

## CHAPTER 32

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### Job Design

MICHAEL A. CAMPION and GINA J. MEDSKER  
Purdue University

#### 32.1 INTRODUCTION

Job design is one of those aspects of managing organizations that is so commonplace it often goes unnoticed. Most people realize the importance of job design when an organization is being built and production processes are being developed. And some even recognize the importance of job design when changes are taking place in organizational structures and processes. But fewer people realize that job design may be affected when organizations grow, retrench, or reorganize, when managers use their discretion in the assignment of miscellaneous tasks on a day-by-day basis, or when the people in the jobs or their managers change. Fewer yet realize that job design change can be used as an intervention to enhance important organizational goals. Job design is, in fact, so basic that many people make job design decisions very early in life (as illustrated in Figure 32.1).

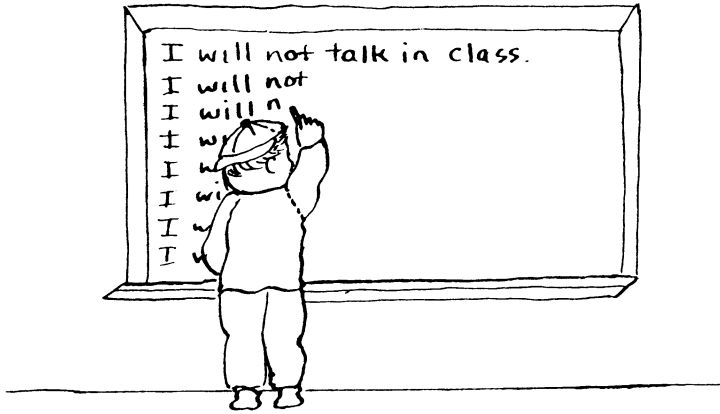
Among the most prolific writers on job design in the engineering literature over the last 35 years has been Louis Davis and his associates.<sup>1-6</sup> At least three themes have emerged from their writings that have had continuing applicability throughout this period and will continue to do so. First, many of the personnel and productivity problems in industry may be the direct result of the design of jobs. Second, many people mistakenly view the design of jobs as technologically determined and, therefore, fixed and inalterable. Third, job designs are actually social inventions. They reflect the values of the era in which they were constructed. These values include the economic goal of minimizing immediate costs<sup>1,7</sup> and the theories of human motivation that inspire work designers.<sup>8,9</sup> These values, and the designs they influence, are not immutable givens, but are subject to change and modification.

The question then becomes: What is the best way to design a job? In fact, there is no single best way. There are actually several major approaches to job design. Each derives from a different discipline and reflects different theoretical orientations and values. This chapter describes the various approaches and their costs and benefits. It highlights the trade-offs and compromises that must be made. This chapter also provides tools and procedures for developing and assessing jobs in all varieties of organizations. Finally, the design of jobs for groups is addressed, and the potential implications of changes in technology and work force are discussed.

#### 32.2 DISTINCTIONS

Several distinctions are useful to clarify the terminology in this chapter. One distinction is between a task and a job. A *task* is a set of actions performed by a worker that transforms inputs into outputs through the use of tools, equipment, or work aids. The actions of the task may be physical, mental, or interpersonal. On the other hand, a *job* is an aggregation of tasks assigned to a worker.<sup>10,11</sup> When the same set of tasks are performed by more than one worker, those workers are said to have the same job.

It is often useful to distinguish between positions, jobs, and occupations (see Figure 32.2). A *position* refers to the set of tasks performed by one worker (e.g., the specific industrial engineering position held by employee X). A *job* is a set of similar positions (e.g., the industrial engineering positions in manufacturing in a particular company). The tasks performed in a given position are usually a combination of tasks that are common to all workers in that job and of tasks that are unique to that position. The unique tasks are sometimes a function of organizational requirements (e.g., different product or equipment) and sometimes a function of the disposition of the particular worker (e.g., different strengths or interests).<sup>12</sup> An *occupation* is a collection of similar jobs (e.g., all industrial engineering jobs across companies). Job design usually focuses, by definition, on the job level. Differences in design between positions are assumed to be small and are often ignored. This may not be the



**Figure 32.1** Childhood Job Design Decisions. In an effort to enhance efficiency, little Johnny simplifies his task by breaking it down into subtasks that can be performed repetitively.

case in all situations, however. And there can be great differences in design across jobs within an occupation.

A final distinction is that between a job and a role. The term *role* is usually used in a broader sense to also include unforeseen tasks and less tangible tasks such as being a good team member.<sup>6</sup> Job design should consider the entire roles of employees.

### 32.3 INFLUENCES ON JOB DESIGN

It is clear that job design does not exist in a vacuum. There are many aspects of an organization that influence job design, especially an organization's structure, technology, processes, and environment. These influences are beyond the scope of this chapter, but they are dealt with in other chapters in this handbook (e.g., Chapter 27) and elsewhere.<sup>5,13</sup> Suffice it to say here that these influences impose constraints and limitations on the possible designs of jobs and will play a major role in any practical application. Nevertheless, it is the assumption of this chapter that considerable discretion exists in the design of jobs in most situations, and the job (defined as a set of tasks performed by a worker) is a convenient unit of analysis in both developing new organizations or changing existing ones.

### 32.4 INFLUENCES OF JOB DESIGN ON IMPORTANT OUTCOMES

The importance of job design lies in its strong influence on a broad range of important efficiency and human resource outcomes. Job design has predictable consequences for outcomes such as the following:

- Productivity.
- Quality.
- Job satisfaction.
- Training times.
- Intrinsic work motivation.
- Staffing.
- Error rates.
- Accident rates.
- Mental fatigue.
- Physical fatigue.
- Stress.
- Mental ability requirements.
- Physical ability requirements.
- Job involvement.

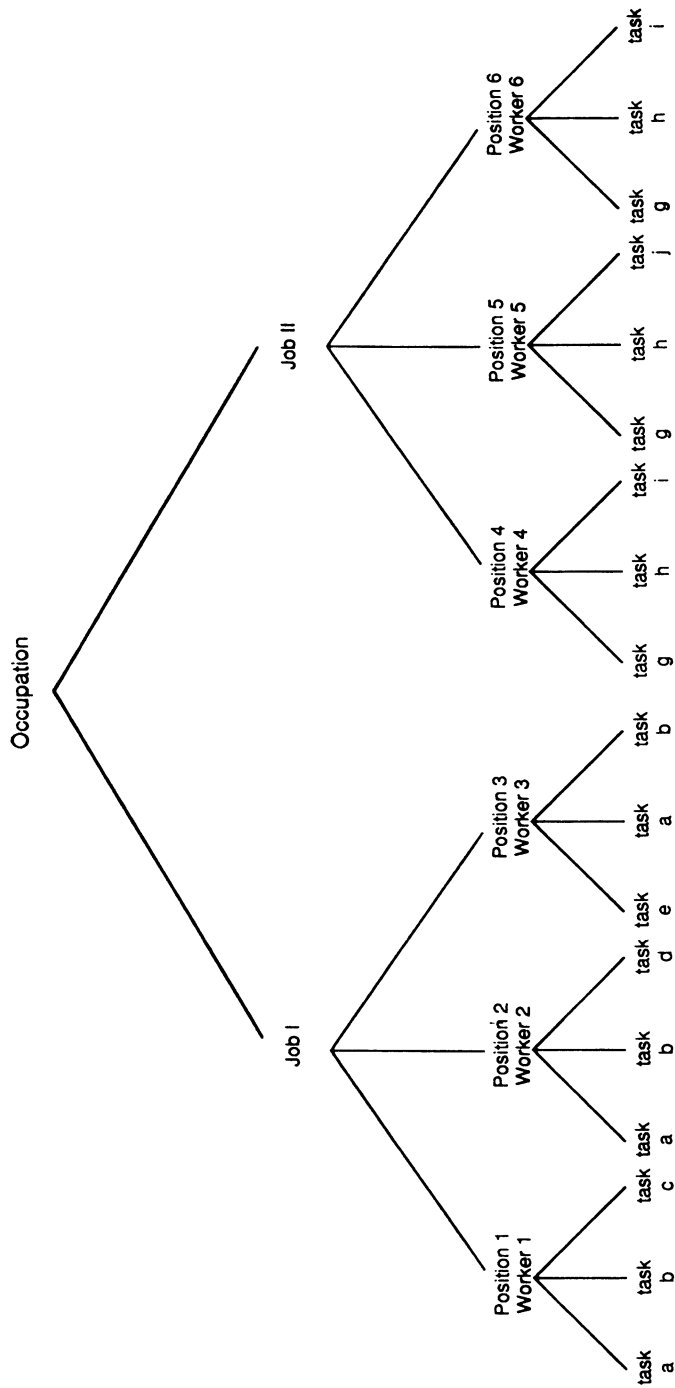


Figure 32.2 Relationships between Positions, Jobs, and Occupations.

Absenteeism.  
 Aches and pains.  
 Incidents in medical records.  
 Boredom.  
 Turnover.  
 Compensation rates.

As indicated by many of these outcomes, job design decisions can influence a broad range of other human resource systems. For example, training programs may need to be developed, revised, or eliminated. Hiring standards may need to be developed or changed. Compensation levels may need to be increased or decreased. Performance appraisal can be affected due to changed responsibilities. Promotion, transfer, and other employee movement systems may also be influenced. Thus, many human resource programs may be dictated by initial job design decisions or may need to be reconsidered following job redesign. In fact, human resources outcomes may constitute the goals of the design or redesign project. Research supporting these outcomes is referenced below during the description of the approaches.

### 32.5 APPROACHES TO JOB DESIGN

This chapter adopts an interdisciplinary perspective on job design. That is, several approaches to job design are considered, regardless of the scientific disciplines from which they came. Interdisciplinary research on job design has shown that several different approaches to job design exist, each is oriented toward a particular subset of outcomes for the organization and the employees, each has costs as well as benefits, and trade-offs are required when designing jobs in most practical situations.<sup>14-21</sup> The four major approaches to job design are reviewed in terms of their historical development, design recommendations, and benefits and costs. Table 32.1 summarizes the approaches, while Table 32.2 provides detail on specific recommendations.

#### Mechanistic Approach

##### *Historical Development*

The historical roots of job design can be traced back to the concept of the division of labor, which was very important to early thinking on the economies of manufacturing.<sup>35,36</sup> The division of labor led to job designs characterized by specialization and simplification. Jobs that were designed in this fashion had many advantages, including reduced learning time, saved time from not having to change tasks or tools, increased proficiency from the repetition of the same tasks, and the development of special-purpose tools and equipment.

A very influential person on this early perspective on job design was Frederick Taylor.<sup>24,37</sup> He expounded the principles of scientific management that encouraged the study of jobs to determine the "one best way" to perform each task. Movements of skilled workers were studied using a stopwatch and simple analysis. The best and quickest methods and tools were selected, and all workers were trained to perform the job in the same manner. Standards were developed, and incentive pay was tied to the standard performance levels. Gilbreth also contributed to this job design approach.<sup>23</sup> Through the use of time and motion study, he tried to eliminate wasted movements in work by the appropriate design of equipment and placement of tools and materials.

Surveys of industrial job designers indicate that this "mechanistic" approach to job design, characterized by specialization, simplification, and time study, has been the prevailing practice throughout this century.<sup>1,7</sup> These characteristics are also the primary focus of many modern-day writers on job design.<sup>22,38-40</sup> The discipline base is indicated as "classic" industrial engineering in Table 32.1. Modern-day industrial engineers practice a variety of approaches to job design.

##### *Design Recommendations*

Table 32.2 provides a brief list of statements that describe the essential recommendations of the mechanistic approach. In essence, jobs should be studied to determine the most efficient work methods and techniques. The total work in an area (e.g., department) should be broken down into highly specialized jobs that are assigned to different employees. The tasks should be simplified so that skill requirements are minimized. There should also be repetition in order to gain improvement from practice. Idle time should be minimized. Finally, activities should be automated or assisted by automation to the extent possible and economically feasible.

TABLE 32.1 Interdisciplinary Approaches to Job Design and Human Resource Benefits and Costs<sup>a</sup>

APPROACH/ Discipline Base (example references)	Illustrative Recommendations	Illustrative Benefits	Illustrative Costs
MECHANISTIC/Classic Industrial Engineering <sup>22-24</sup>	<i>Increase in</i> Specialization Simplification Repetition Automation <i>Decrease in</i> Spare time	<i>Decrease in</i> Training Staffing difficulty Making errors Mental overload and fatigue Mental skills and abilities Compensation	<i>Increase in</i> Absenteeism Boredom <i>Decrease in</i> Satisfaction Motivation
MOTIVATIONAL/Organi- zational Psychology <sup>25-27</sup>	<i>Increase in</i> Variety Autonomy Significance Skill usage Participation Feedback Recognition Growth Achievement	<i>Increase in</i> Satisfaction Motivation Involvement Performance Customer service Catching errors <i>Decrease in</i> Absenteeism Turnover	<i>Increase in</i> Training Staffing difficulty Making errors Mental overload and fatigue Stress Mental skills and abilities Compensation
PERCEPTUAL-MOTOR/ Experimental Psychology, Human Factors <sup>28-31</sup>	<i>Increase in</i> Lighting quality Display and con- trol quality User-friendly equipment <i>Decrease in</i> Information pro- cessing re- quirements	<i>Decrease in</i> Making errors Accidents Mental overload and fatigue Stress Training Staffing difficulty Compensation Mental skills and abilities	<i>Increase in</i> Boredom <i>Decrease in</i> Satisfaction
BIOLOGICAL/Physiology, Biomechanics, Ergonomics <sup>32-34</sup>	<i>Increase in</i> Seating comfort Postural comfort <i>Decrease in</i> Strength require- ments Endurance re- quirements Environmental stressors	<i>Decrease in</i> Physical abilities Physical fatigue Aches and pains Medical incidents	<i>Increase in</i> Financial costs Inactivity

<sup>a</sup> Benefits and costs based on findings in previous interdisciplinary research.<sup>14,16,17,18,21</sup>

### Benefits and Costs

The goal of this approach is to maximize efficiency, both in terms of productivity and in terms of the utilization of human resources. Table 32.1 summarizes some of the human resource benefits and costs that have been observed in previous research. Jobs designed according to the mechanistic approach are easier and less expensive to staff. Training times are reduced. Compensation requirements may be lower because skill and responsibility are reduced. And because mental demands are lower, errors may be less common.

The mechanistic approach also has costs. Too much of the mechanistic approach may result in jobs that are so simple and routine that employees experience less job satisfaction and motivation. Overly mechanistic work can lead to health problems from the physical wear that can result from highly repetitive and machine-paced work.

**TABLE 32.2 Multimethod Job Design Questionnaire (MJDQ)\***

(Specific Recommendations from Each Job Design Approach)

*Instructions:* Indicate the extent to which each statement is descriptive of the job using the following scale. Circle answers to the right of each statement. Scores for each approach are calculated by averaging applicable items.

**Please Use the Following Scale:**

- (5) Strongly agree
- (4) Agree
- (3) Neither agree nor disagree
- (2) Disagree
- (1) Strongly disagree
- ( ) Leave blank if do not know or not applicable

**Mechanistic Approach**

- 1. *Job specialization:* The job is highly specialized in terms of purpose, tasks, or activities. 1 2 3 4 5
- 2. *Specialization of tools and procedures:* The tools, procedures, materials, etc., used on this job are highly specialized in terms of purpose. 1 2 3 4 5
- 3. *Task simplification:* The tasks are simple and uncomplicated. 1 2 3 4 5
- 4. *Single activities:* The job requires you to do only one task or activity at a time. 1 2 3 4 5
- 5. *Skill simplification:* The job requires relatively little skill and training time. 1 2 3 4 5
- 6. *Repetition:* The job requires performing the same activity(s) repeatedly. 1 2 3 4 5
- 7. *Spare time:* There is very little spare time between activities on this job. 1 2 3 4 5
- 8. *Automation:* Many of the activities of this job are automated or assisted by automation. 1 2 3 4 5

**Motivational Approach**

- 9. *Autonomy:* The job allows freedom, independence, or discretion in work scheduling, sequence, methods, procedures, quality control, or other decision making. 1 2 3 4 5
- 10. *Intrinsic job feedback:* The work activities themselves provide direct and clear information as to the effectiveness (e.g., quality and quantity) of job performance. 1 2 3 4 5
- 11. *Extrinsic job feedback:* Other people in the organization, such as managers and co-workers, provide information as to the effectiveness (e.g., quality and quantity) of job performance. 1 2 3 4 5
- 12. *Social interaction:* The job provides for positive social interaction such as team work or co-worker assistance. 1 2 3 4 5
- 13. *Task/goal clarity:* The job duties, requirements, and goals are clear and specific. 1 2 3 4 5
- 14. *Task variety:* The job has a variety of duties, tasks, and activities. 1 2 3 4 5
- 15. *Task identity:* The job requires completion of a whole and identifiable piece of work. It gives you a chance to do an entire piece of work from beginning to end. 1 2 3 4 5
- 16. *Ability/skill level requirements:* The job requires a high level of knowledge, skills, and abilities. 1 2 3 4 5
- 17. *Ability/skill variety:* The job requires a variety of knowledge, skills, and abilities. 1 2 3 4 5
- 18. *Task significance:* The job is significant and important compared with other jobs in the organization. 1 2 3 4 5
- 19. *Growth/learning:* The job allows opportunities for learning and growth in competence and proficiency. 1 2 3 4 5
- 20. *Promotion:* There are opportunities for advancement to higher level jobs. 1 2 3 4 5
- 21. *Achievement:* The job provides for feelings of achievement and task accomplishment. 1 2 3 4 5
- 22. *Participation:* The job allows participation in work-related decision making. 1 2 3 4 5
- 23. *Communication:* The job has access to relevant communication channels and information flows. 1 2 3 4 5
- 24. *Pay adequacy:* The pay on this job is adequate compared with the job requirements and with the pay in similar jobs. 1 2 3 4 5
- 25. *Recognition:* The job provides acknowledgment and recognition from others. 1 2 3 4 5
- 26. *Job security:* People on this job have high job security. 1 2 3 4 5

TABLE 32.2 (Continued)

<b>Perceptual-Motor Approach</b>	
27. <i>Lighting</i> : The lighting in the work place is adequate and free from glare.	1 2 3 4 5
28. <i>Displays</i> : The displays, gauges, meters, and computerized equipment on this job are easy to read and understand.	1 2 3 4 5
29. <i>Programs</i> : The programs in the computerized equipment on this job are easy to learn and use.	1 2 3 4 5
30. <i>Other equipment</i> : The other equipment (all types) used on this job is easy to learn and use.	1 2 3 4 5
31. <i>Printed job materials</i> : The printed materials used on this job are easy to read and interpret.	1 2 3 4 5
32. <i>Workplace layout</i> : The workplace is laid out such that you can see and hear well to perform the job.	1 2 3 4 5
33. <i>Information input requirements</i> : The amount of information you must attend to in order to perform this job is fairly minimal.	1 2 3 4 5
34. <i>Information output requirements</i> : The amount of information you must output on this job, in terms of both action and communication, is fairly minimal.	1 2 3 4 5
35. <i>Information processing requirements</i> : The amount of information you must process, in terms of thinking and problem solving, is fairly minimal.	1 2 3 4 5
36. <i>Memory requirements</i> : The amount of information you must remember on this job is fairly minimal.	1 2 3 4 5
37. <i>Stress</i> : There is relatively little stress on this job.	1 2 3 4 5
<b>Biological Approach</b>	
38. <i>Strength</i> : The job requires fairly little muscular strength.	1 2 3 4 5
39. <i>Lifting</i> : The job requires fairly little lifting, and/or the lifting is of very light weights.	1 2 3 4 5
40. <i>Endurance</i> : The job requires fairly little muscular endurance.	1 2 3 4 5
41. <i>Seating</i> : The seating arrangements on the job are adequate (e.g., ample opportunities to sit, comfortable chairs, good postural support, etc.).	1 2 3 4 5
42. <i>Size differences</i> : The workplace allows for all size differences between people in terms of clearance, reach, eye height, leg room, etc.	1 2 3 4 5
43. <i>Wrist movement</i> : The job allows the wrists to remain straight without excessive movement.	1 2 3 4 5
44. <i>Noise</i> : The workplace is free from excessive noise.	1 2 3 4 5
45. <i>Climate</i> : The climate at the workplace is comfortable in terms of temperature and humidity, and it is free of excessive dust and fumes.	1 2 3 4 5
46. <i>Work breaks</i> : There is adequate time for work breaks given the demands of the job.	1 2 3 4 5
47. <i>Shift work</i> : The job does <i>not</i> require shift work or excessive overtime.	1 2 3 4 5
<i>For jobs with little physical activity due to single workstation add:</i>	
48. <i>Exercise opportunities</i> : During the day, there are enough opportunities to get up from the workstation and walk around.	1 2 3 4 5
49. <i>Constraint</i> : While at the workstation, the worker is <i>not</i> constrained to a single position.	1 2 3 4 5
50. <i>Furniture</i> : At the workstation the worker can adjust or arrange the furniture to be comfortable (e.g., adequate leg room, foot rests if needed, proper keyboard or work surface height, etc.).	1 2 3 4 5

\* Table adopted from Campion and associates.<sup>14,16,21</sup> See supporting references for reliability and validity information.

## Motivational Approach

### Historical Development

Encouraged by the human relations movement of the 1930s,<sup>41,42</sup> people began to point out the unintended drawbacks of the mechanistic design philosophy in terms of worker attitudes and health.<sup>43-45</sup> Overly specialized and simplified jobs were found to lead to dissatisfaction<sup>46-49</sup> and to adverse physiological consequences for workers.<sup>50-52</sup> Jobs on assembly lines and other machine-paced work were especially troublesome in this regard.<sup>53,54</sup> These trends led to an increasing awareness of the psychological needs of employees.

The first efforts to enhance the meaningfulness of jobs simply involved the exact opposite of specialization. It was recommended that tasks be added to jobs, either at the same level of responsibility (i.e., job enlargement) or at a higher level (i.e., job enrichment).<sup>27,55</sup> This job design trend expanded into a pursuit of identifying and validating the characteristics of jobs that make them motivating and

satisfying.<sup>25,26,56,57</sup> This approach to job design considers the psychological theories of work motivation,<sup>4,58,59</sup> thus this “motivational” approach to job design draws primarily from organizational psychology as a discipline base.

A related trend following later in time but somewhat comparable in content is the sociotechnical approach.<sup>60-62</sup> It focuses not only on the work, but also on the technology itself. Interest is less on the job per se and more on roles and systems. The goal, and key concept, is the joint optimization of both the social and technical systems. Although this approach differs somewhat in that consideration is also given to the technical system, it is similar in that it draws on the same psychological job characteristics that affect satisfaction and motivation. The sociotechnical approach is described further in Section 32.11.

### ***Design Recommendations***

Table 32.2 provides a list of statements that describe the recommendations from the motivational approach. It suggests that jobs should allow the worker some autonomy to make decisions about how and when tasks are to be done. The worker should feel that the work is important to the overall mission of the organization or department. This is often done by allowing the worker to perform a larger unit of work, or to perform an entire piece of work from beginning to end. Feedback on job performance should be given to the worker from the task itself, as well as from the supervisor and others. The worker should be able to use a variety of skills and have opportunities to learn new skills and to personally grow on the job. Aside from these characteristics that make jobs meaningful from a task-oriented perspective, this approach also considers the social, or people, interaction aspects of the job. That is, jobs should have opportunities for participation, communication, and recognition. Finally, other human resource systems should contribute to the motivating atmosphere, such as adequate pay, promotion, and job security systems.

### ***Benefits and Costs***

The goal of this approach is to enhance the psychological meaningfulness of the jobs, thus influencing a variety of attitudinal and behavioral outcomes. Table 32.1 summarizes some of the human resource benefits and costs from previous research. Jobs designed according to the motivational approach have more satisfied, motivated, and involved employees. Furthermore, job performance may be higher and absenteeism may be lower. Customer service may even be improved, in part because employees may take more pride in the work, and in part because employees can catch their own errors by performing a larger part of the work.

In terms of cost, jobs that are too high on the motivational approach may have longer training times and be more difficult and expensive to staff because of their greater skill and ability requirements. Higher skill and responsibility may in turn require higher compensation. Overly motivating jobs may be so stimulating that workers become predisposed to mental overload, fatigue, errors, and occupational stress.

## **Perceptual-Motor Approach**

### ***Historical Development***

This approach draws on a scientific discipline that goes by many names, including human factors, human factors engineering, human engineering, human-machine systems engineering, and engineering psychology. As a field, it developed from a number of other disciplines, primarily experimental psychology but also industrial engineering.<sup>63,64</sup> Within experimental psychology, job design recommendations draw heavily from knowledge of human skilled performance<sup>30</sup> and the analysis of humans as information processors.<sup>28</sup> The main concern of this approach is with the efficient and safe utilization of humans in human-machine systems, with emphasis on the selection, design, and arrangement of system components so as to take account of both people's capabilities and limitations.<sup>65</sup> It is more concerned with equipment than are psychologists, and more concerned with people's abilities than are engineers.

This approach received public attention through the Three Mile Island incident where it was concluded that the control room operator job in the nuclear power plant may have created too many demands on the operator in an emergency situation thus predisposing errors of judgment.<sup>15</sup> Government regulations issued since that time require that nuclear power plants consider the “human factors” in their design.<sup>66</sup> The primary emphasis suggested by its title is on perceptual and motor abilities of people. This approach is the most prolific with respect to recommendations for proper job design with the availability of many handbooks giving specific advice for all types of equipment, facilities, and layouts.<sup>29,31,67,68</sup>



### ***Design Recommendations***

Table 32.2 provides a list of statements describing some of the most important recommendations of the perceptual-motor approach. They refer to either equipment and environment on the one hand or information processing requirements on the other. Their thrust is to take into consideration the mental capabilities and limitations of people, such that the attention and concentration requirements of the job do not exceed the abilities of the least capable potential worker. Focus is on the limits of the least capable worker because this approach is concerned with the effectiveness of the total system, which is no better than its "weakest link." Jobs should be designed to limit the amount of information workers must pay attention to, remember, and think about. Lighting levels should be appropriate, displays and controls should be logical and clear, workplaces should be well laid out and safe, and equipment should be easy to use (i.e., user friendly).

### ***Benefits and Costs***

The goals of this approach are to enhance the reliability and safety of the system, and positive user reactions to it. Table 32.1 summarizes some of the human resource benefits and costs found in previous research. Jobs designed according to the perceptual-motor approach have lower likelihoods of errors and accidents. Employees may be less stressed and mentally fatigued because of the reduced mental demands of the job. Like the mechanistic approach, it reduces the mental ability requirements of the job. Thus, it may also enhance some human resource efficiencies, such as reduced training times and staffing difficulties.

On the other hand, there can be costs to the perceptual-motor approach if it is excessively applied. In particular, less satisfaction, less motivation, and more boredom may result because the jobs provide inadequate mental stimulation. This problem is exacerbated by the fact that the least capable potential worker places the limits on the mental requirements of the job.

## **Biological Approach**

### ***Historical Development***

This approach and the perceptual-motor approach share a joint concern for proper person-machine fit. The primary difference is that this approach is more oriented toward biological considerations of job design and stems from such disciplines as work physiology,<sup>32</sup> biomechanics (i.e., the study of body movements),<sup>34</sup> and anthropometry (i.e., the study of body sizes).<sup>69</sup> Although many specialists probably practice both approaches together as is reflected in many texts in the area,<sup>70</sup> a split does actually exist between Americans who are more psychologically oriented and use the title "human factors engineer" and Europeans who are more physiologically oriented and use the title "ergonomist."<sup>71</sup> Like the perceptual-motor approach, the biological approach is concerned with the design of equipment and workplaces, as well as the design of tasks.<sup>33</sup>

### ***Design Recommendations***

Table 32.2 provides a list of important recommendations from the biological approach. This approach tries to design jobs to reduce physical demands, and especially to avoid exceeding people's physical capabilities and limitations. Jobs should not have excessive strength and lifting requirements, and again the capabilities of the least physically able potential worker set the maximum level. Chairs should be designed so that good postural support is provided. Excessive wrist movement should be reduced by redesigning tasks and equipment. Noise, temperature, and atmosphere should be controlled within reasonable limits. Proper work-rest schedules should be provided so that employees can recuperate from the physical demands.

### ***Benefits and Costs***

The goals of this approach are to maintain the comfort and physical well-being of the employees. Table 32.1 summarizes some of the human resource benefits and costs observed in the research. Jobs designed according to the biological approach require less physical effort, result in less fatigue, and create fewer injuries and aches and pains than jobs low on this approach. Occupational illnesses, such as lower back pain and carpal tunnel syndrome, are fewer on well-designed jobs. There may even be lower absenteeism and higher job satisfaction on jobs that are not physically arduous.

A direct cost of this approach may be the expense of changes in equipment or job environments needed to implement the recommendations. At the extreme, there may be other costs. For example, it is possible to design jobs with so few physical demands that the workers become drowsy or lethargic, thus reducing their performance or causing them to leave their workplace. Clearly, extremes of physical

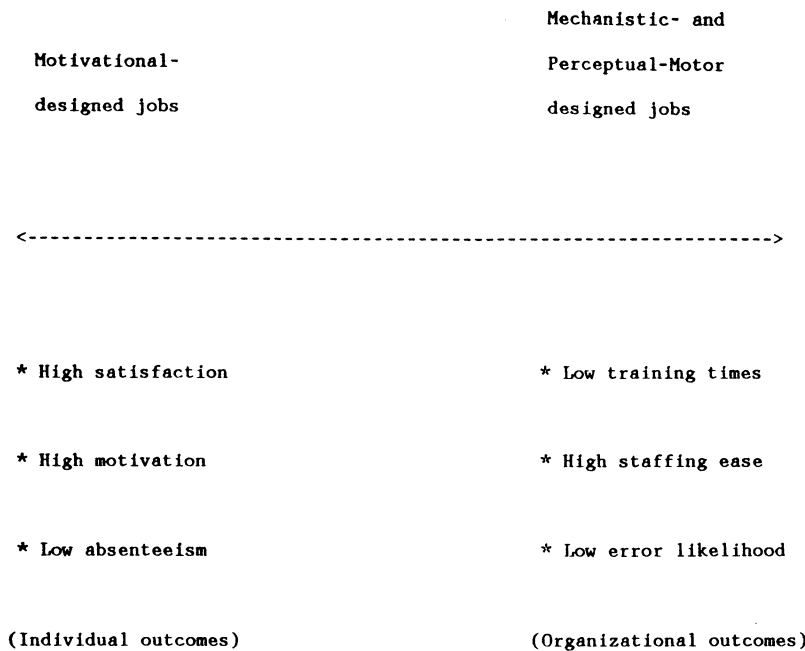


Figure 32.3 Mental Demands Continuum. (Adopted from Campion and Thayer.<sup>15</sup>)

activity and inactivity should be avoided, and there may even be an optimal level of physical activity for various employee groups (e.g., male, female, young, old, etc.).

### Conflicts and Trade-offs among Approaches

Although one should strive to construct jobs that are well designed on all the approaches, it is clear that there are some direct conflicts in design philosophies. As Table 32.1 illustrates, the benefits of some approaches are the costs of others. No one approach can satisfy all outcomes. As alluded to above, the greatest potential conflicts are between the motivational approach on the one hand and the mechanistic and perceptual-motor approaches on the other. They produce nearly opposite outcomes. The mechanistic and perceptual-motor approaches recommend designing jobs that are simple, easy to learn, safe, and reliable, with minimal mental demands on workers. The motivational approach encourages more complicated, challenging, and stimulating jobs, with greater mental demands.

Because of these conflicts, trade-offs and compromises may be necessary in many practical situations. The major trade-offs will be in terms of the mental demands of jobs created by the alternative design strategies. Figure 32.3 illustrates the trade-offs on this dimension. Making the job more mentally demanding increases the likelihood of achieving the workers' goals of satisfaction and motivation. On the other hand, making the job less mentally demanding increases the chances of reaching the organization's goals of reduced training and staffing costs and errors. Which trade-offs will be made depends on which types of outcomes one wants to maximize. In most situations probably a compromise strategy may be optimal.

Trade-offs may not be needed in all situations, however. Jobs can often be improved on one approach while still maintaining their quality on other approaches. For example, in a recent redesign study, the motivational approach was applied to a group of clerical jobs to improve employee satisfaction and customer service.<sup>21</sup> The expected benefits occurred along with some expected costs (e.g., increased training and compensation requirements), but not all potential costs occurred (e.g., quality and efficiency did *not* decrease).

One strategy for minimizing trade-offs is to avoid design decisions that influence the mental demands of jobs. An example of this strategy is to enhance motivational design by focusing on the social aspects (e.g., social interaction, communication, participation, recognition, feedback, etc.). These design features can be raised without incurring the costs of increased mental demands. Moreover, many of these design features are under the direct control of those who manage the job.

The independence of the biological approach provides another opportunity to improve design without incurring trade-offs with the other approaches. One can reduce physical demands without influencing the mental demands of a job. Of course, the cost of equipment may need to be considered.

Finally, the adverse effects of trade-offs can often be reduced by avoiding designs that are extremely high or low on any of the approaches. Or, alternatively, one might require minimum acceptable levels on each approach. Knowing all the approaches to job design and their corresponding outcomes will help make more intelligent job design decisions and avoid unanticipated consequences.

### Lagged Effects, Dissipating Effects, and Spillover Effects

It is important to recognize that some of the effects of job design may not be immediate, others may not be long lasting, and still others may not be obvious. The research has not tended to address these issues directly. In fact, these effects are offered here as potential explanations for some of the inconsistent findings in the literature. The purpose is to simply put the reader on the alert for the possibility of these effects.

Initially when jobs are designed and employees are new, or right after jobs are redesigned, there may be a short-term period of positive attitudes (often called a "honeymoon effect"). As the legendary Hawthorne studies indicated, often changes in jobs or increased attention given to workers tends to create novel stimulation and positive attitudes.<sup>41</sup> Such transitory elevations in affect should not be mistaken for long-term improvements in satisfaction, as they may wear off over time. In fact, with time the employees may realize that the job is now more important or bigger and should require higher compensation.<sup>17</sup> These are only examples to illustrate how dissipating and lagged effects might occur.

Likely candidates for costs that may lag in time include compensation, as noted. Stress and fatigue may also take a while to build up if a job's mental demands have been increased excessively, and boredom may take a while to set in after a job's mental demands have been overly decreased. In terms of lagged benefits, productivity and quality are likely to improve with practice and learning on the new job. And some benefits, like reduced turnover, simply take a period of time to estimate accurately.

Benefits that may potentially dissipate with time include satisfaction, especially if the elevated satisfaction is a function of novelty rather than basic changes to the motivating value of the job. Short-term increases in productivity due to heightened effort rather than better design may not last over time. Costs that may dissipate include the training requirements and staffing difficulties. Once the jobs are staffed and everyone is trained, these costs disappear until turnover occurs. So these costs will not go away completely, but they may be less after initial start-up. Dissipating heightened satisfaction, but long-term increases in productivity were observed in a recent motivational job redesign study.<sup>72</sup>

Another potential effect that may confuse the proper evaluation of the benefits and costs of job design is spillover. Laboratory research has shown that job satisfaction can bias employees' perceptions of the motivational value of their jobs.<sup>73</sup> Likewise, the level of morale in the organization can have a spillover effect onto employees' perceptions of job design in applied settings. If morale is particularly high, it may have an elevating effect on how employees view their jobs; conversely, low morale may have a depressing effect on employees' views. The term *morale* refers to the general level of job satisfaction across employees, and it may be a function of many factors including management, working conditions, wages, and so on. Another factor that has an especially strong effect on employee reactions to job design changes is employment security. Obviously, employee enthusiasm for job design changes will be negative if they view changes as potentially decreasing their job security, and every effort should be made to eliminate these fears. The best method of addressing these effects is to be attentive to their potential existence and to conduct longitudinal evaluations of job design.

## 32.6 WHEN TO CONSIDER JOB DESIGN

There are at least eight situations when job design should be considered.

1. *When Starting-up or Building a New Plant or Work Unit.* This is the most obvious application of job design.
2. *During Innovation or Technological Change.* Continual innovation and technological change are important for survival in most organizations. These changes in procedures and equipment mean there are changes in job design. This is not unique to manufacturing jobs. The introduction of electronic equipment is changing many office jobs. Proper consideration of job design is needed to ensure that the innovations are successful.
3. *When Markets, Products, or Strategies Change.* Modern consumer and industrial markets change rapidly. To keep up with changing demands, organizations must often change marketing strategies and product line mixes. Such changes can affect many jobs throughout an organization and require redesign. For example, salespersons' territories, product line responsibilities, and compensa-

tion packages may need to be modified to reflect changing strategies. Production workers' jobs may also require redesign as styles and quantities of products change.

4. *During Reorganization* Reorganizations of management hierarchies and organizational units frequently mean changes in job assignments or responsibilities of many employees due to the creation and elimination of jobs. To ensure a successful reorganization, principles of proper job design must be considered.

5. *During Growth or Downsizing.* As an organization grows, new jobs are formed. These jobs are often designed haphazardly, reflecting a collection of tasks other employees do not have time to do. Likewise, during downsizing jobs are eliminated, and some of the tasks are assumed by other jobs. This can lead to unfavorable changes in the designs of the remaining jobs.

6. *When Jobs Are Needed for Special Positions or Persons.* Even existing organizations create new positions from time to time. Also, new persons may be hired to fill positions who have different backgrounds, skills, and capabilities than former employees. Both these situations may create a need to reevaluate job design. For example, hiring handicapped workers may require that managers carefully redesign jobs for them. Frequently, special jobs are also designed for newcomers to the organization, for special administrative assistants, or for temporary assignments.

7. *When the Work Force or Labor Markets Change.* Changing demographics, education levels, and economic conditions affecting employment levels can cause changes in the quality and size of the organization's labor force and labor markets from which the organization hires new workers. Jobs may need to be redesigned to fit a work force whose average education level has increased over time, or physically demanding jobs may need to be redesigned to accommodate increasing numbers of older or female workers.

8. *When There Are Performance, Safety, or Satisfaction Problems.* It is quite common for the employee to be blamed when there are problems with performance, safety, or satisfaction. In many of these instances the job design is at least partly to blame. Several examples may illustrate this. Human error was attributed as the cause of the nearly catastrophic nuclear power plant incident at Three Mile Island noted previously, but indeed the design of the operator's job may have been the actual cause.

In a study of a wood products company,<sup>14</sup> one sawmill job with multiple employees involved pulling two-by-fours off a moving belt and placing them in racks. The employees were described as lazy and apathetic. But examination of the job from a motivational design point of view revealed that it lacked variety and any significant skill requirements. It was unimportant, repetitive, and boring. It is no surprise that the employees were not motivated or satisfied. In that same study a plywood plant required an employee to align strips of wood on a moving belt just before they entered the dryer. One time when dryer utilization was not up to standard, the supervisor concluded that the incumbent was negligent and gave her a written reprimand. But the job was very poorly designed from a biological perspective. The employee had to operate a foot pedal while standing, and thus spent all day with most of her body weight on one foot. She also had to bend over constantly while extending her arms to adjust the strips of wood, resulting in biomechanical stresses on the back, arms, and legs. Everyone hated the job, yet the employee was blamed.

As a final example, the first author discovered that a personnel recruiter job in a large company was in need of improved mechanistic design. The job involved running the engineering co-op program that consisted of hundreds of engineering students coming to the company and returning to school each semester. The recruiter had to match employees' interests with managers' needs, monitor everyone's unique schedule, keep abreast of the requirements of different schools, administer salary plans and travel reimbursement, and coordinate hire and termination dates. The job was completely beyond the capability of any recruiter. The solution involved having a team of industrial engineers study the job and apply the mechanistic approach to simplify tasks and streamline procedures.

It is clear that some types of jobs are naturally predisposed to be well designed on some job design approaches and poorly designed on others. It may be in these latter regards that the greatest opportunities exist to benefit from job design as described later.

Many factory, service, and otherwise low-skilled jobs lend themselves well to mechanistic design, but the ideas of specialization and simplification of tasks and skill requirements can be applied to any jobs in order to reduce staffing difficulties and training requirements. Jobs can often be too complex or too large for employees, leading to poor performance or excessive overtime. This is common with professional and managerial jobs, as was illustrated in the recruiter example. Professional jobs are usually only evaluated in terms of the motivational approach to job design, but often they can be greatly improved by mechanistic design principles. Finally, if work load in an area temporarily rises without a corresponding increase in staffing levels, the mechanistic approach may be applied to the jobs to enhance efficiency.

Most managerial, professional, and skilled jobs are fairly motivational by their nature. Factory, service, and low-skilled jobs tend naturally not to be motivational. The latter clearly represent the most obvious examples of needed applications of the motivational approach. But there are many jobs in every occupational group, and aspects of almost every job, where motivational features are low. Application of motivational job design is often only limited by the creativity of the designer.

Jobs involving the operation of complex machinery (e.g., aircraft, construction, factory control rooms) are primary applications of the perceptual-motor approach. Likewise, many product inspection and equipment monitoring jobs can tax attention and concentration capabilities of workers. But jobs in many other occupations may also impose excessive attention and concentration requirements. For example, some managerial, administrative, professional, and sales jobs can be excessively demanding on the information processing capabilities of workers, thus causing errors and stress. And nearly all jobs have periods of overload. Perceptual-motor design principles can often be applied to reduce these demands of jobs.

Traditional heavy industries (e.g., coal, steel, oil, construction, and forestry) represent the most obvious applications of the biological approach. Similarly, this approach also applies to many jobs that are common to most industries (e.g., production, maintenance) because there is some physical demands component. Biological design principles can be applied to physically demanding jobs so that women can better perform them (e.g., lighter tools with smaller hand grips). But there may also be applications to less physically demanding jobs. For example, seating, size differences, and posture are important to consider in the design of many office jobs, especially those with computer terminals. This approach can apply to many light assembly positions that require excessive wrist movements that can eventually lead to the wrist ailment of carpal tunnel syndrome. It should be kept in mind, however, that jobs designed with too little physical activity (i.e., movement restricted due to single position or workstation) should be avoided. Likewise, jobs that require excessive travel should be avoided because they can lead to poor eating and sleeping patterns. (See Chapters 40 and 41 on related concerns.)

### 32.7 MEASURING AND EVALUATING JOB DESIGN USING QUESTIONNAIRES

One easy and versatile way to measure job design is by using questionnaires or checklists. As such, job design can then be defined from an operational point of view as "a set of dimensions of jobs that can be used to describe all jobs, regardless of job content, that influence a wide range of benefits and costs for both the organization and the employee." This method of measuring job design is also highlighted because it has been used widely in research on job design, especially on the motivational approach.

Several questionnaires exist for measuring the motivational approach to job design.<sup>26,74</sup> Only one questionnaire has been developed that measures all four approaches to job design. A version of that questionnaire is presented in Table 32.2. It is called the Multimethod Job Design Questionnaire (MJDQ) because of its interdisciplinary emphasis. It yields an evaluation of the quality of a job's design based on each of the four approaches. Table 32.2 also includes a rating scale so that it can simply be copied and used without being retyped.

#### Sources of Information

##### *Incumbents*

Incumbents are probably the best source of information if there is an existing job. In the area of job analysis, incumbents are considered subject matter experts on the content of their jobs. Also, having input into the job design can enhance the likelihood that suggested changes will be accepted, and involvement in such work-related decisions can enhance feelings of participation thus increasing motivational job design in itself (see item 22 of the motivational scale in Table 32.2). One should include a large number of incumbents for each job because there can be slight differences in perceptions of the same job due to individual differences (to be discussed in Section 32.9). Evidence suggests that one should include all incumbents or at least 10 incumbents for each job.<sup>16,21</sup>

##### *Managers or Supervisors*

First-level managers or supervisors may be the next most knowledgeable persons about an existing job. They may also provide information on jobs under development if they have insight into the jobs through involvement in the development process. Differences in perceptions of the same job among managers should be smaller than among incumbents, but slight differences will exist and multiple managers should be used. Evidence suggests that one should include all managers with knowledge of the job or at least three to five managers for each job.<sup>16,21</sup>

##### *Engineers or Analysts*

Engineers may be the only source of information if the job has not been developed yet, because they are the only ones with insight into what the job will eventually look like. But also for existing jobs, an outside perspective such as may be rendered by an engineer, analyst, or consultant may provide a more

objective viewpoint. Again, there can be small differences among engineers, so at least two to five should evaluate each job.<sup>14,21</sup>

### Uses in Different Contexts

1. *Designing New Jobs.* When a job does not yet exist, the questionnaire is used to evaluate proposed job descriptions, workstations, equipment, and so on. In this role it often serves as a simple design checklist.

2. *Redesigning Existing Jobs.* When a job exists, there is a much greater wealth of information. Questionnaires can be completed by incumbents, managers, and engineers. Questionnaires can be used to measure job design before and after changes are made, and they can be used to evaluate proposed changes.

3. *Diagnosing Problem Jobs.* When problems occur, regardless of the apparent source of the problem, the job design questionnaire can be used as a diagnostic device to determine if any problems exist with the design of the jobs.

### Administration, Scoring, and Interpretation

Questionnaires can be administered in a variety of ways. Employees can complete them individually at their convenience at their workstations or some other designated area, or they can complete them in a group setting. Group settings allow greater standardization of instructions and provide the opportunity to answer questions and clarify ambiguities. Managers and engineers can also complete the questionnaires either individually or in a group session. Engineers and analysts usually find that observation of the job site, examination of the equipment and procedures, and discussions with any incumbents or managers are important methods of gaining information on the job before completing the questionnaires.

Scoring for each job design approach is usually accomplished by simply averaging the applicable items. Then the scores from different incumbents, managers, or engineers, are combined by averaging.<sup>16,21</sup> The implicit assumption is that slight differences among respondents are to be expected because of legitimate differences in viewpoint. However, the absolute differences in scores should be examined on an item-by-item basis, and large discrepancies (e.g., more than one point) should be discussed to clarify possible differences in interpretation. It is often useful to discuss each item until a consensus group rating is reached.

The higher the score on a particular job design scale, the better the quality of the design of the job based on that approach. Likewise, the higher the score on a particular item, the better the design of the job on that dimension. How high a score needed or necessary cannot be stated in isolation. Some jobs are naturally higher or lower on the various approaches as described previously, and there may be limits to the potential of some jobs. The scores have most value in comparing jobs or alternative job designs, rather than evaluating the absolute level of the quality of job design. However, a simple rule of thumb is that if the score for an approach is smaller than 3, the job is poorly designed on that approach and it should be reconsidered. Even if the average score on an approach is greater than 3, one should examine any individual dimension scores that are at 2 or 1.

## 32.8 OTHER ANALYTICAL TOOLS USEFUL FOR JOB DESIGN

In addition to questionnaires like the MJDQ (described in Section 32.7), there are many other analytical tools that are useful for job design. This section only briefly describes a few other techniques to illustrate the range of options available. The intent here is not to provide adequate detail that would allow the reader to use the techniques. Instead, the reader is referred to other citations provided in this section and to other chapters in this handbook.

The disciplines that contributed the different approaches to job design have also contributed different techniques for analyzing tasks, jobs, and processes for design and redesign purposes. These techniques include job analysis methods created by specialists in industrial psychology, variance analysis methods created by specialists in sociotechnical design, time and motion analysis methods created by specialists in industrial engineering, and linkage analysis methods created by specialists in human factors.

### Job Analysis

Job analysis can be broadly defined as any of a number of systematic techniques for collecting and making judgments about job information for a wide variety of purposes. Information derived from job

analysis can be used to aid in recruitment and selection decisions, determine training and development needs, develop performance appraisal systems, and evaluate jobs for compensation, as well as to analyze tasks and jobs for job design.

Different types of job analysis methods exist for different purposes. For example, to develop a training program a job analysis would focus on the tasks performed by the worker, while to develop a hiring procedure a job analysis would focus on the needed abilities and other characteristics. Job analysis may also focus on worker functions, work fields, working conditions, tools and methods, products and services, and so on. Job analysis data can come from job incumbents, supervisors, and analysts who specialize in the analysis of jobs. Data may also be provided by higher management levels or subordinates in some cases.

Considerable literature has been published on the topic of job analysis.<sup>75-79</sup> Some of the more typical methods of analysis are briefly described in the following:

1. *Conferences and Interviews.* Conferences or interviews with job experts, such as incumbents and supervisors, are often the first step in most job analyses. During such meetings, information collected typically includes job duties and tasks, and knowledge, skill, ability, and other worker characteristics.

2. *Questionnaires.* Questionnaires are used to collect information efficiently from a large number of people. Questionnaires require considerable prior knowledge of the job to form the basis of the items (e.g., primary tasks). Often this information is first collected through conferences and interviews, and then the questionnaire is constructed and used to collect judgments about the job (e.g., importance and time spent on each task). Some standardized (or generic) questionnaires have been developed that can be applied to all jobs to collect basic information on tasks and requirements. An example of a standardized questionnaire is the Position Analysis Questionnaire.<sup>80</sup>

3. *Inventories.* Inventories are much like questionnaires, except they are simpler in format. They are usually simple checklists wherein the job expert simply checks whether a task is performed or an attribute is required.

4. *Critical Incidents.* This form of job analysis focuses only on aspects of worker behavior that are especially effective or ineffective.

5. *Work Observation and Activity Sampling.* Quite often the job analysis includes the actual observation of the work performed. More sophisticated technologies involve statistical sampling of work activities (e.g., see Chapter 64).

6. *Diaries.* Sometimes it is useful or necessary to collect data by having the employee keep a diary of activities or events on his or her job.

7. *Functional Job Analysis.* Task statements can be written in more or less standardized fashion. Standardized statements are usually more desirable. Functional job analysis suggests how to write task statements (e.g., start with a verb, follow with an object of the verb, be as simple and discrete as possible, etc.). It also involves rating jobs on the degree of data, people, and things required. This form of job analysis was developed by the U.S. Department of Labor and has been used to describe over 12,000 jobs as documented in the *Dictionary of Occupational Titles*.<sup>81,82</sup>

Very limited research has been done to evaluate the practicality and quality of various job analysis methods for different purposes. But analysts seem to agree that combinations of methods are preferable to single methods.<sup>83</sup>

### Variance Analysis

Variance analysis is a tool of sociotechnical design that is used to identify areas of technological uncertainty in the production process. Information from variance analysis aids the organization in designing jobs so that jobholders can control variability in their work. A variance is defined as an unwanted discrepancy between a specification or desired state and the actual state. A variance is a deviation that falls outside a specified range of tolerance. The variance concept is applied to the technical system and involves five steps<sup>2</sup>:

1. Listing variances that could impede the production or service process.
2. Identifying the causal relationships among the variables. Job designers can often use information about dependencies and points of interrelatedness in order to cluster tasks and link jobs.
3. Identifying and focusing on key variances whose control is most critical to successful outcomes.
4. Constructing a table of key variance control that contains brief descriptions of variances.

5. Constructing a table of skills, knowledge, information, and authority needed so that workers can control key variances.

### Time and Motion Analysis

Industrial engineers have created many techniques for use in the study of job design. These methods help job designers visualize processes and operations in order to improve process efficiencies. A considerable literature exists on the topic,<sup>22,38,39</sup> including other chapters in this handbook.<sup>40</sup> Some of the methods are briefly described now:

1. *Process charts* graphically represent the separate steps or events that occur during performance of a task or series of actions. Charts usually begin with inputs of raw materials and follow the inputs through transportation, storage, inspection, production, and finishing. Charts use symbols for different types of operations, and they are either of the worker type or material type. Several different types of process charts are used.
2. *Operation process charts* show the chronological sequence of operations, inspections, time allowances, and materials used in a process from arrival of raw material to packaging of the finished product.
3. *Flow process charts* contain more detail than operation process charts and are used for less complicated processes. They focus on single-component processes.
4. *Worker and machine process charts* combine operations of both the worker and equipment and show idle time and active time for both. These charts are used to analyze only one workstation at a time.
5. *Gang process charts* are adaptations of worker and machine charts that show a process involving more than one worker and machine.
6. *Operator process charts* are also known as left- and right-hand charts and are sketches of a workplace with motions recorded for each hand. Operator charts are used to analyze workstations for proper layout and motion economy.
7. *Simo charts* are simultaneous motion cycle charts. Some of these charts focus on motions for specific parts of the body, such as hands, arms, legs, or head, whereas others include all the moving members of the body. These movements are drawn on a time scale.
8. *Flow diagrams* differ from process charts because they utilize drawings of an area or building in which an activity takes place. Flow diagrams help designers visualize the physical layout of the work. Lines are drawn to show the path of travel. Process chart symbols and brief notations can be included to describe the process.
9. *Possibility guides* are tools for systematically listing all possible changes suggested for a particular activity or output. They assist in examining consequences of suggestions to aid in selecting the most feasible changes. Suggestions are recorded and are coded as to what classes of change they affect. The five classes of change include the job, the equipment on the job, the process, the product design, and the raw materials.
10. *Network diagrams* are better for use in describing complex relationships than the preceding techniques. They are useful for situations where (a) dependencies are tangled and do not progress uniformly, (b) the output has many components, (c) many of the components are service-type outputs, (c) the relationships among the steps of the process with respect to time are of vital importance, or (d) the process is too complex or large in scope for the usual process chart analysis. In network diagrams a circle or square represents a "status" that is a partial or complete service or substantive output. Heavy lines are "critical paths" that determine the minimum time in which a project can be expected to be completed.

### Linkage Analysis

Linkage analysis is a technique used by human factors specialists to represent relationships between components in a work system.<sup>29</sup> Components can be either people or things, and the relationships between them are called "links." Links fall into three classes as listed here with examples:

1. Communication links.
  - a. Visual (person to person or equipment to person).
  - b. Auditory, voice (person to person, person to equipment, or equipment to person).
  - c. Auditory, nonvoice (equipment to person).
  - d. Touch (person to equipment).



2. Control links.
  - a. Control (person to equipment).
3. Movement links (movements from one location to another).
  - a. Eye movements.
  - b. Manual movements, foot movements, or both.
  - c. Body movements.

Information collected about links generally includes how often components are linked, in what sequence links occur, and the importance of links. Once obtained, linkage data can be summarized in link tables, adjacency layout diagrams, and spatial operational sequence (SOS) diagrams. Designers of physical work arrangements use these tools to represent the relationships between components so that they can better understand how to place these components in advantageous locations in order to minimize lengths between frequent or important links. With complex systems involving many components, quantitative analysis techniques, such as linear programming, can be used.

### 32.9 HOW TO DESIGN JOBS

There are at least several general guiding philosophies that are helpful when designing or redesigning jobs:

1. As noted previously, designs are not fixed, unalterable, or dictated by the technology. There is at least some discretion in the design of all jobs and substantial discretion in most jobs.
2. There is no single best design for a given job; there are simply better and worse designs depending on one's job design perspective.
3. Job design is iterative and evolutionary. It should continue to change and improve over time.
4. When possible, participation of the workers affected generally improves the quality of the resulting design and acceptance of suggested changes.
5. Related to point 4, the process aspects of the project are very important to success. That is, how the project is conducted is important in terms of involvement of all the parties of interest, consideration of alternative motivations, awareness of territorial boundaries, and so on.

#### Designing Original Jobs

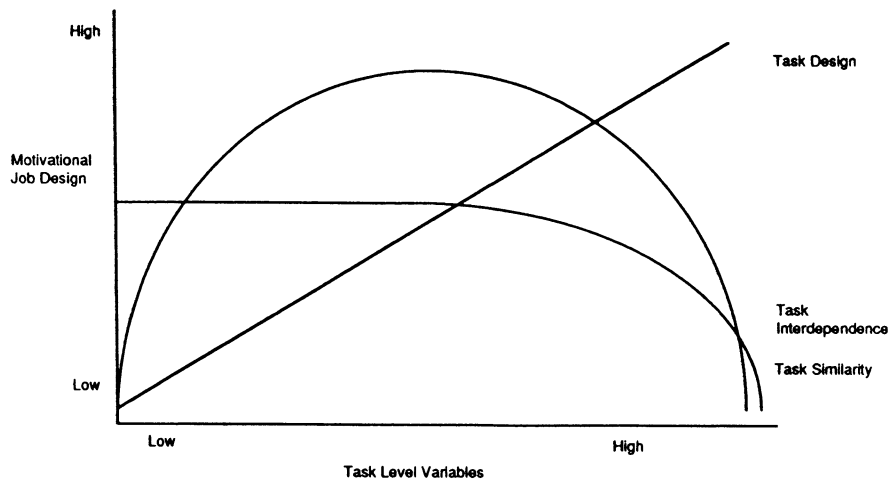
##### *How People Design Jobs*

As noted previously, surveys of industrial job designers have consistently indicated that the mechanistic approach represents the dominant theme of job design.<sup>1,7</sup> Other approaches to job design, such as the motivational approach, have not been given as much explicit consideration. This is not surprising because the surveys only included job designers trained in engineering-related disciplines, such as industrial engineers and systems analysts. It is not necessarily certain that other specialists or line managers would adopt the same philosophies. Nevertheless, there is evidence that even fairly naive job designers (i.e., college students taking management classes) also seem to adopt the mechanistic approach in job design simulations. That is, their strategies for grouping tasks were primarily similarity of functions or activities, and also similarity of skills, education, difficulty, equipment, procedures, or location.<sup>19</sup> Even though the mechanistic approach may be the most natural and intuitive, this research has also revealed that people can be trained to apply all four of the approaches to job design.

##### *A Process Strategy*

In consideration of process aspects of conducting a design project, Davis and Wacker<sup>5</sup> have suggested a strategy consisting of four steps:

1. *Form a Steering Committee.* The steering committee usually consists of a group of high-level executives that have a direct stake in the new jobs. The purpose of this committee is fourfold: (a) to bring into focus the objective of the project, (b) to provide resources and support for the project, (c) to help gain the cooperation of all the parties affected by the project, and (d) to oversee and guide the project.
2. *Form a Design Task Force.* The task force may include engineers, managers, job design experts, architects, specialists, and others with knowledge or responsibility relevant to the project. The



**Figure 32.4** Effects of Task Design, Interdependence, and Similarity on Motivational Job Design. (Adopted from Wong.<sup>84</sup>)

purpose of the task force is to gather data, generate and evaluate design alternatives, and help implement recommended designs.

3. *Develop a Philosophy Statement.* The first goal of the task force is to develop a philosophy statement to guide the many decisions that will be involved in the project. The philosophy statement is developed with considerable input from the steering committee and may include such factors as the purposes of the project, the strategic goals of the organization, assumptions about workers and the nature of work, process considerations, and so on.

4. *Proceed in an Evolutionary Manner.* The essential point here is that jobs should not be overspecified. With considerable input from eventual job holders, the designs of the jobs will continue to change and improve over time.

### **Designing Jobs by Combining Tasks**

In many cases designing jobs is largely a function of combining tasks. Generally speaking, most writing on job design has focused on espousing overall design philosophies or on identifying those dimensions of jobs (once the jobs exist) that relate to important outcomes, but little research has focused on how tasks should be combined to form jobs in the first place. Some guidance can be gained by extrapolating from the specific design recommendations in Table 32.2. For example, variety in the motivational approach can be increased by simply combining different tasks into the same job. Conversely, specialization from the mechanistic approach can be increased by only including very similar tasks in the same job. It is also possible when designing jobs to first generate alternative combinations of tasks, then evaluate them using the design approaches in Table 32.2.

A small amount of research within the motivational approach has focused explicitly on predicting the relationships between combinations of tasks and the design of resulting jobs.<sup>84,85</sup> This research suggests that the motivational quality of a job is a function of three task level variables as illustrated in Figure 32.4 and described in the following:

1. *Task Design.* The higher the motivational quality of the individual tasks, the higher the motivational quality of the job. Table 32.2 can be used to evaluate the individual tasks, then motivational scores for the individual tasks can be summed together. Summing is recommended rather than averaging because it includes a consideration of the number of tasks.<sup>86</sup> That is, both the motivational quality of the tasks and the number of tasks are important in determining the motivational quality of a job.

2. *Task Interdependence.* Interdependence among the tasks has been shown to have an inverted-U relationship with the motivational quality of a job. That is, task interdependence is positively related to motivational value up to some moderate point, beyond that point increasing interdependence leads to lower motivational value. Thus when combining tasks to form motivational jobs, the total amount of interdependence among the tasks should be kept at a moderate level. Both complete independence among the tasks and excessively high interdependence should be avoided. Table 32.3 contains the

TABLE 32.3 Dimensions of Task Interdependence<sup>a</sup>

*Instructions:* Indicate the extent to which each statement is descriptive of the pair of tasks using the following scale. Circle answers to the right of each statement. Scores are calculated by averaging applicable items.

**Please Use the Following Scale:**

- (5) Strongly agree
- (4) Agree
- (3) Neither agree nor disagree
- (2) Disagree
- (1) Strongly disagree
- ( ) Leave blank if do not know or not applicable

**Inputs of the Task**

- |  |           |
|--|-----------|
| 1. <i>Materials/supplies:</i> One task obtains, stores, or prepares the materials or supplies necessary to perform the other task. | 1 2 3 4 5 |
| 2. <i>Information:</i> One task obtains or generates information for the other task.   | 1 2 3 4 5 |
| 3. <i>Product/service:</i> One task stores, implements, or handles the products or services produced by the other task.            | 1 2 3 4 5 |

**Processes of the Tasks**

- |  |           |
|--|-----------|
| 4. <i>Input-output relationship:</i> The products (or outputs) of one task are the supplies (or inputs) necessary to perform the other task. | 1 2 3 4 5 |
| 5. <i>Method and procedure:</i> One task plans the procedures or work methods for the other task.  | 1 2 3 4 5 |
| 6. <i>Scheduling:</i> One task schedules the activities of the other task.   | 1 2 3 4 5 |
| 7. <i>Supervision:</i> One task reviews or checks the quality of products or services produced by the other task.                            | 1 2 3 4 5 |
| 8. <i>Sequencing:</i> One task needs to be performed before the other task.  | 1 2 3 4 5 |
| 9. <i>Time sharing:</i> Some of the work activities of the two tasks must be performed at the same time.                                     | 1 2 3 4 5 |
| 10. <i>Support service:</i> The purpose of one task is to support or otherwise help the other task get performed.                            | 1 2 3 4 5 |
| 11. <i>Tools/equipment:</i> One task produces or maintains the tools or equipment used by the other task.                                    | 1 2 3 4 5 |

**Outputs of the Tasks**

- |   |           |
|---|-----------|
| 12. <i>Goal:</i> One task can only be accomplished when the other task is properly performed.                                   | 1 2 3 4 5 |
| 13. <i>Performance:</i> How well one task is performed has a great impact on how well the other task can be performed.          | 1 2 3 4 5 |
| 14. <i>Quality:</i> The quality of the product or service produced by one task depends on how well the other task is performed. | 1 2 3 4 5 |

<sup>a</sup> Table adopted from Wong.<sup>44</sup> See reference for reliability and validity information. The task similarity measure contains 10 comparable items (excluding items 4, 6, 8, 9, and 14, and including an item on customer/client).

dimensions of task interdependence and provides a questionnaire that can be used to measure interdependence. Table 32.3 can be used to judge the interdependence of each pair of tasks that are being evaluated for inclusion into a particular job.

3. *Task Similarity.* Some degree of similarity among tasks may be the oldest rule of job design (as discussed previously) and seems to have little influence on the motivational quality of the job. But beyond a moderate level, it tends to decrease the motivational value. Thus when designing motivational jobs, high levels of similarity should be avoided. Similarity at the task-pair level can be judged in much the same manner as interdependence by using a subset of the dimensions in Table 32.3 (see the note to Table 32.3).

Davis and Wacker<sup>5,6</sup> have provided a list of criteria for grouping tasks into jobs. Part of their list is reproduced in the following. There are two points to notice. First, the list represents a collection of criteria from both the motivational approach to job design (e.g., 1, 5, 9) as well as the mechanistic approach (e.g., 2, 8). Second, many of the recommendations could be applied to designing work for groups as well as individual jobs as discussed in Section 32.10.

1. Each task group is a meaningful unit of the organization.
2. Task groups are separated by stable buffer areas.
3. Each task group has definite, identifiable inputs and outputs.
4. Each task group has associated with it definite criteria for performance evaluation.
5. Timely feedback about output states and feedforward about input states are available.
6. Each task group has resources to measure and control variances that occur within its area of responsibility.
7. Tasks are grouped around mutual cause-effect relationships.
8. Tasks are grouped around common skills, knowledge, or data bases.
9. Task groups incorporate opportunities for skill acquisition relevant to career advancement.

## Redesigning Existing Jobs

### *Process Considerations*

According to Davis and Wacker,<sup>5</sup> the process of redesigning existing jobs is much the same as designing original jobs with two additions. First, the existing job incumbents must be involved. Second, more attention needs to be given to implementation issues. Most importantly, those involved in the implementation must feel ownership of the change. They should believe that the redesign represents their own interests and efforts. This is important not only so that they will be emotionally committed to the change and willing to put in the effort to make it happen, but also so that they will understand the details of the redesign so as to reduce inherent uncertainty.

### *Potential Steps to Follow*

Along with steps related to the process issues already discussed earlier and in the previous subsection, a redesign project would also include the following five steps:

1. *Measuring the Design of the Existing Job.* The questionnaire methodology described previously may be used as well as the other analysis tools. The goal is to gain a measure of the job as it currently exists.
2. *Diagnosing Potential Job Design Problems.* Based primarily on the measures collected in step 1, the job is analyzed for potential problems. The job design task force and employee involvement are particularly important at this step. Focused group meetings are often a useful vehicle for identifying and evaluating potential problems.
3. *Determining Job Design Changes.* These changes will be guided by the goals of the project, the problems identified in step 3, and by one or more of the theoretical approaches to job design. Often several potential changes are generated and evaluated. Evaluation of alternative changes may consist of a consideration of the costs and benefits identified in previous research (see Table 32.1) and the opinions of engineers, managers, and employees. This may be the point when trade-offs become the most apparent.
4. *Making the Job Design Changes.* Implementation plans should be developed in detail along with backup plans in case there are a few difficulties with the new design. Communication and training are keys to successful implementation. Consideration might also be given to pilot testing the changes before widespread implementation is undertaken.
5. *Conducting a Follow-Up Evaluation of the New Design.* Evaluating the new design after implementation is probably the most neglected component of the process in most applications. Part of the evaluation might include the collection of job design measurements on the redesigned job using the same instruments as in step 1. Evaluation may also be conducted on the outcomes from the redesign, such as employee satisfaction, error rates, training times, and so on (Table 32.1). And it should be noted that some of the effects of job design are not always easy to demonstrate (see Section 32.5). Scientifically valid evaluations require experimental research strategies with control groups. Such studies may not always be possible in ongoing organizations, but often quasi-experimental and other field research designs are possible.<sup>87</sup> Finally, the need for iterations and fine adjustments are identified through the follow-up evaluation.

## Individual Differences among Workers

A common observation made by engineers and managers is that not all employees respond the same to the same job. Some people on a given job have high satisfaction, while others on the very same job have

**TABLE 32.4 Preferences/Tolerances for Types of Work\***

*Instructions:* Indicate the extent to which each statement is descriptive of the job incumbent's preferences and tolerances for types of work on the scale below. Circle answers to the right of each statement. Scores are calculated by averaging applicable items.

**Please Use the Following Scale:**

- (5) Strongly agree  
 (4) Agree  
 (3) Neither agree nor disagree  
 (2) Disagree  
 (1) Strongly disagree  
 ( ) Leave blank if do not know or not applicable

**Preferences/Tolerances for Mechanistic Design**

23. I have a high tolerance for routine work. 1 2 3 4 5  
 28. I prefer to work on one task at a time. 1 2 3 4 5  
 33. I have a high tolerance for repetitive work. 1 2 3 4 5  
 38. I prefer work that is easy to learn. 1 2 3 4 5

**Preferences/Tolerances for Motivational Design**

22. I prefer highly challenging work that taxes my skills and abilities. 1 2 3 4 5  
 26. I have a high tolerance for mentally demanding work. 1 2 3 4 5  
 27. I prefer work that gives a great amount of feedback as to how I am doing. 1 2 3 4 5  
 30. I prefer work that regularly requires the learning of new skills. 1 2 3 4 5  
 32. I prefer work that requires me to develop my own methods, procedures, goals, and schedules. 1 2 3 4 5  
 35. I prefer work that has a great amount of variety in duties and responsibilities. 1 2 3 4 5

**Preferences/Tolerances for Perceptual-Motor Design**

25. I prefer work that is very fast paced and stimulating. 1 2 3 4 5  
 31. I have a high tolerance for stressful work. 1 2 3 4 5  
 36. I have a high tolerance for complicated work. 1 2 3 4 5  
 39. I have a high tolerance for work where there are frequently too many things to do at one time. 1 2 3 4 5

**Preferences/Tolerances for Biological Design**

24. I have a high tolerance for physically demanding work. 1 2 3 4 5  
 29. I have a fairly high tolerance for hot, noisy, or dirty work. 1 2 3 4 5  
 34. I prefer work that gives me some physical exercise. 1 2 3 4 5  
 37. I prefer work that gives me some opportunities to use my muscles. 1 2 3 4 5

\* Table adopted from Campion.<sup>16</sup> See reference for reliability and validity information. Interpretations differ slightly across the scales. For the mechanistic and motivational designs, higher scores suggest more favorable reactions from incumbents to well-designed jobs. For the perceptual-motor and biological approaches, higher scores suggest less unfavorable reactions from incumbents to poorly designed jobs.

low satisfaction. Some people seem to like all jobs, others dislike every job. Clearly, there are individual differences in how people respond to their work.

There has been a considerable amount of research looking at individual differences in reaction to the motivational approach to job design. It has been found that some people respond more positively (e.g., are more satisfied) than others to highly motivational work. These differences were initially considered to be reflections of underlying work ethic<sup>88</sup> but later were viewed more generally as differences in needs for personal growth and development.<sup>26</sup>

Using the broader notion of preferences/tolerances for types of work, the consideration of individual differences has been expanded to all four approaches to job design.<sup>16,21</sup> Table 32.4 provides a set of rating scales that can be used with job incumbents to determine their preferences/tolerances. These scales can be administered in the same manner as the questionnaire measures of job design discussed in Section 32.7.

Although a consideration of employee differences is strongly encouraged, in many situations there are limits to which such differences can be accommodated. As examples, many jobs have to be designed for groups of people that may differ in their preferences/tolerances, often jobs need to be designed without knowledge of the future workers, and the workers on a job may change over time. Fortunately, even though the cumulative evidence is that individual differences moderate reactions to the motivational approach,<sup>89</sup> the differences are ones of degree but not direction. In other words some people

respond more positively than others to motivational work, but very few respond negatively. It is likely that this also applies to the other approaches to job design.

### Other Implementation Advice

Several other writers from the motivational approach to job design have provided advice for how to implement job redesign in existing organizations. Their ideas are summarized briefly here. Further information can be obtained from the citations.

#### *Ford's<sup>55</sup> Art of Reshaping Jobs*

Based on extensive experience redesigning jobs in the AT&T system, Ford advocated the use of "work-itself workshops." These are basically groups of managers, and perhaps employees, who are trained in motivational job design and then attempt to come up with ways to improve jobs. Ford provides advice for these teams on the following topics:

1. Start with a meeting with senior management.
2. Work within a single department at first.
3. Gain commitment.
4. Pick a job to focus on.
5. Conduct workshop meetings.
6. Facilitate creative thinking.
7. Deal with visitors to the job site.
8. Search for a natural module of work.
9. Deal with resistance due to expense.
10. Individualize feedback.

#### *Hackman and Oldham's<sup>26</sup> Five Choices*

Hackman and Oldham have provided five strategic choices that relate to implementing job redesign. They note that little research exists indicating the exact consequences of each choice, and that correct choices may differ by organization. The basic choices are as follows:

1. *Individual versus Group Designs for Work.* A key initial decision is to either enrich individual jobs or create self-managing work teams. This also includes consideration of whether any redesign should be undertaken and its likelihood of success.
2. *Theory-Based versus Intuitive Changes.* This choice was basically defined as the motivational (theory) approach versus no particular (atheoretical) approach. In the present chapter this choice may be better framed as choosing among the four approaches to job design. However, as argued earlier, consideration of only one approach may lead to some costs or additional benefits being ignored.
3. *Tailored versus Broadside Installation.* The choice here is between tailoring the changes to the individual employee or making the changes to all employees in a given job. This issue of individual differences was addressed earlier.
4. *Participative versus Top-Down Change Processes.* The most common orientation, and that of this chapter, is that the participative approach is best. However, there are costs to participation including the time commitment involved, the fact that incumbents may lack needed broader knowledge of the business, and the fact that the focus of the interactions may change from the job to morale related concerns (see Section 32.5).
5. *Consultation versus Collaboration with Stakeholders.* The effects of job design changes often extend far beyond the individual incumbent and department. For example, the output from the job may be an input to another job elsewhere in the organization, and the presence of a union always constitutes another interested party. Depending on many considerations, participation of stakeholders may range from no involvement, through consultation, to full collaboration.

#### *Griffin's<sup>57</sup> Implementation Framework*

Griffin's advice is geared toward the manager who is considering a job redesign intervention in his or her area. He notes that the manager may also rely on consultants, task forces, or informal discussion groups. Griffin suggests that redesign projects should follow nine steps:

1. Recognition of a need for change.
2. Selection of job redesign as a potential intervention.
3. Diagnosis of the work system and content on the following factors:
  - a. Existing jobs.
  - b. Existing work force.
  - c. Technology.
  - d. Organization design.
  - e. Leader behaviors.
  - f. Group and social processes.
4. Cost-benefit analysis of proposed changes.
5. Go/no-go decision.
6. Establishment of a strategy for redesign.
7. Implementation of the job changes.
8. Implementation of any needed supplemental changes.
9. Evaluation of the redesigned jobs.

### Illustration

A study conducted by the first author is briefly described here as an illustration of a job redesign project.<sup>21</sup> It best illustrates the evaluation component of redesign and the value of considering both potential benefits and costs, rather than the implementation and process components of redesign. The setting was a large financial services company. The unit under study processed the paperwork in support of other units that sold the company's products. Jobs were designed in a mechanistic manner in that separate employees prepared, sorted, coded, computer keyed, and performed other specific functions on the paper flow.

The organization viewed the jobs as perhaps too mechanistically designed. Guided by the motivational approach, the project intended to enlarge jobs by combining existing jobs. In so doing the organization hoped to attain three objectives. First, larger jobs might enhance motivation and satisfaction of employees. Second, larger jobs might increase incumbent feelings of ownership of the work, thus increasing customer service. Third, management recognized that there may be potential costs of enlarged jobs in terms of lost efficiency, thus every attempt was made to maintain (i.e., avoid decreased) productivity.

As indicated by the third objective, the study considered the consequences of the redesign in terms of all approaches to job design. It was anticipated that the project would increase motivational consequences, decrease mechanistic and perceptual-motor consequences, and have no effect on biological consequences (Table 32.1).

The evaluation consisted of collecting detailed data on job design and a broad spectrum of potential benefits and costs of enlarged jobs. The research strategy involved comparing several varieties of enlarged jobs with each other and with unenlarged jobs. Questionnaire data were collected and focused group meetings were conducted with incumbents, managers, and analysts. The study was repeated at five different geographic sites.

Results indicated that enlarged jobs had the benefits of more employee satisfaction, less boredom, better quality, and better customer service; but they also had the costs of slightly higher training, skill, and compensation requirements. Another finding was that all the potential costs of enlarging jobs were not observed, suggesting that redesign can lead to benefits without incurring every cost in a one-to-one fashion. Finally, the study revealed several improvements to the enlarged jobs.

### 32.10 DESIGNING JOBS FOR GROUPS

The major approaches to job design, as discussed in Section 32.5, typically focus on designing jobs for individual workers; however, it is also possible to design jobs around work groups. Many U.S. organizations are experimenting with work teams.<sup>90,91</sup> New manufacturing systems (e.g., flexible, cellular) and advancements in our understanding of group processes not only allow designers to consider the use of work groups, but often seem to encourage the use of work group or team approaches.<sup>91-93</sup>

In designing jobs for groups, one assigns a task or set of tasks to a group of workers rather than an individual and considers the group to be the unit of performance. Objectives and rewards focus on

TABLE 32.5 Advantages and Disadvantages of Work Groups

Advantages	Disadvantages
Group members learn from one another	Lack of compatibility of some individuals with group work
Possibility of greater work force flexibility with cross training	Additional need to select workers to fit group as well as job
Opportunity for synergistic combinations of ideas and abilities	Possibility some members will experience less motivating jobs
New approaches to tasks may be discovered	Possible incompatibility with cultural, organizational, or labor management norms
Social facilitation and arousal	Increased competition and conflict between groups
Social support for difficult tasks and situations	More time consuming due to socializing, coordination losses, and need for consensus
Increased communication and information exchange between group members	Inhibition of creativity and decision-making processes; possibility of groupthink
Greater cooperation among group members	Less powerful evaluation and rewards; social loafing or free-riding may occur
Beneficial for interdependent work flows	Less flexibility in cases of replacement, turnover, or transfer
Greater acceptance and understanding of decisions when group makes decisions	
Greater autonomy, variety, identity, significance, variety, and feedback possible for workers	
Commitment to the group may stimulate performance and attendance	

group, not individual, behavior. Depending on the nature of the tasks, a group's workers may be performing the same tasks simultaneously or they may break tasks into subtasks to be performed by individuals within the group. Subtasks could be assigned on the basis of expertise or interest, or group members might rotate from one subtask to another to provide job variety and to increase the breadth of skills and flexibility in the work force.

Some tasks are of a size, complexity, or, otherwise, seem to naturally fit into a group job design, whereas others may seem to be appropriate only at the individual job level. In many cases, though, there may be a considerable degree of choice regarding whether one organizes work around groups or individuals. In such situations the engineer should consider the advantages and disadvantages of the use of groups as the unit for job design with respect to an organization's goals, policies, technologies, and constraints.

### Advantages of Groups

Work groups can offer several advantages over the use of individuals working separately. Table 32.5 lists some of these advantages. To begin with, groups can be designed so that members bring a combination of different knowledge, skills, and abilities (KSAs) to bear on a task. Such combinations of different KSAs benefit organizations in several ways. Group members can improve their KSAs by working with those who have different KSAs, and workers can act as performance models for others in their group.<sup>94</sup> Cross training on different tasks can occur as a part of the natural work flow. As workers become capable of performing different subtasks, the work force becomes more flexible. Members can also provide performance feedback to one another that they can use to adjust and improve their work behavior.

Creating groups whose members have different KSAs also provides an opportunity for synergistic combinations of ideas and abilities that are not possible for individuals working alone. Heterogeneity of abilities and personalities has been found to have a generally positive effect on group performance, especially when task requirements are diverse.<sup>95,96</sup> In addition, simply having individuals working together can allow for different ways of approaching the task to emerge that would not be discovered by individuals working alone.

Other advantages include social facilitation and support. Facilitation refers to the fact that the presence of others can be psychologically arousing. Research has shown that such arousal can have a positive effect on performance when the task is well learned<sup>97</sup> and when other group members are perceived as potentially evaluating the performer.<sup>98,99</sup> With routine jobs this arousal effect may counteract boredom and performance decrements.<sup>100</sup> Social support can be particularly important when groups face difficult or unpopular decisions. It can also be important in groups such as military squads, medical teams, and police units for helping individual workers deal with the difficult emotional and psychological aspects of tasks they perform.

Another advantage of groups is that they may increase the information exchanged between mem-



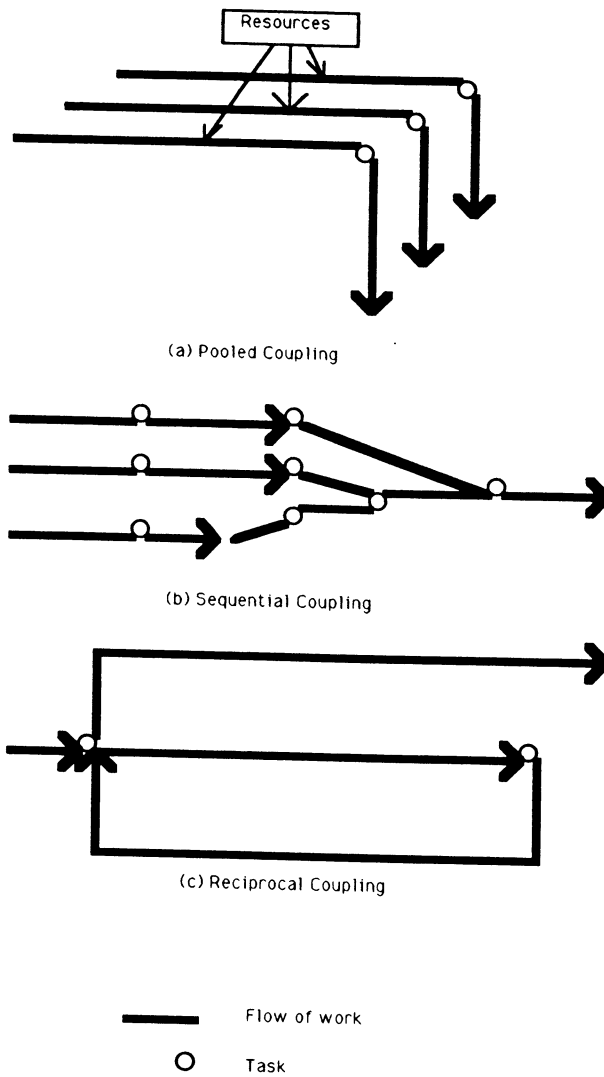


Figure 32.5 Types of Work Flow Relationships. (Adopted from Mintzberg.<sup>105</sup>)

bers. Communication can be increased through proximity and the sharing of tasks.<sup>94</sup> Intragroup cooperation may also be improved because of group-level goals, evaluation, and rewards.<sup>101,102</sup> If groups are rewarded for group effort, rather than individual effort, members will have the incentive to cooperate with one another. The desire to maintain power by controlling information may be reduced. More experienced workers may be more willing to help train the less experienced when they are not in competition with them. Group job design and rewards are also helpful in situations where it is difficult or impossible to measure individual performance or where workers mistrust supervisors' assessments of performance.<sup>103</sup>

Increased cooperation and communication within groups can be particularly useful when workers' jobs are highly coupled. Figure 32.5 shows three types of work flow — pooled, sequential, and reciprocal coupling. In pooled coupling members share common resources but are otherwise independent. In sequential coupling members work in a series. Workers whose tasks come later in the process must depend on the performance of workers whose tasks come earlier. In reciprocal coupling workers feed their work back and forth among themselves. Members receive both inputs and outputs from other

members.<sup>104,105</sup> Group job design would be especially useful for work flows that have sequential or reciprocal coupling.

Many of the advantages of work groups depend on how groups are designed and supported by their organization. The nature of group tasks and their degree of control can vary. According to much of the theory behind group job design, which is primarily from the motivational approach, decision making and responsibility should be pushed down to the group members.<sup>106</sup> If this philosophy is followed, groups can provide several additional advantages. By pushing decision making down to the group and requiring consensus, the organization will find greater acceptance, understanding, and ownership of decisions among workers.<sup>99</sup> The increased perceived autonomy resulting from making work decisions should be both satisfying and motivating for groups.<sup>106</sup>

A motivational approach would also suggest that the set of tasks assigned to a group should provide a whole and meaningful piece of work (i.e., have task identity).<sup>106</sup> This allows group members to see how their work contributes to a whole product or process, which might not be possible with individuals working alone. This can give workers a better idea of the significance of their work and create greater identification with the finished product or service. If group workers rotate among a variety of subtasks and cross train on different operations, workers should also perceive greater variety in the work. Autonomy, identity, significance, variety, and feedback are all motivating characteristics that can be enhanced through group job design.

Finally, groups can be beneficial to the organization if group members develop a feeling of commitment and loyalty to their group.<sup>100</sup> For workers who do not develop high commitment to their organization or management and who do not become highly involved in their job, work groups can provide a source of commitment. Members may feel responsible to attend work, report on time, and perform well because of commitment to a work group even though they are not strongly committed to the organization or the work itself.

Thus, designing work around groups can provide several advantages to organizations and their workers. Unfortunately, there are also some disadvantages to using work groups. Whether or not groups are beneficial can depend on several factors particular to the composition, structure, and environment of groups and the nature of their tasks.

### Disadvantages of Groups

Table 32.5 lists some of the possible disadvantages of designing work around groups. For example, some individuals may dislike group work and may not have the necessary interpersonal skills or desire to work in a group. When selecting group members, one needs to select workers to fit both the job and the group.

Individuals may experience less autonomy and less personal identification when working on a group task than an individual task. Designing work around groups does not guarantee workers greater variety, significance, and identity. If members within the group do not rotate among tasks or if some group members are assigned exclusively to less desirable tasks, not all members will benefit from group job design. Members can still have fractionated, demotivating jobs. How one organizes work within the group is important in determining the effects of group job design.

Group work can also be incompatible with cultural norms. The United States has a very individualistic culture.<sup>107</sup> Applying group methods that have been successful in collectivistic societies like Japan can be problematic in the United States. In addition, organizational norms, practices, and labor management relations may be incompatible with group job design, making its use more difficult.

Some of the advantages of group design can create other disadvantages. Although group rewards can spur greater cooperation and reduce competition within a group, they may cause greater competition and reduced communication between groups. If members identify too strongly with the group, they may fail to recognize when behaviors that benefit the group detract from organizational goals. Competition between groups can be motivating up to a point, after which it can create conflicts that are detrimental to productivity.

Increased communication within groups may not always be task relevant. Groups may spend work time socializing. Group decision making can take longer than individual decision making, and reaching a consensus can be time consuming. The need for coordination within groups takes time and faulty coordination can create problems.

Decision making and creativity can also be inhibited by group processes. When groups become highly cohesive they may become so alike in their views that they develop "groupthink."<sup>108</sup> When groupthink occurs, groups tend to underestimate their competition, fail to adequately critique fellow group members' suggestions, not survey and appraise alternatives adequately, and fail to work out contingency plans. In addition, group pressures can distort judgments. Decisions may be based more on the persuasive abilities of dominant individuals or the power of majorities, rather than on the quality of decisions. Research has found a tendency for group judgments to be more extreme than the average of individual members' predecision judgments.<sup>94,109,110</sup> This may aid reaching a consensus but be detrimental if judgments are poor.

**TABLE 32.6 When to Design Jobs Around Work Groups\***

1. Do the tasks require a variety of knowledge, skills, and abilities such that combining individuals with different backgrounds would make a difference in performance?
2. Is cross training desired? Would breadth of skills and work force flexibility be essential to the organization?
3. Could increased arousal, motivation, and effort to perform make a difference in effectiveness?
4. Can social support help workers deal with job stresses?
5. Could increased communication and information exchange improve performance rather than interfere?
6. Could increased cooperation aid performance?
7. Are individual evaluation and rewards difficult or impossible to make or are they mistrusted by workers?
8. Could common measures of performance be developed and used?
9. Would workers' tasks be highly interdependent?
10. Is it technologically possible to group tasks in a meaningful and efficient way?
11. Would individuals be willing to work in groups?
12. Does the labor force have the interpersonal skills needed to work in groups?
13. Would group members have the capacity and willingness to be trained in interpersonal and technical skills required for group work?
14. Would group work be compatible with cultural norms, organizational policies, and leadership styles?
15. Would labor-management relations be favorable to group job design?
16. Would the amount of time taken to reach decisions, consensus, and coordination not be detrimental to performance?
17. Can turnover be kept to a minimum?
18. Can groups be defined as a meaningful unit of the organization with identifiable inputs, outputs, and buffer areas that give them a separate identity from other groups?
19. Would members share common resources, facilities, or equipment?
20. Would top management support group job design?

\* Affirmative answers support the use of group job design.

Although evidence shows that highly cohesive groups are more satisfied with the group, high cohesiveness is not necessarily related to high productivity. Whether cohesiveness is related to performance depends on the group's norms and goals. If the group's norm is to be productive, cohesiveness will enhance productivity; however, if the norm is not one of commitment to productivity, cohesiveness can have a negative influence.<sup>97,111</sup>

The use of groups and group-level rewards can also decrease the motivating power of evaluation and reward systems. If group members are not evaluated for their individual performance, do not believe that their output can be distinguished from the group's, or do not perceive a link between their own performance and their outcomes, social loafing<sup>100,112</sup> or free-riding<sup>113</sup> can occur. In such situations groups do not perform up to the potential expected from combining individual efforts.

Finally, groups may be less flexible in some respects because they are more difficult to move or transfer as a unit than individuals.<sup>114</sup> Turnover, replacements, and employee transfers may disrupt groups. And members may not readily accept new members.

Thus, whether work groups are advantageous or not depends to a great extent on the composition, structure, reward systems, environment, and task of the group. Table 32.6 presents questions that can help determine whether work should be designed around groups rather than individuals. The greater the number of questions answered in the affirmative, the more likely groups are to succeed and be beneficial for an organization. If one chooses to design work around groups, suggestions for designing effective work groups and avoiding problems are presented in the following discussion.

### Guidelines for Designing Effective Work Groups

Figure 32.6 is a model for designing group work.

#### *Stage 1: The Task*

The model suggests that the engineer begin by determining the task and assessing the costs, benefits, and feasibility of using a team (e.g., see Table 32.6). Aspects of tasks to consider include complexity, uncertainty, variety, interdependence, size, cause-effect relationships, and information processing needs. As discussed earlier, groups should be organized around whole tasks or task clusters that can

Stage 1 The Task	Stage 2 Group Structure and Composition	Stage 3 Organizational Structure and Resources	Stage 4 Evaluation and Feedback
<p>Determine what the group task is and how it can be structured</p> <p>Assess costs, benefits and feasibility of assigning task to group</p>	<p>Determine the degree to which group will have authority and autonomy for group decisions</p> <p>Determine the group's size</p> <p>Design the physical layout of the group's work station</p> <p>Determine how tasks will be allocated to members unless group is to allocate its own tasks</p> <p>Consider composition of group in terms of members' technical and interpersonal skills</p>	<p>Provide information, training, and clear inputs and outputs</p> <p>Use an evaluation and reward system that encourages both group and individual effort</p> <p>Provide clear, challenging, reachable goals and expectations</p> <p>Provide supportive and facilitative management and ongoing assistance</p>	<p>Determine which variables affect performance</p> <p>Determine if there is unrealized group potential</p> <p>Look for performance blocks within the group</p> <p>Look for performance blocks in the organizational context and environment</p> <p>Deliver feedback and create solutions to target diagnosed problems</p>

Figure 32.6 Model for Work Group Development.

provide workers with identity, significance, and variety.<sup>5,106</sup> If needed, groups can be assigned some simple along with complex tasks, some undesirable along with desirable tasks, and some uncomfortable along with comfortable tasks.<sup>6</sup> This is a way of evening out requirements across groups, and it can provide variety and balance within a group.

Frequently tasks or workers can be grouped on the following criteria: common knowledge and skills, similar work process and function, temporal proximity, output interdependence, common clients or markets, common physical or geographical location, task interdependence and flow, scale of task, common use of data or information, or social interdependencies and needs.<sup>105</sup> Tasks and workers sometimes seem to group together in relatively natural ways according to one of these bases; however, one should adequately appraise all realistic options for grouping before making a decision.

### Stage 2: Group Structure and Composition

One major aspect of structure is the level of authority and autonomy the group will have. Three levels have been used. Manager-led groups have the least autonomy. They have responsibility only for the execution of their work. Management designs the work, designs the group, and provides an organizational context. Self-managing groups have greater autonomy. Here, management is responsible for group design and organizational context, but group members design and monitor their own work and performance. Self-designing groups have the most autonomy. Management is only responsible for the organizational context. The group designs the team structure (e.g., membership, relationships), and also designs and monitors its own work.<sup>106</sup>

Another important aspect of structure is group size. Evidence supports the use of small groups. Generally, it is best to use the smallest number of people necessary to do the work. Small groups reduce chances of loafing and lack of coordination, and they improve group cohesiveness.<sup>106,114</sup>

Other suggestions for structuring effective work groups include locating group members together physically in an area that can provide separation from others and providing the opportunity for group members to have face-to-face interaction.<sup>6</sup> The proximity enhances communication, while the separation enhances identity. The physical layout of a group can have an effect on which group members communicate with one another and whether or not some members become dominant in the group.<sup>102,115,116</sup> It is generally suggested that authority in groups be decentralized and that status differences be minimized to encourage participation of all members in decisions.<sup>91,117</sup> Rotation of group members is suggested for providing skill variety and cross training.<sup>91,114</sup>

Group composition is very important and should be considered when designing new groups or changing the membership of existing groups. As with any job, members should be selected according to whether they have the necessary technical and interpersonal skills, but interpersonal skills gain impor-

tance in group work.<sup>5,6,106</sup> Research encourages moderately heterogeneous groups in terms of skills, personality, and attitudes.<sup>95,96,118</sup> Consideration should also be given to whether potential members would like working in groups and have the willingness to be trained in group-related skills if needed. In self-designing work groups, members would be involved in the selection of fellow members.

### *Stage 3: Organizational Structure and Resources*

Organizational structure and resources must be considered in order to create a supportive context for groups. With respect to resources, groups need to be given adequate information, technical consultation, and training.<sup>114</sup> Training content might include group decision making processes and other group dynamics. It is also recommended that groups be given the authority to make decisions as near as possible to the point at which problems and uncertainties occur. Groups should be capable of self-regulation and adaptation to environmental variations. They should be given definite, identifiable inputs and outputs to aid group identity, resources to measure and control variances in their work, and timely feedback to make adjustments in their work.<sup>6</sup>

Important aspects of organizational structure include providing positive consequences for good performance and effort. Evaluation systems and rewards should promote behavior that is good for both the group and organization, so that group and organizational goals are consistent. Definite criteria, clear and challenging goals, and well-defined expectations should be provided.<sup>6,106</sup> A feeling of group potency, or the perception that the group is capable of performing effectively, should be encouraged.<sup>119</sup> Group-level rewards are generally considered to be most appropriate<sup>106</sup>; however, it is also suggested that some degree of individual evaluation and reward be established to create a feeling of individual responsibility and prevent social loafing and free-riding.<sup>91,118</sup> It may sometimes be possible for the organization to provide group-level evaluation and rewards, and for group members themselves to be responsible for observing and promoting individual performance within groups. Both group and individual evaluations are preferable, if possible.

Managers in charge of groups should be facilitative and not overly directive or controlling in order not to interfere with group processes. Managers should represent the group to higher management and help the group integrate with the rest of the organization. Group boundaries need to be managed to balance the needs for group separation and integration. There should be greater interdependence among tasks within boundaries than across boundaries.<sup>5,6,91</sup>

Ongoing assistance should be given to promote positive processes and group synergy. Management should help groups foster open communication, supportiveness, and discussions of strategy.<sup>91,106</sup> Informal, rather than formal, communication channels and mechanisms of control should be promoted to ease coordination.<sup>91</sup> Managers should encourage self-evaluation, self-observation, self-reinforcement, self-management, and self-goal setting by groups. Self-criticism for purposes of recrimination should be discouraged.<sup>120</sup>

### *Stage 4: Evaluation and Feedback*

The final step in group development is the evaluation of effectiveness. Criteria include: (a) performance, including productivity, attendance, safety, and innovation; (b) satisfaction and positive attitudes; and (c) group maintenance over time.<sup>106,114</sup> In order to diagnose any problems that may be detracting from optimum performance, the following steps are suggested:

1. Determining which class(es) of variables (skills, arousal, strategies, effort) objectively affect performance.
2. Determining if there is unrealized potential in the group.
3. Examining the group to see if it is blocking effective performance.
4. Examining the organizational context and external environment of the group to see if they are blocking effective performance.
5. Delivering feedback to the group. Help the group target problems discovered in the diagnosis and create solutions.<sup>106</sup>

## **32.11 SOCIOTECHNICAL SYSTEMS**

Sociotechnical systems theory essentially suggests the use of group job design and the motivational approach to job design. In fact, autonomous, self-designing, and self-regulating work groups derive their conceptual basis from sociotechnical systems theory. However, this theory goes beyond simply encouraging group job design and a motivational approach.

The essential premises of sociotechnical design are that (a) there are joint social and technological operating systems that interlock and cannot be separated and (b) every sociotechnical system is embedded in an environment that is influenced by culture and values. Overall performance cannot be

optimized without jointly optimizing both social and technological systems. The technological system does not determine the social system. That is, true technological determinism is rare. Social choices are contained within technological and organizational designs, and work should be designed to achieve a best match between workers and technology. Sociotechnical systems are considered to be "open systems," which means that boundaries between the environment and system are permeable. To understand a work system, one must understand environmental forces that are operating on it. There is a constant interchange between the environment and organizational system.<sup>3,121-123</sup> For a system to survive, it must perform four functions: (a) attain goals of the organization, (b) adapt to the environment, (c) integrate the activities of the people in the organization, and (d) provide for the continued occupation of the essential roles through recruitment and socialization.<sup>61</sup>

Principles of sociotechnical design are:

1. *Compatibility*: Designing should be compatible with its objectives.
2. *Minimal Critical Specification*: Specifying only what is absolutely essential in order to prevent premature closing of options.
3. *The Sociotechnical Criterion*: Controlling variances as close to their point of origin as possible (see Section 32.8).
4. *The Multifunctional Principle*: Allowing multifunctionalism (i.e., multiple uses or purposes) and equifinality (i.e., multiple routes to the same goal).
5. *Boundary Location*: Departmental boundaries have to be drawn somewhere; the role of the supervisor is to manage boundaries.
6. *Information Flow*: Information systems should provide information initially to the point where action will need to be taken.
7. *Support Congruence*: Systems of social support (e.g., human resource systems such as selection, compensation, and training) should reinforce behaviors the organizational structure is designed to elicit.
8. *Design and Human Values*: The objectives of organization design should include the provision of high-quality work for workers.
9. *Incompletion*: There is a constant need for redesign; design is a reiterative process.<sup>61</sup>

## 32.12 NEW TECHNOLOGIES AND WORK FORCE CHANGES

### New Technologies and Job Design

Technology has an enormous influence on the workplace. The emergence of automated systems has been compared to the Industrial Revolution and is having a profound impact on organizations that utilize them.<sup>124</sup> Flexible manufacturing technology (FMT), group technology (GT), computer-assisted design (CAD), computer-assisted manufacturing (CAM), computer-assisted engineering (CAE), computer-integrated manufacturing (CIM), and automated manufacturing technology (AMT) are just some of the labels and acronyms attached to new technologies in manufacturing. FMT will be used in this section as an umbrella term in order to discuss the general effects of these technologies. The implications of these new technologies for job design are significant in that they appear to allow considerable discretion in how jobs are constructed.

FMT uses the computer to integrate production functions. It has been described as a synthesis of batch, mass, and continuous process technologies. For example, FMT permits the use of the general-purpose machines and skilled workers of batch production, but approaches the quality control and lower costs of mass production.<sup>125</sup> With FMT the emphasis is on achieving efficiencies through flexibility. Flexibility is expected to allow greater responsiveness to customer demands, yet competitiveness on the basis of cost.

In contrast, mass production organizations are generally organized as machine bureaucracies with an emphasis on standardization and control over the variability of worker behavior. Task routinization, sequential interdependence, specific performance measures, high structure, and high control are all job design characteristics of mass production operations. The scientific management style of designing jobs is the norm (see mechanistic approach in Section 32.5), because efficiency is valued above all else.<sup>126</sup>

The expected implications of FMT for job design are that jobs can be more motivating without adding costs and inefficiencies to the system. Due to the desire for flexibility, workers' tasks can be more craftlike and less routine, repetitive, and specialized. Knowledge is more important, and the

system can allow workers more responsibility and freedom to act. It is predicted that job variety will not lead to inefficiency but instead will maximize both equipment and operator utilization for greater efficiency.<sup>126,127</sup> As such, the traditional trade-off between efficiency and satisfaction should be reduced with FMT.

Although FMT often provides an opportunity to design more enriched, flexible jobs for workers, not all FMT systems have been organized that way. These new technologies can result in jobs that have a great number of control mechanisms, such as might be the case with historical mass or process production systems. There are more alternative ways of organizing and controlling work with FMTs, and thus what emerges often reflects management's philosophy of designing jobs rather than technological influences.<sup>92</sup> With FMT, changes in job design have been made in both the direction of increasing and of decreasing skill requirements. In some cases operators' jobs have been designed to provide little variety, autonomy, challenge, task identity, and other motivating characteristics and have involved more stress, pressure, and isolation. In other cases FMT jobs have been designed to provide greater skill and challenge and have removed difficult, dangerous, or unpleasant tasks.<sup>91,124,125</sup> Although new technologies can either increase or decrease skills required, the net effect is probably a slight increase in skill requirements and utilization of workers' abilities.<sup>124,125</sup> But what is more certain is that the new technologies provide greater choice in designing jobs.

It is also apparent that FMT may shift the types of skills needed. For example, there appears to be a trend toward greater cognitive and interpersonal skill use and less motor skill use. Workers often control a greater portion of an overall task, are required to coordinate more with operators and technical support specialists, but have less contact with materials.<sup>125</sup>

It is also important to consider how new technologies and job designs are implemented. Failure rates of new technology implementation suggest a need to give more attention to the human aspects of implementation. In a study of 2000 U.S. companies that had implemented new office technologies, 40% reported that intended results had not been achieved.<sup>128</sup> It is also estimated that between 50 and 75% of newly implemented manufacturing technologies in the United States have failed. Failures were considered to be caused by disregard for human and organizational issues, rather than by technical problems.<sup>91,124</sup> The number one obstacle to implementation was considered to be human resistance to change.<sup>129</sup>

In order to avoid failures in the implementation of FMTs, several recommendations have been made. For example, engineers and managers should try to match job design, equipment, organizational structure, and people to achieve the organization's objectives. The organization's particular situation needs to be analyzed because different FMT systems and equipment have different parameters and implications for the human infrastructure of the organization. The amount of integration, unreliability, rigidity, work flow unpredictability, feedback, and accident proneness in the new technology needs to be considered along with work force characteristics and environmental constraints. Needs for increased coordination, information, discretion over tasks, and human-machine redundancy should be evaluated.<sup>91</sup>

Several job design options are possible, but scientific management methods are not recommended. Aside from problems with motivation and satisfaction, rigid job designs may require more workers than flexible designs. "The research clearly discredits the utility of the scientific management approach for FMT jobs" (p. 44).<sup>91</sup> Suggested job design options include job rotation, work teams, job enlargement, job enrichment, and sociotechnical systems.

Because FMTs generally create increased interdependence among workers, evaluation of individual performance can be more problematic. Several experts suggest the use of group reward systems.<sup>91,92,126</sup> Other suggested compensation strategies include all salaried work forces, pay for knowledge, or rewards based on quality and system maintenance.<sup>125</sup> It is also suggested that computer monitoring is useful if utilized to give workers accurate, meaningful, and nonevaluative feedback so they can monitor their performance, but that it has a negative impact on motivation and attitudes if it is used to closely control workers.<sup>124</sup>

Recommendations for successful implementation of new technologies also include top management involvement, long-term strategies, decentralization, and participative decision making. Workers should be informed of changes in advance, adequately trained, and involved in the process. Gradual implementation is considered better than a widespread, major introduction of the new technology.<sup>91,92,124</sup> Some common guidelines for reducing resistance to change are provided in Table 32.7.

### Work Force Changes and Job Design

Changes in the demographics of the U.S. labor force also have important implications for the design of jobs. In the last 30 years the educational level of the American labor force has increased dramatically. For those over age 25, median school years completed increased from 10.6 in 1960 to 12.7 in 1987. The

**TABLE 32.7 Recommendations for Reducing Resistance to Change<sup>a</sup>****Who brings change?**

1. Resistance is less if participants feel the project is their own and not imposed from outside.
2. Resistance is less if it is supported strongly by top officials.

**What sort of change?**

3. Resistance is less if the change is seen to reduce present burdens.
4. Resistance is less if the project accords with existing values.
5. Resistance is less if the project offers new interesting experience.
6. Resistance is less if existing autonomy and security are not threatened.

**Procedures to institute change.**

7. Resistance is less if the participants were involved in the diagnosis of the problem.
8. Resistance is less if the project is adopted by consensus.
9. Resistance is less if the proponents can empathize with the opponents (recognize valid objections and relieve unnecessary fears).
10. Resistance is reduced if it is accepted that innovations will be misunderstood and provision made for feedback and clarification.
11. Resistance is less if the participants experience support, trust, and have confidence in each other.
12. Resistance is reduced if the project is kept open to revision and reconsideration with experience.

<sup>a</sup> Table adopted from Gallagher and Knight.<sup>92</sup>

percentage over 25 with four years of high school or more increased from 52.3% in 1970 to an estimated 75.6% in 1987.<sup>130</sup> Educational levels have increased and so have job expectations. Better educated workers are more concerned with participation in decision making, work that challenges and interests them, and opportunities to develop their skills and abilities on the job.<sup>131,132</sup> In a national survey in 1979, 30% of the U.S. work force reported that their education was underutilized.<sup>133</sup>

In order to utilize the potential of these educated workers and meet their desire for challenging work, some degree of motivational job design may be needed. Jobs should be designed to provide workers with knowledge of results, the experience of responsibility for their work, and meaningful tasks. The use of self-managing work teams may also be more satisfying to these more educated workers. With self-managing teams, cross training and job rotation can be used to provide skill variety. As discussed in Section 32.9, research has shown that workers who desire more motivational work, such as more highly educated workers, will respond more positively to it.

It should be recognized, however, that at the same time formal education has been increasing, many believe that the quality of education has been decreasing in the public school system, especially in math and science.<sup>131</sup> As of 1985, more than 25 million adult Americans could not read the front page of a daily newspaper or the warning label on a bottle of poison, and 15% of graduates from U.S. urban high schools read at a sixth-grade level or lower. Many firms are offering programs in basic and remedial education.<sup>134</sup> A study in Illinois found that 90% of high school graduates are scientifically and technologically illiterate. Sixteen percent of white, 44% of black, and 56% of Hispanic-American adults are either functionally or marginally illiterate. Among the 158 member countries in the United Nations, the United States is ranked only 49th highest in terms of literacy.<sup>135</sup> There is the possibility of a widening gap between the best and worst educated members of the U.S. labor force.<sup>131</sup>

In conjunction with problems regarding the quality of education, in upcoming decades the U.S. labor force will grow more slowly and the total work force will decrease in size. Labor force entrants between the ages of 16 and 24 will decrease, and the number of workers between the ages of 45 and 64 will increase. The work force will become considerably more diverse as the proportion of women, minority, and older workers increases. Due partly to fewer labor force entrants, there will be an increasing need to employ undereducated youth from culturally diverse groups. It will be even more important to utilize all workers because of the smaller total work force. Unfortunately, work force trends in education and demographics are in conflict with meeting the increasing need for highly trained workers due to changing technologies as discussed previously.

Training has been suggested as a solution to closing the gap between labor force abilities and changing job requirements.<sup>136</sup> Another possibility is to design jobs to fit the skill levels of the available labor force (e.g., including the use of mechanistic design to reduce skill requirements, or motivational design to take advantage of higher skill availabilities). As noted, new technologies often provide greater choice in the design of jobs. It will be important to design jobs in order to optimally utilize the available labor force in all its diversity.



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