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The following case illustrates the development of a project planning, management, and control system for large capital engineering projects. Senior management's goal in developing the system was primarily financial, in terms of keeping projects from exceeding budget and optimally allocate increasingly scarce investment funds. It is interesting to compare this system to that of Hewlett-Packard in the reading in Chapter 2.

Case

Heublein: Planning a Project Management and Control System[1]

Herbert F. Spirer and A. G. Hulvey

Heublein, Inc., develops, manufactures, and markets consumer food and beverage products domestically and internationally. Their Group sales revenues are shown in Figure 1. The four major Groups use different manufacturing plants, equipment, and processes to produce their products. In the Spirits Group, large, continuous process bottling plants are the rule; in the Food Service and Franchising Group, small fast food restaurants are the "manufacturing plants."

The amount of spending for capital projects and support varies greatly among the Groups, as would be expected from the differences in the magnitude of sales revenues.

The engineering departments of the Groups have responsibility for operational planning and control of capital projects, a common feature of the Groups. However, the differences among the Groups are reflected in differences in the sizes of the engineering departments and their support services. Similarly, financial tracking support varies from full external support to self-maintained records.

Prior to the implementation of the Project Management and Control System (PM&C) described in this paper, the capital project process was chiefly concerned with the financial justification of the projects, as shown in Figure 2. Highlights include:

- A focus on cost-benefit analysis.
- Minimal emphasis on execution of the projects; no mechanism to assure that non-financial results were achieved.

The following factors focused attention on the execution weaknesses of the process:

- Some major projects went over budget.
- The need for optimal utilization of capital funds intensified since depreciation legislation was not keeping pace with the inflationary rise in costs.

Responding to these factors, Heublein's corporate management called for a program to improve execution of capital

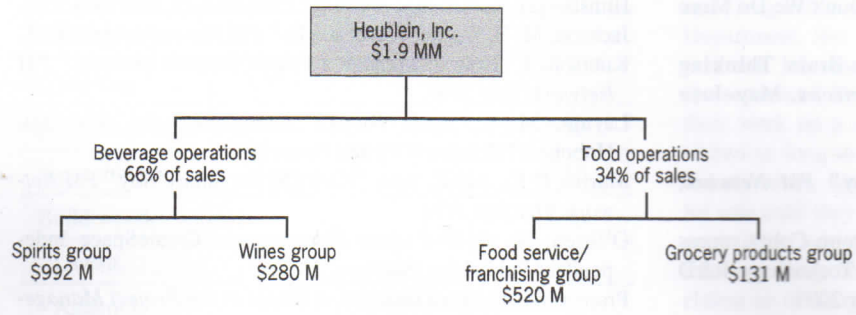

FIGURE 1 Heublein, Inc.

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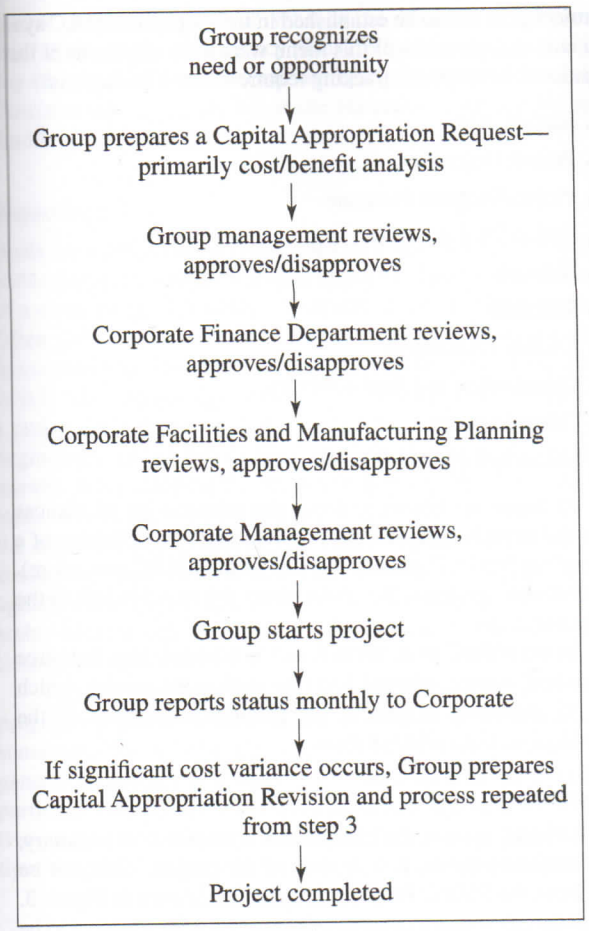

FIGURE 2 Capital project progress prior to PM&C.

projects by implementing PM&C. Responsibility for this program was placed with the Corporate Facilities and Manufacturing Planning (F&MP) Department, which, in addition to reviewing all Capital Appropriation Requests, provided technical consulting services to the corporation.

Feasibility Study

Lacking specialized expertise in project management, the Director of Corporate (F&MP) decided to use a consultant in the field. Interviewing of three consultants was undertaken to select one who had the requisite knowledge, compatibility with the style and goals of the firm, and the ability to communicate to all levels and types of managers. The latter requirement was important because of the diversity of the engineering department structures and personnel involved. The first author was selected as the consultant.

With the consultant selected, an internal program manager for PM&C was selected. The deferral of this choice until after selection of the consultant was deliberate, to allow for development of interest and enthusiasm among candidates for this position and so that both the selected individual and the selection committee would have a clear picture of the nature of the program. A program manager was chosen from the corporate staff (the second author).

Having the key staff in place, ground rules were established as follows:

- The PM&C program would be developed internally to tailor it to the specific needs of the Groups. A "canned" or packaged system would limit this flexibility, which was deemed essential in this application of project management principles.
- The directors of the engineering departments of each of the Groups were to be directly involved in both the design and implementation of the PM&C system in total and for their particular Group. This would assure the commitment to its success that derives from ownership and guarantees that those who know the needs best determine the nature of the system.

To meet the above two ground rules, a thorough fundamental education in the basic principles of project management would be given to all involved in the system design.

The emphasis was to be project planning as opposed to project control. The purpose of PM&C was to achieve better performance on projects, not catch mistakes after they have occurred. Success was the goal, rather than accountability or identification of responsibility for failure.

Program Design

The option of defining a uniform PM&C system, to be imposed on all engineering departments by corporate mandate, was rejected. The diversity of projects put the weight in favor of individual systems, provided planning and control was such that success of the projects was facilitated. The advantage to corporate staff of uniform planning and reporting was given second place to accommodation of the unique needs of each Group and the wholehearted commitment of each engineering manager to the effective use of the adopted system. Thus, a phased implementation of PM&C within Heublein was planned in advance. These phases were:

Phase I. Educational overview for engineering department managers

A three-day seminar with two top-level educational objectives: (1) comprehension by participants of a maximal set of project management principles and (2) explanation of the corporate objectives and recommended approach for any PM&C system.

Phase II. PM&C system design

A "gestation period" of three weeks was deliberately introduced between Phases I and II to allow for absorption, discussion, and review of the project management principles and objectives by the engineering department managers. At the end of this period a session was called for the explicit purpose of defining the system. The session was chaired by the consultant, a deliberate

choice to achieve the "lightning rod" effect whereby any negative concern was directed to an outsider. Also, the consultant—as an outsider—could criticize and comment in ways that should not be done by the engineering department managers who will have long-term working relationships among each other. It was agreed in advance that a consensus would be sought to the greatest possible extent, avoiding any votes on how to handle particular issues which leaves the "nay" votes feeling that their interests have been overridden by the majority. If consensus could not be achieved, then the issue would be sidestepped to be deferred for later consideration; if sufficiently important, then a joint solution could be developed outside the session without the pressure of a fixed closing time.

Phase III. Project plan development

The output of Phase II (the set of consensus conclusions) represented both guidelines and specific conclusions concerning the nature of a PM&C system. Recognizing that the PM&C program will be viewed as a model project and that it should be used as such, serving as an example of what is desired, the program manager prepared a project plan for the PM&C program. The remainder of this paper is primarily concerned with the discussion of this plan, both as an example of how to introduce a PM&C system and how to make a project plan. The plan discussed in this paper and illustrated in Figures 3 to 11 is the type of plan that is now required before any capital project may be submitted to the approval process at Heublein.

Phase IV. Implementation

With the plan developed in Phase III approved, it was possible to move ahead with implementation. Implementation was in accordance with the plan discussed in the balance of this paper. Evaluation of the results was considered a part of this implementation.

Project Plan

A feature of the guidelines developed by the engineering managers in Phase II was that a "menu" of component parts of a project plan was to be established in the corporate PM&C system, and that elements of this menu were to be chosen to fit the situational or corporate tracking requirements. The menu is:

1. Introduction
2. Project Objectives
3. Project/Program Structure
4. Project/Program Costs
5. Network
6. Schedule
7. Resource Allocation
8. Organization and Accountability
9. Control System
10. Milestones or Project Subdivisions

In major or critical projects, the minimal set of choices from the menu is specified by corporate staff (the definition of a "major" or "critical" project is a part of the PM&C procedure). For "routine" projects, the choice from the menu is left to the project manager.

In the PM&C plan, items 6 and 7, Schedule and Resource Allocation, were combined into one section for reasons which will be described as part of the detailed discussions of the individual sections which follow.

Introduction

In this PM&C system, the Introduction is an executive summary, with emphasis on the justification of the project. This can be seen from the PM&C Program Introduction shown in Figure 3. It is to the advantage of everyone concerned with a project to be fully aware of the reasons for its existence. It is as important to the technicians as it is to the engineers or the corporate financial department. When the project staff clearly comprehends the reason for the project's existence, it is much easier to enlist and maintain their support and wholehearted efforts. In the Heublein PM&C system, it is expected that the introduction section of a project plan will include answers to these questions: What

External and internal factors make it urgent to ensure most efficient use of capital funds. Implementation of a project management and control ("PM&C") system has been chosen as one way to improve the use of capital funds. The Corporate Management Committee defined this need.

Subsequently, Corporate Facilities and Manufacturing Planning performed a feasibility study on this subject. A major conclusion of the study was to develop the system internally rather than use a "canned" system. An internally developed system can be tailored to the individual Groups, giving flexibility which is felt to be essential to success. Another conclusion of the study was to involve Group engineering managers in the design and implementation of the system for better understanding and acceptance.

This is the detailed plan for the design and implementation of a corporate-wide PM&C System. The short-term target of the system is major capital projects; the long-term target is other types of projects, such as new product development and R&D projects. The schedule and cost are:

Completion Date: 1 year from approval.

Cost: $200,000, of which $60,000 is out of pocket.

FIGURE 3 Introduction to PM&C program project plan.

type of project is involved? What is the cost-benefit relationship? What are the contingency plans? Why is it being done this way (that is, why were alternatives rejected)? Figure 3 not only illustrates this approach, but is the executive summary for the Heublein PM&C system.

Objectives

Goals for a project at Heublein must be stated in terms of deliverable items. To so state a project objective forces the definition of a clear, comprehensible, measurable, and tangible objective. Often, deliverable items resulting from a project are documents. In constructing a residence, is the deliverable item "the house" or is it "the certificate of occupancy"? In the planning stages of a project (which can occur during the project as well as at the beginning), asking this question is as important as getting the answer. Also, defining the project in terms of the deliverables tends to reduce the number of items which are forgotten. Thus, the Heublein PM&C concept of objectives can be seen to be similar to a "statement of work" and is not meant to encompass specifications (detailed descriptions of the attributes of a deliverable item) which can be included as appendices to the objectives of the project.

Figure 4 shows the objectives stated for the Heublein PM&C program. It illustrates one of the principles set for objective statement: that they be hierarchically structured, starting with general statements and moving to increasingly more detailed particular statements. When both particular and general objectives are defined, it is imperative that there be a logical connection; the particular must be in support of the general.

Project Structure

Having a definition of deliverables, the project manager needs explicit structuring of the project to:

- Relate the specific objectives to the general.
- Define the elements which comprise the deliverables.
- Define the activities which yield the elements and deliverables as their output.
- Show the hierarchical relationship among objectives, elements, and activities.

The work breakdown structure (WBS) is the tool used to meet these needs. While the WBS may be represented in either indented (textual) or tree (graphical) formats, the graphic tree format has the advantage of easy comprehension at all levels. The tree version of the WBS also has the considerable advantage that entries may be made in the nodes ("boxes") to indicate charge account numbers, accountable staff, etc.

Figure 5 is a portion of the indented WBS for the PM&C Program, showing the nature of the WBS in general and the structure of the PM&C Program project in particular. At this point we can identify the component elements and the activities necessary to achieve them. A hierarchical numbering system was applied to the elements of the WBS, which is always a convenience. The 22 Design Phase Reports (2100 series in Figure 5) speak for themselves, but it is important to note that this WBS is the original WBS: All of these reports, analyses, and determinations were defined prior to starting the program and there were no requirements for additional items.

General Objectives

1. Enable better communication between Group and Corporate management with regard to the progress of major projects.
2. Enable Group management to more closely monitor the progress of major projects.
3. Provide the capability for Group personnel to better manage and control major projects.

Specific Objectives[a]

1. Reporting and Control System
   - For communication of project activity with Group and between Group and Corporate.
   - Initially for high-cost capital projects, then for "critical," then all others.
2. Procedures Manual
   - Document procedures and policies.
   - Preliminary manual available for use in general educational seminars.
3. Computer Support Systems
   - Survey with recommendations to establish need for and value of computer support.
4. General Educational Package
   - Provide basic project planning and control skills to personnel directly involved in project management, to be conducted by academic authority in field.
   - Technical seminars in construction, engineering, contract administration, and financial aspects of project management.

[a]Defined at the PM&C Workshop, attended by representatives of Operating Groups.

FIGURE 4 Objectives of PM&C program.

Work Breakdown Structure

HEUBLEIN PM&C PROGRAM
1000 Program Plan
2000 PM&C System
2100 Design-Phase Reports
2101 Analyze Project Scope
2102 Define Performance Reports
2103 Define Project Planning
2104 Define Revision Procedure
2105 Define Approval/Signoff Procedure
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2121 Define Record Retention Policy
2122 Define Computer Support Systems Requirements
2200 Procedures Manual
2201 Procedures Manual
2202 Final Manual
2300 Reporting and Control System
2400 Computer Support Survey
2401 PERT/CPM
2402 Scheduling
2403 Accounting
3000 General Training
3100 Project Planning and Control Seminar
3101 Objective Setting
3102 WBS
.
.
.

FIGURE 5 Project structure.

Project Costs

The WBS provides a listing of the tasks to be performed to achieve the project objectives; with only the WBS in hand it is possible to assemble a preliminary project estimate. The estimates based only on the WBS are preliminary because they reflect not only uncertainty (which varies considerably among types of projects), but because the allocation of resources to meet schedule difficulties cannot be determined until both the network and the schedule and resource evaluations have been completed. However, at this time the project planner can begin to hierarchically assemble costs for use at any level. First the lowest level activities of work (sometimes called "work packages") can be assigned values. These estimates can be aggregated in accordance with the WBS tree structure to give higher level totals. At the root of the tree there is only one element—the project—and the total preliminary estimated cost is available.

Figure 6 shows the costs as summarized for the PM&C program plan. This example is supplied to give the reader an idea of the nature of the costs to be expected in carrying out such a PM&C program in this type of situation. Since a project-oriented cost accounting system does not exist, out-of-pocket costs are the only incremental charges. Any organization wishing to cost a similar PM&C program will have to do so within the framework of the organizational approach to costing indirect labor. As a guide to such costs, it should be noted that in the Heublein PM&C Program, over 80 percent of the costs—both out-of-pocket and indirect—were in connection with the General Training (WBS code 3000).

Seminars were limited to two and two-and-a-half days to assure that the attendees perceived the educational process as efficient, tight, and not unduly interfering with their work; it was felt that it was much better to have them leaving with a feeling that they would have liked more rather than the opposite. Knowing the number of attendees, it is possible to determine the labor-days devoted to travel and seminar attendance; consultant/lecturer's fees can be obtained (expect preparation costs) and the incidentals (travel expenses, subsistence, printing, etc.) are easily estimated.

Network

The PM&C system at Heublein requires networks only for major projects, but encourages their use for all projects. Figure 7 shows a segment of the precedence table (used to create the network) for the PM&C Plan. All the usual principles of network creation and analysis (for critical path, for example) may be applied by the project manager to the extent that it facilitates planning, implementation, considerable emphasis PM network creation and analysis techniques in the educational phases of the PM&C Program because the network is the basis of the scheduling methods presented, is potentially of great value, and is one of the hardest concepts to communicate.

Labor costs	
Development & Design	$ 40,000
Attendees' time in sessions	60,000
Startup time of PM&C in Group	40,000
Basic Educational Package	
Consultants' fees	20,000
Attendees' travel & expenses	30,000
Miscellaneous	10,000
Total Program Cost	$200,000

Out-of-pocket costs: $60,000

FIGURE 6 Program costs.

Act'y Short Descr.	Time (weeks)	Immediate Predecessors
4000 prepare final rpt	2	2000, 2122, 3200
2000 monitor system	6	2000: hold group workshops
2000 hold group w'shps	2	2000: obtain approval
2000 prepare final proc	2	2000: monitor system
2000 prepare final proc manual, revise syst	2	2116–2121: approvals
2000 monitor system	8	2000: hold group workshops
2000 prepares for impl'n	2	3100: hold PM&C seminar
2122 get approval	2	2122: define com & supp needs
2122 def comp supp needs	4	3100: hold PM&C sem
3200 hold tech seminars	4	3200: prepare seminars
3200 prepare seminars	8	3200: obtain approvals
3200 obtain approvals	2	3200: def tech sem needs
3200 def tech sem needs	2	3100: hold PM&C sem
3100 hold PM&C seminar	3	3100: integrate proc man in sem 2201: revise prel proc man
3100 int. proc man in sem	1	2201: prel. proc manual
2201 revise prel proc man	.6	2201–2300: get approval
.		
.		
.		

Note: Because of space limitations, the network is given in the form of a precedence table. An activity-on-node diagram may be directiy constructed from this table. Numerical designations refer to the WBS in Figure 5.

FIGURE 7 Network of PM&C program.

In the Heublein PM&C system, managerial networks are desired—networks which the individual project managers will use in their own management process and which the staff of the project can use to self-direct where appropriate. For this reason, the view toward the network is that no one network should exceed 50 nodes. The toplevel network represents the highest level of aggregation. Each activity on that network may well represent someone else's next lower-level network consisting of not more than 50 nodes. This is not to say that there are not thousands of activities possible in a Heublein project, but that at the working managerial level, each manager or project staff person responsible for a networked activity is expected to work from a single network of a scope that can be easily comprehended. It is not an easy task to aggregate skillfully to reduce network size, but the exercise of this discipline has value in planning and execution in its own right.

The precedence table shown reflects the interdependencies of activities for Heublein's PM&C Program; they are dependent on the design of the Program and the needs of the organization. Each organization must determine them for themselves. But what is important is that institution of a PM&C Program be planned this way. There is a great temptation in such programs to put all activities on one path and not to take advantage of parallel activities and/or not to see just what is the critical path and to focus efforts along it.

Schedule and Resource Allocation

The network defines the mandatory interdependency relationships among the tasks on a project; the schedule is the realization of the intent of the PM, as it shows when the manager has determined that tasks are to be done. The schedule is constrained in a way that the network is not, for the schedule must reflect calendar limitations (vacations, holidays, plant and vendor shutdowns, etc.) and also the limitations on resources. It is with the schedule that the project manager can develop the resource loadings and it is the schedule which ultimately is determined by both calendar and resource constraints.

Organization and Accountability

Who is responsible for what? Without clear, unambiguous responses to this question there can be no assurance that the task will be done. In general, committees do not finish projects and there should be one organizational unit responsible for each element in the WBS and one person in that organizational unit who holds final responsibility. Thus responsibility implies a single

Activity	PM&C Mgr	Consultant	Mgrs. of Eng. FS/F	GPG	Wines	Spirits	Dir F&MP
Program Plan	I	P					A
Design-Phase Reports	I	P	P	P	P	P	
Procedures Manual	I						A
Reporting & Control System	I	P	P	P	P	P	
Computer Support Survey	I	P					P
Project Planning & Control Seminar	A	I					P
Technical Seminars	I		P	P	P	P	A

Legend: I: Initiate/Responsibility
A: Approve
P: Provide input

FIGURE 8 Accountability matrix for PM&C program.

name to be mapped to the task or element of the WBS, and it is good practice to place the name of the responsible entity or person in the appropriate node on the WBS.

However, accountability may have multiple levels below the top level of complete responsibility. Some individuals or functions may have approval power, veto power without approval power, others may be needed for information or advice, etc. Often, such multilevel accountability crosses functional and/or geographical boundaries and hence communication becomes of great importance.

A tool which has proved of considerable value to Heublein where multilevel accountability and geographical dispersion of project staff is common is the "accountability matrix," which is shown in Figure 8.

The accountability matrix reflects considerable thought about the strategy of the program. In fact, one of its great advantages is that it forces the originator (usually the project manager) to think through the process of implementation. Some individuals must be involved because their input is essential. For example, all engineering managers were essential inputs to establish the exact nature of their needs. On the other hand, some individuals or departments are formally involved to enlist their support, even though a satisfactory program could be defined without them.

Control System

The basic loop of feedback for control is shown in Figure 9. This rationale underlies all approaches to controlling projects. Given that a plan (or budget) exists, we then must know what is performance (or actual); a comparison of the two may give a variance. If a variance exists, then the cause of the variance must be sought. Note that any variance is a call for review; as experienced project managers are well aware, underspending or early completions may be as unsatisfactory as overspending and late completions.

The PM&C program did not involve large purchases, or for that matter, many purchases. Nor were large numbers of people working on different tasks to be kept track of and coordinated. Thus, it was possible to control the PM&C Program through the use of Gantt conventions, using schedule bars to show plan and filling them in to show performance. Progress was tracked on a periodic basis, once a week.

Figure 10 shows the timing of the periodic reviews for control purpose and defines the nature of the reports used.

Milestones and Schedule Subdivisions

Milestones and Schedule Subdivisions are a part of the control system. Of the set of events which can be, milestones form a limited subset of events, in practice rarely exceeding 20 at any given level. The milestones are predetermined times (or performance states) at which the feedback loop of control described above (Figure 9) should be exercised. Other subdivisions of the project are possible, milestones simply being a subdivision by events. Periodic time subdivisions may be made, or division into phases, one of the most common. Figure 11 shows the milestones for the PM&C Program.

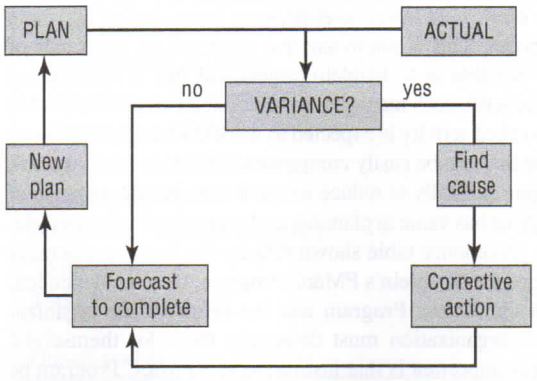

FIGURE 9 The basic feedback loop of control.

1. Periodic status checking will be performed monthly.
2. Labor costs will be collected manually and estimated where necessary from discussion with Group engineering management.
3. Out-of-pocket costs will be collected through commitments and/or invoice payment records.
4. Monthly status reports will be issued by the PM&C Program project manager including:
   a. Cost to date summaries.
   b. Cost variances.
   c. Schedule performance relative to schedule in Gantt format.
   d. Changes in scope or other modifications to plan.
5. Informal control will be exercised through milestone anticipation by the PM&C Program project manager.

FIGURE 10 Control system.

Summary

The Heublein PM&C Program met the conditions for a successful project in the sense that it was completed on time and within the budgeted funds. As is so often the case, the existence of a formal plan and continuing reference to it made it possible to deal with changes of scope. Initial reaction to the educational package was so favorable that the population of attendees was increased by Group executives and engineering managers.

To deliver on time and within budget, but to deliver a product which does not serve the client's needs, is also unsatisfactory. Did this PM&C Program achieve the "General Objectives" of Figure 4? As is so often the case in managerial systems and educational programs, we are forced to rely on the perceptions of the clients. In this PM&C Program, the clients are Corporate Management, Group Management, and most importantly, the Managers of Engineering and their staffs. In the short run, the latter two operational clients are primary. In addition to informal feedback from them, formal feedback was obtained in the form of Impact Statements (item number 4000 in the WBS of Figure 5). The Impact Statements concerned the impact of the PM&C Program on the concerned organization ("How many labor-hours are expected to be devoted to the PM&C System?) and response to the PM&C Program ("Has this been of value to you in doing your job better?").

Clearly, the response of perceived value from the operating personnel was positive. Can we measure the improvement which we believe to be taking place in the implementation of capital and other projects? It may be years before the impact (positive or negative) can be evaluated, and even then there may be such confounding with internal and external variables that no unequivocal, quantified response can be defined.

At this point we base our belief in the value of the PM&C Program on the continuing flow—starting with Impact Statements—of positive perceptions. The following is an example of such a response, occurring one year after the exposure of the respondent:

> *. . . find attached an R&D Project Tracking Diagram developed as a direct result of the [PM&C] seminar . . . last year. [In the seminar we called it] a Network Analysis Diagram. The Product Development Group has been using this exclusively to track projects. Its value has been immeasurable. Since its inception, fifteen new products have gone through the sequence. . . .*

Date	Description
Feb 5	Program plan approved by both Corporate & Groups
Feb 26	Reporting and control system approved by Corporate and Groups
Mar 5	Organizational impact analysis report issued
Apr 7	Basic project planning and control seminars completed
Aug 24	Final procedures manual approved Technical Seminars completed Computer support systems survey completed
Nov 30	Final impact assessment report issued

FIGURE 11 Milestones.

Questions

1. Which of the project planning aids described in the chapter was used in the case?
2. How did their project plan differ from the project charter described in the chapter?
3. How did their WBS differ from that described in the chapter? How did their accountability matrix differ?
4. What was wrong with the previous focus on cost-benefit? Does the PM&C system still include a cost-benefit analysis?
5. Why did lagging depreciation legislation increase the importance of using capital funds optimally?
6. What do you think of developing a system that accommodates the unique needs of each group versus developing a more standardized system? What are the advantages and disadvantages of each approach?

The following reading updates the practical applications of Agile in terms of adjusting and combining it with other approaches including the traditional waterfall method taught in most textbooks. It also emphasizes the changes that are needed in project transitioning to Agile, not only within the team but also within the organization as well as outside stakeholders. Last, it illustrates the application of Agile to other applications beyond the original software programming area.