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61 IMPROVING EFFICIENCY AND SATISFACTION THROUGH JOB DESIGN

Michael A. Campion, Chi Sum Wong

It is the manager's responsibility to ensure that employees are performing and satisfied with their jobs. In many instances, job design may help achieve these goals.

Many people believe that the design of a job is fixed, dictated by the technology or the work that has to be done. This may be in error. In many cases jobs can be changed, with fairly predictable consequences for efficiency and satisfaction.

WHEN SHOULD JOB DESIGN BE CONSIDERED?

There are at least five situations where job design should be considered:

1. *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 also changes in jobs. This is not unique to manufacturing industries. The introduction of electronic equipment is changing many office jobs, and innovation frequently results in changes in the responsibilities of many employees. Techniques in job design may be helpful in ensuring that effectiveness is improved.
2. *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. A successful reorganization must consider the implications of these changes in job design.
3. *When starting up or building a new plant or work unit.* Building a new organization requires many decisions about the division of labor. That is, who will do what? Consideration of proper job design may help make these decisions more effective.
4. *When jobs are needed for special positions or persons.* Even existing organizations create new positions from time to time. Also, new persons may be entering the organization who have different skills and capabilities. Both of these situations may create a need to reevaluate job design. For example, physically demanding jobs may need to be redesigned to accommodate female workers, and hiring handicapped workers may require that managers carefully redesign jobs for them. Frequently, special jobs are also designed for newcomers to the organization or for special administrative assistants or temporary assignments.
5. *When there are performance or satisfaction problems.* There is a common tendency to blame the worker rather than the job when performance is poor. For instance, human error was initially blamed in the nearly catastrophic nuclear power plant incident at Three Mile Island. Closer examination revealed that the operator's job created excessive mental demands during emergency situations such that the job was actually predisposed to error. If there are performance or satisfaction problems with many employees on the same job, this is evidence that the job may be the problem. For example, in a recent article the following situation was described for a group of technical report writers. They have to write reference manuals that describe complex electronic equipment, yet they are not technical experts themselves. The number of details they must remember is excessive. The lighting in their office is poor, and there is a glare on their computer screen. Their chairs are uncomfortable, and the keyboards are too high. The office is noisy and

either too hot or too cold. Clearly, job design may be part of the problem here.

As a final example, in a different study, a group of sawmill employees were described as lazy and apathetic. Examination of the jobs revealed that they lacked variety and any significant skill requirements. The jobs were unimportant, repetitive, and boring. Not surprisingly, the employees were not motivated or satisfied.

HOW SHOULD JOBS BE CHANGED? THE INTERDISCIPLINARY PERSPECTIVE

Research has discovered four approaches to job design. They come from many different scientific disciplines (e.g., psychology and engineering). Effectively utilizing these techniques can improve many important outcomes, from efficiency to job satisfaction. In the following paragraphs, the four approaches to job design are described along with the outcomes they influence.

Motivational Approach

This approach stems from the work on job enrichment and enlargement and from the major theories of work motivation and organizational behavior. Its basis is organizational psychology.

Recommendations. According to this approach, jobs should be designed to give the worker autonomy and the opportunity to make some decisions about how tasks are done. The worker should get feedback on job performance, be able to use a variety of skills, and have opportunities for growth and learning. In addition to taking into account these characteristics that make jobs meaningful from a task-oriented perspective, this approach also considers the social or people-interaction aspects of the job content (including the need for participation, communication, and recognition).

Outcomes. This job design approach is intended to increase satisfaction and motivation. In addition, job performance may be higher, and absenteeism may be lower. Customer service may even be improved. On the other hand, 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 mental ability requirements. Higher mental ability requirements can also lead to higher compensation requirements. Further, the stimulating nature of overly motivating jobs could predispose workers to stress and errors.

Examples. Many managerial and professional jobs are naturally high on the motivational approach. Craft and technical jobs may also be high because of their skill requirements. Jobs usually low on the motivational approach include many factory, service, and other semiskilled or unskilled jobs. There are many jobs in every occupational group, as well as aspects of almost every job, where motivational features are low. However, most jobs do not have to be poorly designed on the motivational approach. Managers can change most of these job design features by following the recommendations above. Knowledge of motivational job design is a powerful tool for increasing the satisfying and motivating outcomes from jobs.

Mechanistic Approach

This approach comes from scientific management, time and motion study, and work simplification. Its primary discipline basis is industrial engineering.

Recommendations. This approach suggests that jobs be closely studied to determine the most efficient work methods and techniques. In addition, work should be broken down into highly specialized jobs, tasks and skills should be simplified, there should be repetition to benefit from practice, and there should be little idle time.

Outcomes. This approach is intended to increase human resource efficiency. Jobs high in mechanistic features can be easily and inexpensively staffed, training time is typically short, and lower compensation may be required. Because mental demands are less, errors may be less common. On the other hand, too much of the mechanistic approach may result in less satisfied and motivated employees. Sometimes overly mechanistic work can lead to health complaints from the physical wear that can result from highly repetitive and machine-paced work.

Examples. Jobs high on the mechanistic approach are often the same ones that are low on the motivational approach: many factory, service, and semiskilled or unskilled jobs. Assembly line jobs are good examples of this approach. Obviously, most managerial and

professional jobs are usually low on this approach. Sales and negotiating positions, which have a less than optimal probability of success, and jobs that are needed only in emergency situations (e.g., firefighter) are low on this approach because of their inefficient nature. Many office jobs are also poorly designed from a mechanistic point of view. However, managers can apply concepts like specialization and simplification of tasks and skill requirements to many jobs in order to reduce staffing difficulties and training requirements. In addition, often jobs are simply too complex or too large for the employees, and so performance is poor or overtime is excessive. Sometimes work load rises without corresponding increases in staffing levels. These are times to apply the mechanistic approach to increase efficiency.

Human Factors Approach

This approach comes from human factors engineering and from research on skills and how humans mentally process information. Its basis, with its emphasis on perceptual and motor abilities, is experimental psychology. This approach has received public attention through the Three Mile Island incident. Government regulations issued since that time require that nuclear power plants consider human factors in their design.

Recommendations. This approach tries to ensure that the attention and concentration requirements of the job do not exceed the abilities of the workers. The job is designed to limit the amount of information the worker must pay attention to, remember, and think about. In addition, this approach is also concerned with such features as appropriate lighting levels, safety, and user-friendly equipment (simpler and easier-to-use equipment).

Outcomes. This approach is intended to decrease the likelihood of errors and accidents, as well as mental stress and fatigue. Like the mechanistic approach, it may also increase human resource efficiency (e.g., reduced training and staffing costs) because it reduces the mental ability requirements of the job. On the other hand, too much of the human factors approach may result in less satisfaction, less motivation, and more boredom because the jobs provide inadequate mental stimulation.

Examples. The nuclear power plant operator's job is low on this approach. An air traffic controller's job is also low because of the amount of information to attend to and the stress from the consequences of an error. Jobs involving the operation of complex machinery, like aircraft or heavy construction vehicles, are also low in this approach. Other jobs that can tax attention and concentration capabilities include many product-inspection and equipment-monitoring jobs. Not only must much information be attended to in these jobs, but the vigilance requirements are also mentally demanding. Jobs in numerous other occupations may also impose excessive attention and concentration requirements. For example, many managerial, administrative, professional, and sales jobs can be excessively demanding on the information-processing capabilities of the incumbents, thus predisposing errors and stress. All jobs may have periods of overload. The human factors approach can be used to reduce these demands of jobs through the redesign of tasks, equipment, or environments.

Biological Approach

This approach stems from biomechanics (the study of body movements), work physiology, occupational medicine, and anthropometry (the study of body sizes). It is often called ergonomics.

Recommendations. This approach tries to ensure that people's physical capabilities and limitations are not exceeded by the design of their jobs. Recommendations include reducing strength and lifting requirements, modifying or replacing chairs so that postural support is provided, redesigning tasks and equipment so that wrist movement is reduced, eliminating excessive noise, maintaining comfortable temperatures, and other changes that reduce the physical demands of jobs.

Outcomes. Jobs high on 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. The jobs may even be associated with lower absenteeism and higher job satisfaction because they are less physically arduous. A drawback of this approach may be the expense of changes in equipment or job environments needed to implement the recommendations. In addition, it is possible to design a job with so few physical demands that the workers become drowsy or lethargic, thus reducing their performance or leaving their workplace.

Examples. Jobs low on this approach obviously include those in traditionally heavy industries (e.g., coal, steel, oil, forest, and construction), which have

substantial physical ability requirements. But this approach also applies to many other jobs that have some physical component (e.g., production, maintenance). Recommendations from the biological approach have been applied to the redesign of equipment and tasks in physically demanding jobs so that women can better perform them (e.g., lighter tools with smaller hand grips). This approach can also be applied to many lighter 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 also apply to many light assembly positions that require excessive wrist movements that can eventually lead to a chronic wrist condition known as carpal tunnel syndrome. On the other hand, there may be jobs with too little physical activity (i.e., movement restricted due to single position or work station) or jobs that require excessive travel, which results in poor eating and sleeping patterns.

IMPLEMENTATION

Step 1: Measure the Design of the Job

A questionnaire was developed to assess whether a job is well designed in terms of each of the approaches. The questionnaire is called the Multimethod Job Design Questionnaire (MJDQ) and is contained in appendix 61–A. It can either be administered to employees, or managers can complete it by observing the job or discussing it with employees. The MJDQ can also be used in any of the situations described earlier. For example, during the start-up of a new organization, it can be used as a checklist to evaluate equipment and job descriptions, during a reorganization or technological innovation it can be used to evaluate and guide proposed changes, and when problems occur it can be used to determine whether the job design is part of the cause.

Step 2: Analyze Potential Job Design Problems

The average score across the items on a particular approach represents how well the job is designed based on that approach, with smaller scores indicating better design. A simple rule of thumb is that if the score for an approach is larger than 3, the job is poorly designed by that approach and it should be examined. Even if the average score on an approach is greater than 3, you should examine any individual item scores that are at 2 or 1. As noted in discussing the four approaches, some jobs naturally score lower in certain approaches, and this should be considered in interpreting the scores. However, the designs of most jobs can still be improved on one or more approaches.

Step 3: Determine Job Design Changes

The MJDQ items not only help determine design problems, but they offer redesign recommendations as well.

Conflicts. It would be ideal to have jobs designed well on all approaches. Unfortunately, the four approaches are not independent. Although there are some similarities, there are also some conflicts. No one approach can satisfy all outcomes. Table 61–1 summarizes the outcomes from each approach.

The greatest potential conflicts are between the motivational approach on the one hand and the mechanistic and human factors approaches on the other. They produce nearly opposite outcomes. This occurs because the mechanistic and human factors approaches strive to design 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.

Trade-offs. Because of these conflicts, trade-offs may be necessary. But trade-offs are not unavoidable in all situations. Jobs can often be improved on one approach and still maintain their good scores on other approaches. The independence of the biological approach provides such an opportunity. Managers can reduce physical demands without sacrificing the mental quality of a job's design. The cost of equipment may sometimes be a significant deterrent to implementation.

The major trade-offs will be in terms of the mental demands of jobs. Table 61–2 illustrates the trade-offs on this dimension. Making the job more mentally demanding increases the likelihood of achieving the

Table 61–1
Summary of Outcomes from the Job Design Approaches

Design Approach	Positive Outcomes	Negative Outcomes
Motivational	Higher satisfaction Higher motivation Higher job performance Lower absenteeism Higher customer service	Increased training time Decreased staffing ease Greater error and stress likelihood Increased compensation
Mechanistic	Decreased training time Increased staffing ease Lesser error and stress likelihood Decreased compensation	Lower satisfaction Lower motivation Potential for more physical wear
Human factors	Lesser error and accident likelihood Decreased stress Decreased training time Increased staffing ease	Lower satisfaction Increased boredom
Biological	Less physical effort and fatigue Fewer injuries and aches and pains Higher satisfaction and lower absenteeism	Financial costs of changes in equipment or job environment Too little physical activity

Table 61–2
Mental Demands Continuum

Motivational-Designed jobs	Mechanistic- and Human Factors–Designed jobs
High satisfaction	Low training times
High motivation	High staffing ease
Low absenteeism	Low error likelihood
(Individual outcomes)	(Organizational outcomes)

Source: Figure adopted from M.A. Campion and P.W. Thayer, Job design: Approaches, outcomes, and tradeoffs. *Organizational Dynamics, 15* (3) (1987) : 66–79.

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 a manager wants to maximize.

These trade-offs may not be absolute. There may be times when a job's design can be changed to gain certain benefits without incurring every cost. In a recent study, the motivational approach was applied to a group of clerical jobs to improve employee satisfaction and customer service. 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).

In addition, adverse effects of trade-offs can often be minimized by avoiding extremes or by specifying minimum acceptable levels on each approach. Knowing all the approaches to job design and their corresponding outcomes may help make more intelligent job design decisions and avoid unanticipated consequences.

Step 4: Make the Job Design Changes

Workers are experts on their jobs. Therefore, they can provide excellent job design and implementation recommendations, and they should always be consulted. Participation in the redesign can also increase employee acceptance.

It should be noted that workers can significantly influence the design of their jobs by seeking out different tasks, ignoring other tasks, changing the physical environment (e.g., through homemade padding or extra lighting), or developing a job aid (e.g., chart of frequently used information). Observing such changes might indicate that job redesign is needed.

When jobs are changed, the abilities needed to perform the jobs may also change. The levels of abilities needed may be increased or decreased; new abilities may be required and others no longer required. This could mean changes in various human resources practices. For example, training programs may need to be developed, revised, or eliminated. Hiring standards may need to be raised or lowered. Promotion, transfer, and other employee movement systems may be influenced. The compensation program may need to be revised subject to changed job demands. Existing performance appraisal systems may also need revision due to changed responsibilities. Thus, many

human resource programs may need to be reconsidered following job redesign. In fact, greater savings and increased flexibility in human resources may be a goal of the redesign.

Step 5: Conduct a Follow-up Evaluation of the New Design

After the job has been designed or redesigned, a follow-up evaluation should be conducted to ensure that the design actually turned out as expected and that the proper outcomes are emerging. The MJDQ can be used to evaluate the design. Again, it can either be administered to employees, or the manager can complete it by observing the job or discussing it with employees. Scores on the different approaches can be compared with previous scores or with planned changes to determine how successful the intervention has been.

The proper outcomes anticipated from job design should also be evaluated. For example, if motivational features of jobs were increased, the resulting levels of satisfaction, motivation, and performance should be evaluated. If the mechanistic and human factors features were strengthened, the impact on training times, staffing ease, error rates, and so on should be evaluated. If biological job design was improved, subsequent levels of physical stress and strain should be evaluated.

It is not unlikely that other changes or fine-tuning of the job design will be necessary based upon follow-up evaluation. Job design is often an iterative process.

CONCLUSION

Poorly designed jobs may be the cause of more performance and satisfaction problems than managers realize. The four-factor job design framework and questionnaire described in this chapter are intended to raise awareness of alternative job designs and the outcomes they influence and to provide a means of analyzing and changing job designs to enhance individual and organizational goals.

APPENDIX 61–A: MULTIMETHOD JOB DESIGN QUESTIONNAIRE (MJDQ)

Motivational Approach

1. *Autonomy:* The job allows freedom, independence, or discretion in work scheduling, sequence, methods, procedures, quality control, or other decision making.
2. *Intrinsic job feedback:* The work activities themselves provide direct and clear information as to the effectiveness (e.g., quality and quantity) of job performance.
3. *Extrinsic job feedback:* Other people in the organization, such as managers and coworkers, provide information as to the effectiveness (e.g., quality and quantity) of job performance.
4. *Social interaction:* The job provides for positive social interaction such as teamwork or coworker assistance.
5. *Task/goal clarity:* The job duties, requirements, and goals are clear and specific.
6. *Task variety:* The job has a variety of duties, tasks, and activities.
7. *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.
8. *Ability/skill level requirements:* The job requires a high level of knowledge, skills, and abilities.
9. *Ability/skill variety:* The job requires a variety of knowledge, skills, and abilities.
10. *Task significance:* The job is significant and important compared with other jobs in the organization.
11. *Growth/learning:* The job allows opportunities for learning and growth in competence and proficiency.
12. *Promotion:* There are opportunities for advancement to higher-level jobs.

Adopted from M.A. Campion (1989), *Journal of Applied Psychology, 73,* 467—481.

13. *Achievement:* The job provides for feelings of achievement and task accomplishment.
14. *Participation:* The job allows participation in work-related decision making.
15. *Communication:* The job has access to relevant communication channels and information flows.
16. *Pay adequacy:* The pay on this job is adequate compared with the job requirements and with the pay in similar jobs.
17. *Recognition:* The job provides acknowledgment and recognition from others.
18. *Job security:* People on this job have high job security.

Mechanistic Approach

19. *Job specialization:* The job is highly specialized in terms of purpose, tasks, or activities.
20. *Specialization of tools and procedures:* The tools, procedures, materials, and soon used on this job are highly specialized in terms of purpose.
21. *Task simplification:* The tasks are simple and uncomplicated.
22. *Single activities:* The job requires you to do only one task or activity at a time.
23. *Skill simplification:* The job requires relatively little skill and training time.
24. *Repetition:* The job requires performing the same activity(s) repeatedly.
25. *Spare time:* There is very little spare time between activities on this job.
26. *Automation:* Many of the activities of this job are automated or assisted by automation.

Human Factors Approach

27. *Lighting:* The lighting in the workplace is adequate and free from glare.
28. *Displays:* The displays, gauges, meters, and computerized equipment on this job are easy to read and understand.
29. *Programs:* The programs in the computerized equipment on this job are easy to learn and use.
30. *Other equipment:* The other equipment (all types) used on this job is easy to learn and use.
31. *Printed job materials:* The printed materials used on this job are easy to read and interpret.
32. *Workplace layout:* The workplace is laid out such that you can see and hear well to perform the job.
33. *Information input requirements:* The amount of information you must attend to in order to perform this job is fairly minimal.
34. *Information output requirements:* The amount of information you must output on this job, in terms of both action and communication, is fairly minimal.
35. *Information processing requirements:* The amount of information you must process, in terms of thinking and problem solving, is fairly minimal.
36. *Memory requirements:* The amount of information you must remember on this job is fairly minimal.
37. *Stress:* There is relatively little stress on this job.

Biological Approach

38. *Strength:* The job requires fairly little muscular strength.
39. *Lifting:* The job requires fairly little lifting, and/or the lifting is of very light weights.
40. *Endurance:* The job requires fairly little muscular endurance.
41. *Seating:* The seating arrangements on the job are adequate (e.g., ample opportunities to sit, comfortable chairs, good postural support, etc.).
42. *Size differences:* The workplace allows for all size differences between people in terms of clearance, reach, eye height, legroom, and other factors.
43. *Wrist movement:* The job allows the wrists to remain straight without excessive movement.
44. *Noise:* The workplace is free from excessive noise.
45. *Climate:* The climate at the workplace is comfortable in terms of temperature and humidity, and it is free of excessive dust and fumes.
46. *Work breaks:* There is adequate time for work breaks given the demands of the job.
47. *Shift work:* The job does not require shift work or excessive overtime.

For jobs with little physical activity due to single workstation add:

48. *Exercise opportunities:* During the day, I have enough opportunities to get up from my work station and walk around.
49. *Constraint:* While at my workstation, I am *not* constrained to a single position.
50. *Furniture:* In at my workstation, I can adjust or arrange the furniture to be comfortable (e.g., ade-

quate legroom, foot rests if needed, proper keyboard or work surface height, etc.).

Instructions: Indicate the extent to which each statement is descriptive of the job on a scale of: (5) strongly agree, (4) agree, (3) neither agree nor disagree, (2) disagree, (1) strongly disagree, and (blank) don't know or not applicable. Scores for each approach are calculated by averaging applicable items.

APPENDIX 61–B: RESEARCH UNDERLYING THE INTERDISCIPLINARY PERSPECTIVE ON JOB DESIGN

Extensive research has been conducted on the interdisciplinary approaches to job design. This research began with an exhaustive search of all the literature on jobs and the extraction of specific "rules" as to how to design jobs. Rules were collected for everything: equipment, facilities, and environments, as well as for job content and methods. These rules were then analyzed and sorted into distinct groups based on similarity of underlying theoretical orientation. Four job design approaches resulted, forming the basis of the MJDQ.

Five major studies have been conducted. Industries have included the low-technology forest products industry, the high-technology electronics industry, and the service-oriented financial industry. Over 220 jobs have been studied, including all levels and types. Nearly 2,000 employees and managers have been interviewed or surveyed. Information was also collected on a broad spectrum of outcomes, including satisfaction, absenteeism, training time, staffing difficulty, physical effort required, injury rates, error rates, job stress, mental demands, a large number of job-related abilities, and many compensation and job evaluation indexes. Additional ongoing research is examining how people naturally go about designing jobs and how specific tasks should be combined or changed in order to improve job design. The practical consequences of these studies are discussed in this chapter, and the technical details are presented elsewhere (see Additional Resources).

More research is needed on the interdisciplinary approaches in order to improve our understanding of job design. We are looking for research sites where jobs are being developed or changed in order to further the study of job design and to determine whether jobs can be designed optimally on all approaches with minimal trade-offs.

ADDITIONAL RESOURCES

Six technical articles describe the research on interdisciplinary approaches to job design:

Campion, M.A. (1988). Interdisciplinary approaches to job design: A constructive replication with extensions. *Journal of Applied Psychology, 73,* 467–481.

Campion, M.A. (1989). Ability requirement implications of job design: An interdisciplinary perspective. *Personnel Psychology, 42,* 1–24.

Campion, M.A., & Berger, C.J. (1988). Conceptual and empirical integration of job design and job evaluation. In F. Hoy (Ed.), *Academy of Management Best Papers Proceedings* (268–272).

Campion, M.A., & McClelland, C.L. (in press). Interdisciplinary examination of the costs and benefits of enlarged jobs: A job redesign quasi-experiment. *Journal of Applied Psychology.*

Campion, M.A., & Stevens, M.J. (1989). A laboratory investigation of how people design jobs: Naive predispositions and the influence of training. In F. Hoy (Ed.), *Academy of Management Best Papers Proceedings* (261–264).

Campion, M.A., & Thayer, P.W. (1985). Development and field evaluation of an interdisciplinary measure of job design. *Journal of Applied Psychology, 70,* 29–43.

Two practitioner-oriented articles also describe the interdisciplinary approaches to job design:

Campion, M.A., & Thayer, P.W. (1987). Job design: Approaches, outcomes, and trade-offs. *Organizational Dynamics, 15* (3), 66–79.

Campion, M.A., & Thayer, P.W. (1989). How do you design a job? *Personnel Journal, 68* (1), 43–44, 46.

Two contemporary books that summarize the literature for each of the job design approaches are cited:

Motivational Approach

Griffin, R.W. (1982). *Task design: An integrative approach.* Glenview, IL: Scott-Foresman.

Hackman, J.R., & Oldham, G.R. (1980). *Work redesign.* Reading, MA: Addison-Wesley.

Mechanistic Approach

Barnes, R.M. (1980). *Motion and time study: Design and measurement of work* (7th ed.). New York: Wiley.

Konz, S. (1979). *Work design.* Columbus, OH: Grid.

Human Factors Approach

McCormick, E.J. (1976). *Human factors in engineering and design* (4th ed.). New York: McGraw-Hill.

Van Cott, H.P., & Kinkade, R.G. (Eds.) (1972). *Human engineering guide to equipment design* (Rev. ed.). Washington, DC: U.S. Government Printing Office.

Biological Approach

Grandjean, E. (1980). *Fitting the task to the man: An ergonomic approach* (3d ed.). London: Taylor & Francis.

Tichauer, E.R. (1978). *The biomechanical basis of ergonomics: Anatomy applied to the design of work situations.* New York: Wiley.