6.1 INTRODUCTION

The generation and evaluation of a number of layout alternatives is a critical step in the facilities planning process, since the layout selected will serve to establish the material flow patterns and physical relationships between activities. Recognizing that the layout ultimately selected will be either chosen from or based on one of the alternatives generated, it is important for the facilities planner to be both creative and comprehensive in generating a reasonable number of layout alternatives.

Most facility layouts can be viewed at two levels: The *block layout* (which shows the location, shape, and size of each planning department) and the *detailed layout* (which shows the exact location of all equipment, work benches, and storage areas *within* each department). The block layout is concerned primarily with the "macro" flows in the facility, while the detailed layout is often concerned with the "micro" flows. For the facility layout to be complete and effective, both the block layout and the detailed layout need to be developed and evaluated carefully. Although some of the models and techniques we show in this chapter can be applied to detailed layouts as well, our focus is primarily on quantitative methods for developing and evaluating alternative block layouts.

We previously addressed how to determine the requirements. In Chapter 1, we treated the strategic relationship between facilities planning and manufacturing, distribution, and marketing. From that discussion, we recognized the importance of taking a long-range viewpoint and coordinating the facilities plan with the plans of other organizational units. A facilities layout strategy should emerge from the overall strategic

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plan. Product, manufacturing, marketing, distribution, management, and human resource plans will be impacted by and will have an impact on the facilities layout.

The facilities requirements resulting from product design, process design, and schedule design decisions were examined in Chapter 2. The impact of personnel requirements on space, proximities, and special features of the facility was treated in Chapter 4.

Chapter 3 provided a comprehensive treatment of activity relationships, space requirements, and types of planning departments as they relate to facilities planning. From that discussion, as well as the emphasis in Chapter 1 on the establishment of activity relationships and determination of space requirements, it is clear that both the block layout and the detailed layout are critically important in designing a layout for a facility.

Before proceeding further, it seems appropriate to address two questions, which frequently come up in a layout planning project:

1. Which comes first, the material handling system or the facility layout?
2. Which comes first, the block layout or the detailed layout?

Many appear to believe the layout should be designed first and then that the material handling system should be developed. Yet material handling decisions can have a significant impact on the effectiveness of a layout. For example, the following decisions will affect the layout:

1. Centralized versus decentralized storage of work-in-process (WIP), tooling, and supplies
2. Fixed-path versus variable-path material handling
3. The handling unit (unit load) planned for the systems versus one-piece flow
4. The degree of automation used in handling
5. The type or level of inventory control, physical control, and computer control of materials

Each of the above considerations affects the requirements for space, equipment, and personnel, as well as the degree of proximity required between various departments.

Why do people tend to focus first on layout? Perhaps one reason is an overemphasis on the manufacturing process. For example, it seems perfectly logical to place department B next to department A "if process B occurs immediately after process A." In such a situation, the handling problem is reduced to the question, "What is the best way to move materials from A to B?" Conventional wisdom suggests that the handling problem can be addressed after the layout is finalized.

However, if materials cannot flow directly from department A to department B, then WIP storage is required in A, B, and/or elsewhere. Depending on the storage and control requirements, a centralized WIP storage area might be used, so that materials flow from A to S (storage), and then from S to B. With such a centralized WIP storage system, materials do not flow from A to B, and B no longer needs to be placed next to A. Furthermore, the centralized system provides added flexibility when the process sequence changes. Yet lean manufacturing teaches us to redefine the departments and create "cells" so that the parts flow, one at a time, directly from one workstation to the next, which eliminates intermediate storage areas and significantly reduces the material handling distances and delays incurred due to batching.

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Another reason for the "layout first" approach could be a misapplication of the "handling less is best" adage. For example, in one-piece flow (the make one, move one principle practiced in lean manufacturing), the parts are handled more times compared to batching (when all the parts are placed in one container and moved only once as a unit load). Yet, due to delays introduced by batching, in a large majority of cases, one-piece flow is the preferred approach, provided the workstations are placed next to each other. Hence, when one says "handling less is best," one needs to be careful in how handling is defined and how less or more handling impacts measures such as WIP inventory, the expected time it takes for the parts to travel through the system, and walk times/material handling times for the operators.

So, which comes first, the material handling system or the facility layout? Our answer is, "Both!" The layout and the handling system should be designed simultaneously. The complexity of the design problem, however, generally requires that a sequential process be used. For this reason, we recommend that a number of alternative layout plans be developed and the appropriate handling system be designed (at least at a conceptual level) for each alternative. The preferred layout will be that which results from a consideration of the system as a whole [72].

As for the second question, our recommendation is to first obtain basic requirements for each department (such as space requirements, shape constraints, and so on) and then develop a set of alternative block layouts. Once the desirable block layout is identified, the analyst can then develop a detailed layout for each department. In the process, he/she may very well go back and "massage" or "modify" the block layout, creating an iterative process, which can be repeated for some of the other block layout alternatives as well. Since the process often ends up being an iterative one, the starting point is less critical, although gathering basic information for each department and then starting with macro-flows is often a practical approach.

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