level of definition. Couple this with the possibility that several systems (i.e., pyramids) will eventually become the plant RCM program, and we can rather easily visualize the necessity for some accounting structure for the RCM information. Such an accounting structure will permit not only traceability down through a specific pyramid (i.e., system), but will also develop the structure that leads to the creation of an electronic file (if hard copy reports are not desired) and a computerized database of certain key data for future reference.

There are several ways to establish information coding for an accounting structure. In your particular situation, there may already be an active CMMS which contains coding for the plants in your company, the systems in these plants, and the components in the systems. The primary need for coding, then, resides with the information that is peculiar to the RCM process. A simple way to handle this coding is shown below for a given system of interest:

| | |
|---|---|
| Functional system: | X |
| Function: | .XX |
| Functional failure: | .XX |
| Component: | .XX |
| Failure mode: | .XX |
| Failure cause: | .XX |
| PM task: | .XX |

Thus, for a given plant and system, each piece of RCM information will have a unique 13-digit number for identification and traceability purposes. While this may seem a bit cumbersome at first glance, this is actually not the case when the systems analysis information is committed to a computer for storage and processing.

Furthermore, the value of such an accounting system becomes clearly evident, even with a single complex system, when you find it necessary to retrieve or cross-reference a piece of systems analysis data. With multiple systems, the numbering structure avoids what otherwise might well become an accounting quagmire by providing a unique identification and label for each piece of RCM data.

## 9.9 Key Factors in Success—and Failure

We have attempted in this chapter to condense many of the salient features that we have learned throughout our years of involvement about making RCM a success. The features, if recognized, planned for, and executed can provide a high probability of success; or, if ignored, will likely contribute to the program's failure.

In summary, we present our Key Features—Do's and Don'ts:

- *Do* obtain Buy-In from all levels, especially the craft people and your peers. Everyone wants to succeed, show them in real terms how it can happen and make them all a part of it.
- *Don't* ignore the financial and budget groups. They have more influence than is generally recognized. So establish a strong relationship and gain concurrence on accepted business costs and ROI calculations.
- *Don't* make RCM just another *flavor of the day*. The benefits are real and everyone should see that RCM is supported by the management team and is here to stay.
- *Do* keep the feedback channels to management and those doing RCM open and active. Other important issues arise daily, but establishing and maintaining a presence for RCM is critical to its long-term success.
- *Do* place the "best" craft people on the RCM teams. What you put into RCM determines what you get out.
- *Do* implement RCM's recommendations as soon as possible, even the simplest change. The sooner you begin to implement, the sooner RCM will become ingrained in the daily plant activities and culture. Do not wait for the big push at the end—you may never have that opportunity!
- *Don't* put your head in the sand and assume that all is well; look for the obstacles and the opportunities around the next corner and act accordingly. Plan, plan, plan, and then plan some more!
- *Don't* let an opportunity go by where you could have touted the improvements made by the program. We cannot emphasize enough that positive visibility is a major key to success.
- *Do* assign a caretaker to all IOIs. IOIs are manna from heaven, they come free of charge, and together they contribute unimaginable wealth.

In summary, stay on top of the game, maintain visibility, and never assume that all is well.