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THE CHALLENGE OF "INCREASED PRODUCTIVITY"

The need to increase the productivity of analysts and programmers is recognized by many data processing executives, in the face of a growing workload and a shortage of qualified development people. Also, the new office automation systems may be expected to pay their way through increased productivity of office staffs. In a broader context, company managements in the western countries see the need to increase employee productivity in order to be more competitive with Japanese companies. Here is some interesting research on the motivation and management of computer personnel that may give some clues as to how significant productivity gains can come about.

The Monsanto Company, with headquarters in St. Louis, Missouri, is a leading manufacturer of textiles, chemicals, plastics, resins, and agricultural products. Annual sales exceed $6 billion, and the company employs about 64,000 people.

Monsanto's approach to the use of office automation in the central information services (CIS) function at corporate headquarters has been a bit unusual—and includes elements that other companies might do well to adopt. CIS has a total of about 120 employees. Their office automation program did not get off to a particularly auspicious start, they say. One of their first efforts was to study certain office procedures and tasks in CIS, in an attempt to identify common activities. After several months of intensive effort along these lines, management decided to abandon these efforts; the analysts did not seem to be grasping well enough what was being done in the offices.

So they switched to a participative program, in which individuals and groups of office workers consider how new technology might be used to improve their jobs. For this project, they have used the organizational units that have shown the most interest in improving their work methods and environment. Also, they have identified the 'lead implementors' in each section—the enthusiasts who, while doing their regular jobs, are strong supporters of the new systems. These people have received a more extensive training than the others.

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This participative program has consisted of three main phases, and is still underway.

Office design. The first phase of their program was to re-design office and work area layouts, with the goal of improving the work environment and assuring flexibility for future changes. An outside consulting firm aided in this phase. All members of the staff participated in designing their own work areas, for the work that they do. The managers then participated in designing the overall layouts for their sections.

CIS management chose to use an open office layout, with movable space dividers. Also, they developed a set of standard modules—for office furniture, filing cabinets, storage cabinets, etc. Employees can assemble their work areas from these modules to meet their specific needs.

For most of the past ten years, Monsanto has made an effort to promote an open management style. There is now much more open-ness and communication between managers and subordinates, we were told, and this open management style goes well with the open office layout. The company uses the management-by-objectives concepts, which encourages employees to harmonize their goals with those of their organizational units.

In performing this office and work area design, sufficient cost savings had to be apparent to pay back the costs of changeover in a reasonable time. In reviewing the results in improved productivity and reduced turnover, they feel that this first phase *has* paid for itself.

Work effectiveness program. The second phase of Monsanto's office automation program has concentrated on work effectiveness. The director of CIS was looking for a way to implement a work improvement program when he came across the consulting firm of Roy W. Walters and Associates, Inc., of Mahwah, New Jersey. Walters uses the 'Job Diagnostic Survey' (the JDS—to be discussed later in this report) to measure employee perceptions of the design of specific jobs, and this approach made sense to the CIS director. So the Walters firm was engaged in 1977.

As a first step, a group of managers from CIS received three days of training in the use of the JDS, how to spot trouble areas in job designs, and how to develop and implement solutions. Then one of the sections within CIS was selected for a pilot study. Everyone in that section filled out a JDS questionnaire, asking them such questions as, "How would you evaluate the smoothness and efficiency of the workflow in your job?" The employees answered by selecting a number between 1 (low) and 7 (high). Supplementary questions ask for comments to explain this quantitative answer.

A team was then formed, with some five people—four representing different activities within the function, plus one person from outside the department. (When there is a possibility that the use of computer technology will be involved, one person from data processing is also on the team, to act as an advisor.) The team, with the help of the consultant, reviewed the JDS scores, and compared them with some 'norm' scores derived by the developers of the JDS. These comparisons pointed up some possible problem areas.

The next step was to review these findings with the section as a whole. This discussion brought out difficulties and workflow problems that the JDS had not uncovered.

Next, the team sent questionnaires to the departments that this section interfaced with—those supplying information to the section and/or receiving information from the section. The questions were designed to get reactions on the workflow in general and the suspected weak points in particular. At the same time, the team member who came from outside the department conducted personal interviews with some of the section members. Finally, the workflows with suspected difficulties were flow charted, to determine just what was actually going on.

By this time, the problem areas were coming into quite clear focus. So another meeting was held with all of the section employees, to go over the findings and to begin a discussion of possible solutions. Again, this discussion resulted in some valuable points being brought up that had not been mentioned (or had not been fully understood) before.

With the problems quite well identified and priorities assigned, the next step was for small

groups (2 to 3) of team members to consider solutions to the problems. As solutions emerged, they were discussed with affected section employees. Finally, recommendations for changes were made to CIS management. Upon approval, the section began implementing the changes.

As the pilot study got underway and it was apparent that it was going well, similar studies were begun in other sections.

As might be supposed, all of this effort has taken a good number of work hours. Typically, we were told, a team might hold 2 to 3 meetings a week, of 2 to 3 hours each, for over 3 months.

The results have been impressive. In the past few years, CIS has had an increase in workload of 20%, but the work force has decreased by 22%. Job re-design has typically changed jobs from being 'specialized' to being 'complete'—handling all types of transactions for a group of customers, say, instead of handling just one or two types of transactions for all customers. This job re-design, coupled with the re-design of work areas, led a supervisor to comment to us about one section, "It is hard to believe what they did with their space; it looks like they now have twice the space that they used to have."

Introducing new technology. The third phase of the CIS program is to encourage employees to make use of new office system technology in their re-designed jobs. The employees have been given training on how they can make use of word processing capabilities (on IBM System 6) and data processing capabilities (on an IBM System 34) within CIS. It is up to the employees to figure out how they want to use these computer facilities as a part of their jobs.

And last fall, a group of CIS managers received a one-day seminar on new office automation technologies. Out of this training came the group's decision to install a computerized calendar system, as the next phase of the office system program.

So Monsanto's central information services is approaching the use of modern office systems by way of *employee participation* in the re-design of their jobs and in the decisions on how best to use the new computer technology.

A facilities management firm

We talked with a data processing executive who used the Job Diagnostic Survey (JDS) on a previous job. His previous employer is a facilities management firm, which manages the computer installations for a number of organizations around the country. The firm not only runs the computer operations but performs application software development as well, at a number of dispersed sites.

This executive was familiar with the research being done by two professors at the University of Colorado—Professors Couger and Zawacki—on the use of the JDS to measure employee attitudes about their jobs. He thought it was worth trying out, and sold the idea to the president of the firm. Both he and the president *thought* that all was well, but they wanted to check on how the employees actually felt. Also, they wanted to be able to compare employee attitudes at their different sites.

The survey was administered by the data processing directors at each location. Couger provided counsel on the process via telephone. After the scores were tablulated and averaged, the results were delivered to the executive.

In brief, the study showed: (a) no major problems, (b) a few surprises, and (c) employee attitudes about as management expected. The reasons for expecting these results were that the company was offering its employees positions with above-average challenges, had selected employees with above-average abilities, and felt that it was providing the employees with above-average working conditions.

But the JDS turned up one point that required prompt attention. The programmer/analysts had strong negative feelings about the amount of system maintenance they had to do. Each programmer/analyst was totally responsible for one or more application systems, and each was also trying to do new system development. But users were continually asking for changes and enhancements to existing systems—and the programmer/analysts felt trapped by these requests.

Management was, of course, aware of the problem; it is a common problem in the computer field. What they were not aware of was

the strength of the negative feelings. So management's reaction, upon seeing the JDS results, was, "Let's get this thing cleaned up quickly."

The job changes that were made were not major re-designs but rather minor adjustments. Each programmer/analyst still had primary responsibility for one or more application systems. But, in addition, he or she was now backed up by one or two other programmer/analysts who became the secondary resources for these systems. So the maintenance workload for any application system could be and was shared among two or more programmer/analysts.

In addition, a user liaison position was created, to act as a buffer between the users and the programmer/analysts. Requests could be reviewed—and perhaps even handled—by the liaison person; only relevant requests flowed through to the programmer/analysts. Further, somewhat more formal procedures were imposed on the users, for submitting these requests, to try to weed out some of the more spur-of-the-moment cases.

The executive left for his new job before having a chance to use the JDS again, to measure the changes in programmer/analyst attitudes. But he sees a big value for it in this role, even though (in his words) "it is no magic formula." In most companies and at any point in time, he said, management is usually making a number of changes, in an attempt to improve performance. The JDS provides a way of measuring employee attitudes *before* making a new set of changes, in order to establish a baseline for future reference. Then the JDS should be used periodically to measure changes in attitudes. It is one way of providing quantitative feedback to management on the effectiveness of their changes. The executive demonstrated his belief in this point by arranging for the use of the JDS at his new firm.

Seeking improved productivity

A good portion of the sales claims for new computer technology—such as the new office systems, the new distributed systems, and programmer work-benches—say that these developments offer users the chance to significantly increase the productivity of their employees.

The major point to be made in this report is that computer technology, by itself, (or any other major technology, for that matter) probably cannot provide the productivity gains that are so much the center of attention today. Management should not be led to expect this of technology. Instead, it is the *employees*, not the technology, that can provide the big gains.

We will approach this point in the following four steps:

- How the work environment will change
- How new technology fits in
- How job re-design fits in
- How technology can best impact jobs

We will consider both the current problem of obtaining increases in productivity (say, of programmers or of office staffs), as well as the longer range program of the type that (hopefully) will strengthen the competitive positions of the western countries.

The changing work environment

With the growing Japanese dominance of such markets as automobiles, television, motorcycles, and steel, it is becoming clear that the Japanese as a nation are doing a number of things better than other industrial countries. The U.S. has been accustomed to a leading role; now the Japanese have taken over in many major markets. And it is equally clear that this trend is continuing; Japan's competitor countries have not yet been able to turn things around.

Also, high inflation rates have built up and have continued during the last half of the 1970s. A good part of the cause, but not all of it, can be attributed to the rapid rise in OPEC oil prices. But oil prices will not get better; instead, they very likely will go higher. The problem of high inflation will have to be solved almost regardless of oil prices.

Conventional wisdom is saying that the best answer to both of these problems—tough competition from Japan and continued high inflation—is to increase productivity. Get more units of output for the same number of units of input, say the adherents of the increased productivity theory, and balance will be re-established.

However, the methods that are being used by the western nations to increase productivity are not delivering gains of the magnitude needed. So it appears to us that competition from Japan and the problem of inflation will force managements to seek new ways for accomplishing the needed increases in productivity.

And what will these 'new ways' be? One answer is: look at Japan, to find out what firms in that country are doing to increase their outputs and decrease their costs so dramatically. Spot the things that seem to have the greatest impact, then see what we can learn from those things.

Let us briefly describe, then, some of the main characteristics of the Japanese style of management, to see what might account for that country's competitive achievements.

The Japanese management style

The following brief discussion is based on a seminar given in Los Angeles last fall, under the auspices of the Southern California chapter of the Society for Management Information Systems, a paper by R. C. Beaird in Reference 1, plus a variety of other source materials, as well as several trips to Japan. The SMIS seminar was on the subject "Applying Japanese management techniques to improve productivity," and included two executives of Japanese companies plus an executive of a U.S. company who has studied Japanese methods and uses them in his work. Beaird's paper was published by the emerging issues group of the corporate planning division of the American Telephone and Telegraph Company.

The Japanese management methods appear to include the following four major components.

Create a 'family' spirit. Japanese managements seem to be very concerned for their employees—and as whole people, not just during their working hours. Men are offered employment for a lifetime (meaning until age 55 or 58), as members of the corporate 'family.'

In the same way that a son would not be discharged from the family, a male employee is not discharged from the firm. In the same way that a parent visits a sick child in a hospital, a supervisor visits a sick employee. And in the same way that parents are proud of the accomplishments of their offspring, Japanese companies show their pride in their employees and the accomplishments of the employees.

In periods of bad times, the main concern is to save everyone's jobs, not just some jobs. If pay must be cut, the cuts start with (and are greatest at) the top. If it makes no sense to produce products, because there is no market for them, the employees are kept busy cleaning up the plant, fixing machines, and so on. In Japan, relatively large bonuses are paid each year and represent a large fraction of an employee's income; in recession times, however, the bonuses can be cut or eliminated—but the basic pay continues. Thus, 'unemployment' pay in Japan is really paid by the companies, not by the government. Unemployment is spread over all employees, and is not limited to discharged employees, as in the western world. Further, the employees retain their dignity and sense of family membership in recession periods.

If new machines and systems are brought into the firm, they are brought in to *help* the employees do their jobs, not to replace the employees—because typically employees are not fired and leave only when they retire.

Due to these long term employment commitments, Japanese management must hire people very carefully, to make sure that they do not over-commit the company.

Another policy is to move people around the company, from department to department, over a period of years, in order to expose them to more of the company's operations. Japanese management feels that this policy gives the employees a broader view of what the company is trying to do, and helps build an emotional attachment to the company.

The net result of this policy of creating a family spirit is a sense of great loyalty both *by* the company (to the employees) and *to* the company (by the employees). There is a price, however, that the employees pay; the company comes first and families come second, in the priority of things. But there is essentially no employee turnover.

Concern for quality. Japanese firms have developed an over-riding concern for the quality of their products.

This concern has led to the widespread use of the interesting *quality circle* concept. Small groups of employees meet on company time, to discuss and identify recurrent quality problems that they see or that have been pointed out to them

Beaird says that the idea of quality control circles, or quality circles, really originated in the U.S. It was taken to Japan as a means of improving product quality during the days when Japanese quality was not as highly regarded as it is today. Now the concept is recognized as important in contributing to Japan's success.

Having identified a quality problem, the members of the quality circle try to trace it back to its source, and then find ways to correct it. They seek to produce a product that everyone in the company can be proud of. In theory, every employee is a member of a quality circle and these discussions can be a regular part of each job.

Japanese executives feel that U.S. hiring-and-firing policies lead to high employee turnover, which in turn leads to poor product quality.

Teamwork, not competition. Since employee turnover is very low (even in Japanese plants in countries outside of Japan), and expansion must be carefully controlled because of the long-term job commitments, there are not a lot of job openings on the managerial ladder. This seems to lead to less competition among managers, and more of a teamwork spirit.

Related to this teamwork is the concept of *consensus decision making.* Every person who is involved with a particular decision gets heard. Participants can 'take sides' and members of the group try to persuade others to their view. So it can take a long time to make a decision. But once made, it is set; as one of the seminar speakers said, "A committed date is a sacred thing."

A corollary of this teamwork is *group responsibility.* No single person is acclaimed for an achievement; instead, the whole group is acclaimed. One speaker at the seminar said that if one department at his plant sets a record, the *whole plant* gets a celebration party.

Concern for the learning curve. The learning curve concept is well-known in some U.S. industries, such as aerospace, but in general one does not hear it referred to often. The concept is simple; the more units of a product that are built, the less time and cost it takes to build each new unit, because the people learn to do the job better.

The Japanese have adopted this idea with fervor. To them, volume is critical; more volume means greater learning and lower unit costs. So prices are often set based on these *expected* cost reductions. This leads to lower prices and greater sales, so the policy tends to be self-fulfilling. As a greater and greater share of the market comes, so do the profits.

The key points. The over-riding principle that comes through to us from these Japanese principles of management is: *they treat employees as human beings.* Each employee is a part of the 'family.' Each person gets a chance to participate in company decision making—through the quality circle process, if not otherwise. This apparently has built a great sense of company loyalty in the employees.

(The Japanese do not have all the answers, in this regard. For instance, lifetime employment is still only for men. Women are hired on a more temporary basis, as a reflection of the oriental culture. The Japanese seem far behind the western world in making effective use of the capabilities of women—and even the western world has a long way to go in this regard.)

The next most important principle that comes through to us is: increased productivity is a *by-product* of management policies; it is not a main goal of the companies. *Quality* is a main goal; *learning curve improvements* are a main goal. Out of these come productivity increases.

The upshot is this. The United States and other industrial countries are being out-distanced by the Japanese. The present rates of inflation in most industrial countries are really intolerable for healthy economies. Easy solutions and minor adjustments won't solve these problems. Something has to be done to achieve *substantial* increases in output for each unit of input. Management will be looking for effective solutions.

And where will these effective solutions be found? The answer is, we think: *in the work environment.* Competition and inflation will force

major changes in management policies, as they pertain to employees and their jobs.

And what will these changes be like? We suspect that, like Japanese firms, the companies in the western industrialized nations will seek ways to gain much greater employee loyalty and motivation. Does that mean that U.S. companies, for instance, will have to start offering lifetime employment to employees? The answer probably is No; it is not clear that employees even would want that, since it would limit their ability to change jobs or to move to a different part of the country. Employees in the U.S. are accustomed to more job mobility.

What it *does* mean, we think, is that U.S. companies will become even more concerned than they already are about the well-being of their employees. Things must be done to build up a more positive attitude on the part of employees toward their jobs.

Motivation: A complex subject

There are a number of conflicting theories about human motivation, and research studies of employee attitudes about their jobs do not *really* confirm any of them.

LeDuc (Reference 2) gives a good overview of some leading theories and how they relate to research studies. He identifies two types of employee motivation: *internal*, involving finding and satisfying employee needs, and *external*, involving things given to the employees, such as wages and benefits. He quotes studies that show a general increase in job dissatisfaction during the past 10 to 20 years, and notes that the attitudes of data processing personnel exhibit this same trend.

The leading theories within the internal motivation camp are those of Abraham Maslow and Frederick Herzberg. We discussed Herzberg's theories some years back, as they were being applied within the Bell Telephone System. These theories have to do with the needs that humans have for self-actualization, esteem, and performing meaningful work.

Perhaps the leading exponent of the external motivation concept is B. F. Skinner, originator of the stimulus-response theory of behavior.

Space does not allow a more thorough review of these different theories; if you are interested, read LeDuc's paper. But his conclusions are of interest.

"External motivation is probably discredited...," says LeDuc. "Internal motivation, or the search for intrinisic qualities that characterize programmers, has some promise....The programming manager needs to establish and encourage an atmosphere in which the people are motivated by the work itself, an atmosphere that values achievement and challenge...The manager ought to sponsor participatory job improvement."

One way to do this is to design *more humanized* jobs. And the Job Diagnostic Survey is one tool for accomplishing this goal.

Note the point here: job re-design is only *part* of the solution for getting better employee attitudes toward their jobs. And, in turn, the JDS is only one tool for aiding in job re-design.

Before discussing the re-design of jobs, let us consider where new technology fits in, in this search for increased productivity.

How new technology fits in

The point was made above that new technology, including new computer technology, by itself probably cannot deliver the magnitude of productivity gains that are needed. That point needs some amplification.

Argument. The 1960s and 1970s saw the widespread introduction of computer technology in the U.S. and other western countries. In fact, the U.S. still is the leader in developing and using computer technology. In addition to computer technology, there has been significant progress in the use of other technologies—communications and transportation, to name two.

During this same time period, Japan also introduced these new technologies. But there is no evidence that Japan is ahead of the western nations in its use of computers, communications, or transportation.

However, it is precisely during this time period that Japan shook off the impact of World War II and began its dramatic penetration of world markets. That achievement cannot be attributed to Japan's superior use of new technol-

ogy (except perhaps in the case of steel—and Japan's success cannot be attributed to this one instance alone).

In fact, if a superior use of new technology did occur during this time period, it generally occurred in the western countries. By itself, this use of new technology has not kept the western world abreast of Japan.

Argument. During the last five years, there has been a widespread introduction of word processing in the U.S. and other western countries. But a 1979 report by the U.S. Government's General Accounting Office (FGSMD-79-17), about the use of word processing in agencies of the federal government, concluded that "most agencies can neither demonstrate that they have increased their productivity nor that their word processing systems are, in fact, cost effective."

In previous issues, we have mentioned a number of reasons why word processing has not been successful in upping productivity. The root cause, we think, is that most organizations sought immediate cost savings to offset the cost of the 'expensive' word processing systems. So job and organizational changes were made which had the effect of upsetting established relationships, such as between a manager and a secretary (where the latter is often a 'personal assistant'). What was perhaps gained by centralizing the typing function was lost by transferring secretarial functions to managers and professionals.

There is no reason to believe, therefore, that the introduction of new computer technology—such as office automation systems or distributed data processing systems—will by itself lead to the significant gains in productivity that are needed. In fact, based on the evidence of the past twenty years, one can say with some assurance that the technology by itself will *not* do the job.

No, the key to increased productivity is *people.* Technology can *help* people do their jobs better *if they are willing to use it.* And the fact must be faced: many end users are not all that impressed with the performance of their computerized systems. They have had to adapt their ways to the computer more than the reverse. Too often, they were told how their computerized systems would work, not asked how the systems should work. Maybe lip service has been paid to the study of user requirements, but the actual effort has been far from adequate.

Roy W. Walters, whose company worked with Monsanto with their work effectiveness program (see Reference 5), believes that the new office technology can often fail to deliver the anticipated productivity increases when it is used with poorly designed work systems.

International Data Corporation, of Waltham, Massachusetts, has conducted several studies for client companies, dealing with productivity and motivation of programming staffs; one such study was reported in the December 1, 1980, issue of *Computerworld.* Data processing management was found to be the primary source of discontent with jobs (poor management, poor company planning, etc.), while 'feeling of accomplishment' was the factor most often cited for job satisfaction. In another such study, IDC found that "poor (programming and analysis) staff performance, itself, turned out to be one of the causes of high staff turnover. If you do the things necessary to create a high performance organization, you will minimize turnover at the same time."

Increased productivity, then, depends on employee attitudes about their jobs, and the feelings they have about how management is treating them. As mentioned above, it seems to us that the main reason for Japan's success has been Japanese management's treatment of (male) employees as people. One step that the western countries can take along this same road is to redesign jobs to make them more humanized. So let us now look at how job re-design fits in.

How job re-design fits in

Two professors at the University of Colorado, Colorado Springs campus—J. Daniel Couger and Robert A. Zawacki—have been conducting research in the area of motivating and managing computer personnel. The results of their initial studies were recently published in book form (Reference 3).

The reasons behind their research were based on their perceptions of the problems of managing computer personnel. They were aware of the growing shortage of qualified people, particu-

larly in the system analyst and programmer areas, coupled with the continued high turnover in these jobs. Not only is this personnel shortage getting worse, most user organizations are faced with the need for an increased workload in system development—more application systems, more complexity of those systems, and an increase in the maintenance of those systems.

These are problems that most data processing executives will recognize, of course. And when one thinks about it, these problems are closely related to the subject of this issue—the search for increased productivity. How can an organization handle an increasing workload when faced with a shortage of qualified staff, and when the turnover rate of the staff members is high?

Couger and Zawacki decided to measure the attitudes that computer personnel have about their jobs. For this study, they chose the Job Diagnostic Survey (JDS), developed in the mid-1970s by J. R. Hackman (University of Illinois) and G. R. Oldham (Yale University). Hackman and Oldham established the validity and accuracy of their instrument by testing over 6000 individuals who were performing over 500 different jobs at more than 50 organizations. From these tests, Hackman and Oldham developed some normative averages on job attitudes.

The JDS

The Hackman/Oldham JDS is based on a model of human motivation that has three main elements. First, there are five *core job dimensions*: skill variety, task identity, task significance, autonomy, and feedback. These are related to three *critical psychological states*: experienced meaningfulness of work, experienced responsibility for outcomes of the work, and knowledge of the actual results of the work activities. If all of these are 'right,' then the final element, *personal and work outcomes*, is positive—high internal work motivation, high quality work performance, high satisfaction with the work, and low absenteeism and turnover.

As an example, the model says these final positive outcomes will occur in part if the employee actually experiences meaningfulness is his/her work. And real meaningfulness results if the work involves the use of a number of different skills and talents of the employee, if the work requires the completion of a 'whole' and identifiable piece of work (doing a job from beginning to end with a visible outcome), and if the work has a substantial impact on the lives or work of other people.

The JDS consists of a series of questions in a questionnaire that the employee answers anonymously. Examples of such questions are: "How well do the present practices and procedures promote productivity and efficiency in your job?" "How concerned is your management about the number of complaints received by you?" "How would you rate the morale in your work group?" The employee answers each question by selecting a number from 1 (meaning low) to 7 (high).

Only the average scores of a group of people doing the same work is meaningful; individual scores are not. Further, employees are likely to answer with their true feelings only if they believe that the results will not be used against them personally, which argues for complete anonymity. The JDS should *not* be used for placement purposes nor in diagnosing jobs of individuals. Also, people taking the JDS must be moderately literate.

The average values ('scores') on each question are then used for analyzing employee perceptions about the job. One of the computed measures is *growth need strength.* A high growth need strength indicates that the people in the group have a high need for personal growth and development. In turn, the people in this group will become internally motivated if their jobs have a high motivating potential.

Another computed measure is *social need strength.* A high group score in this indicates that the people in the group have a strong desire to interact with others; a low score indicates that they prefer to be 'loners.'

A third important computed measure is the *motivating potential score* of the job. There are other computed measures, but these three are the most meaningful for the purposes of this discussion.

The growth need strength score is determined by averaging the employee answers for the questions having to do with personal growth and de-

velopment. The social need strength is obtained from those questions having to do with interacting with other people. And the motivating potential score for the job is computed from questions that measure the five core job dimensions—skill variety, task identity, and so on.

The research

In the study on which their book is based, Couger and Zawacki added some components to the JDS for probing certain aspects of computer personnel problems. But many of the important research findings came from the basic JDS itself.

They obtained the co-operation of 50 organizations—34 companies and 16 government organizations (representing federal, state, and local agencies). The computer staffs at these organizations ranged in size from 25 to over 300. In all, they administered the JDS to about 1000 programmers and analysts, and some 1500 data processing managers and operating staff members.

Some general conclusions. The research uncovered the fact that programmers and analysts have the highest growth need strength of any job category that has been analyzed using the JDS. In a sense, this is not surprising; data processing management has long since learned that programmers in particular want to be working with the latest in hardware, operating systems, and languages. But the fact that they rate the highest in this respect means that particular attention must be paid to it. If the programmers and analysts seek high personal development and their jobs do not provide it, they are going to change jobs.

Another survey finding has serious implications for data processing managers. Programmers and analysts have the lowest social need strength of any of the more than 500 occupations that have been measured by the JDS. On the other hand, most *users* have a high social need strength. Persons with a high need of this type utilize meetings as a prime device for fulfilling their social needs. "Programmers and analysts don't need meetings," Couger says, "and users don't understand why systems personnel show frustration at lengthy or frequent meetings."

The same point applies to project or department meetings, according to Couger. "Programmers and analysts are not anti-social; they will participate actively in meetings that are meaningful to them. But their high growth need also causes intolerance for group activities that are not well organized and conducted efficiently."

Couger, in a discussion with us, pointed out another factor that data processing management must consider. The position of system analyst usually is being filled by people who did well at programming, where low social interaction might be tolerable. But as system analysts, they are expected to interact extensively with users. If they exhibit this low need for social interaction, this means that they probably (1) have as little interaction with users as possible, and (2) tend to rush through whatever interactions they do have. "Might not this help to explain why the study of user requirements has often been so incomplete?" asks Couger.

Another general conclusion of Couger and Zawacki was that the area of program maintenance needs further study. So they have set up a research project for this area, and again are using their modified JDS. The results of this research were not available as we went to press, but should be ready soon.

Some specific results. In most cases, the JDS results just confirmed management's opinion that: "We are doing all right; there are no major problems with employee attitudes."

In five of the organizations, though, the results pointed up the need for corrective action. This action most generally involved job re-design—and, typically, it was the interface between the development staff and the users that demanded attention. Each of the five organizations followed a somewhat different course of action, to meet local needs.

It should be pointed up that this use of the JDS was based on *today's* work environment as the norm. The organizations simply compared the attitudes of their employees with today's average attitudes. But we see the JDS as a potential tool for moving into the new work environment that we think will be necessary in order to obtain the desired productivity gains.

How technology can best impact jobs

If you are concerned about increasing analyst and programmer productivity, or are worried whether a new office automation system can pay for itself through greater productivity by the office staff, what can you do? It seems to us that job re-design is a fundamental part of the solution.

If the views of the 'satisfaction of needs' people appeal to you (as they do to us), then consider the following elements of a program for creating a new work environment in which technology is used. Note that this is an on-going program that aims at *significant* improvements, not just some fine-tuning (such as modifying the program maintenance job).

Measure current employee attitudes. The JDS, or something like it, should be used to measure current employee attitudes toward their jobs. This attitude study would use today's work environment as the norm, and could point out any areas where attitudes are not up to this norm. Even more importantly, the study would provide a base line from which future progress would be measured.

Options for using technology. Whoever is in charge of the program for introducing new technology into the organization should develop a list of optional ways for using it. The options should be described in a way that allows the employees to easily relate such uses to their jobs.

These options, of course, should be developed using corporate standards, such as standard communication protocols, standard data definitions, and documentation standards, to avoid the proliferation of incompatible systems.

Stress quality of products. The Japanese have demonstrated the value of stressing quality of products. The same attitude should be fostered in connection with information systems. The concept of quality circle groups, for attacking quality problems, would seem desirable. The quality circles in data processing should receive feedback from user departments, on how well their application systems are meeting user needs.

Training of employees. The employees should receive training both in the need for quality of products and what the new technology can do for them in the performance of their jobs. This training should describe the optional uses that are available.

Management by objectives. One of the key points is determining the goals and objectives of the organization which (hopefully) can be brought into harmony with the goals and objectives of the employees. In today's work environment, too often management sets the objectives for the organization and employees are expected to adjust their personal goals to fit the organization's goals. We suspect that in the new work environment, this goal setting will become more of a true dialog.

Job re-design. Taking all of these factors into account—goals, current attitude problems, options for using technology, etc.—job re-design can be conducted, by the employees themselves working in small peer groups. Outside help probably will be needed, to demonstrate various ways in which jobs can be re-structured and to prevent the discussions from turning into gripe sessions. The job re-design activities should decide which options for using computer technology will be used, and how they will be used.

(It seems quite possible that someday analysts and programmers will move out of the data processing department and into line jobs in the user departments. There they will come face-to-face with the needs and problems of serving customers, or building products, or such. They will be expected to create computer systems to support these needs. At that point in time, they would have much more 'complete' jobs; today, they tend to be insulated from these needs. Next month's report will be the first of two on 'end user programming,' as a step in the direction of complete programming jobs.)

Measure progress (or lack of it). Again, using the JDS or something like it, progress toward the goal of significantly improved employee attitudes can be measured.

The point here is that management cannot rely on *its* intuition to tell whether or not progress is being made. Almost of necessity, managers see the world differently from the employees. The JDS provides a way to get a quantitative measurement of how employees feel about their jobs. If the JDS is administered correctly, there

seems to be a good chance that employee attitudes will be measured accurately and validly.

Repeat the process. What do employees expect from employers, in order for them (the employees) to be well motivated to do the best work they can? Clearly, the answer is: No one knows. Not the employers, because they cannot really see things from the viewpoint of the employees. Not the employees, in general, because many of them cannot even visualize a working situation where they would really enjoy their jobs. So it probably will be necessary to have a progressive refinement of the work environment.

Creating the new working environment will not be a case of copying the Japanese or anyone else. Nor will it be a quick and easy course. It is going to require quite a change of attitude on the part of many managers, whose mental set is toward today's work environment. It will involve a program of measure attitudes, plan changes, implement changes, measure new attitudes—and then repeat the process.

If the U.S. and other western industrial nations are going to bring inflation under control and to become more competitive with the Japanese, something of this sort will have to happen, it seems to us.

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SUPPLEMENTARY READING

There are a number of articles appearing in the literature on the problem of increasing both productivity and quality of products. Some of these discuss Japanese approaches to these problems. Here are four recent articles you might like to read.

In *Harvard Business Review* (Soldiers Field, Boston, Mass. 02163), the Nov/Dec 1980 issue has the article "It's not lonely upstairs' on the open-style top management policies at Versatec Inc. Founded in 1969 to manufacture computer printer-plotters, Versatec now outsells all competitors combined. And in the Jan/Feb 1981 issue, Peter Drucker discusses what he sees as "Behind Japan's success." Japan, he says, has defined more ably than other countries some of today's essential management rules.

In *Fortune* (Time and Life Building, New York, N.Y. 10020), the Dec. 29, 1980 issue has an article by Jeremy Main ("The battle for quality begins") that discusses how U.S. industry is rousing itself to meet the standards set by the Japanese. And in the Jan. 26, 1981, ("Can the twain meet at Mitsubishi?"), H. D. Menzies tells how a Japanese company is trying to run its U.S. operations using Japanese management principles for its American employees—and is finding the cultural chasm to be large.

Editorial: Richard G. Canning, Editor and Publisher; Barbara McNurlin, Associate Editor. While the contents of this report are based on the best information available to us, we cannot guarantee them.

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EDP ANALYZER
Editor and Publisher
RICHARD G. CANNING

AN EDP ANALYZER
FEATURE REPORT

Spring, 1981

THE NEXT FIVE YEARS

The way we see it, the next five years will bring the biggest changes yet to computer-using organizations. Why? Well, the technology has been developed and the users are "ready." New automated office systems, computer message systems, "personal" computers for managers—all of these and more are now in the market place. And all are aimed at one thing: increasing the *productivity* of managers and staff. In periods of intense competition and high inflation, there is a crying need for substantial increases in productivity. So the new technology will be put to work at a rapid pace. Further, this new technology is sure to have a major impact on data processing, as it is now conducted, and on user organizations. In this Feature Report, we briefly review some of these impacts and suggest how you can better keep abreast of them.

What new computer-field technology is now available, just waiting to be put to widespread use—and that will have a significant impact on data processing? Actually, the list is so long and the potentials of each are so great that it is hard to know where to start.

Note, too, that versions of this new computer technology are coming to market at prices that even medium-size and smaller organizations can afford; the use of the technology is no longer limited just to the larger computer departments. Much of it is being offered on today's mini-computers, which in turn are being successfully marketed to *departments* of larger organizations. And it appears that these developments will soon be seen on micro-computers.

So, all in all, a lot of new computer technology *is* arriving, and will continue to arrive over the next few years, that can have a big impact on data processing as we know it today. Consider the following:

People productivity. Pressures from foreign competition, as well as the continuing pressure of double-digit inflation, will force most companies to seek greater productivity. One way that management will seek productivity gains is through the use of new computer technology. And the way this may well be done is by having employees themselves re-design their jobs, to create more meaningful,

more "complete" jobs, as opposed to today's fractionalized, specialized jobs. And in redesigning their jobs, employees will be encouraged to make more use of computer technology.

Computer technology, by itself, probably cannot provide the needed productivity gains—as recent history has demonstrated. But with employee support and participation, the gains *can* be realized. And computers will become much more a part of employees' everyday jobs.

How will this happen? It will happen through the installation of data management systems, distributed systems, and office automation systems, to be discussed shortly.

Sound impractical? Actually, the general approach is very much like what many Japanese companies have been doing so successfully for years. Read the April 1981 issue of EDP ANALYZER to learn more about this approach—and what some pioneering U.S. organizations are already doing along this line.

Data management systems. These new systems are springing up all over—for use on mainframes as well as on minis, and they are also available on some time-sharing networks. They provide easy-to-use, friendly interfaces for defining new files and record types, allocating disk storage space, defining application logic, entering records and transactions, retrieving data, answering queries, and performing report requests. In short, they provide the "programming" for essentially all of the routine functions of an application.

We have seen these new systems in use in organizations of all sizes, ranging from as few as 15 employees to companies with many thousands of employees. And all of these users have agreed about the benefits they are obtaining. New application systems can be set up in a fraction of the time it takes with conventional programming methods—often in just a few days. In fact, end users can do a fair amount of their own "programming," thus relieving the programming staff of some workload.

These new data management systems tie in with the subject discussed above—employee productivity. They will help to make computer technology available and easy to use—for a myriad of small jobs in employees' everyday work, jobs of the type that data processing usually does not want to bother with but which can help the employees do their daily work better.

You will find the use of these new data management systems discussed in the March through June 1981 issues of EDP ANALYZER.

Automated office systems. Surely these systems must be near the top of the list in importance and magnitude of likely impact, of all of the new technologies. As a matter of fact, one can argue that they represent the "true" distributed systems that people have been discussing so much in recent years.

Office systems consist of a series of new technologies, not just one. At the outset, these technologies are likely to be installed one at a time. Soon, though, it will become apparent that a planned, integrated approach will be needed. We will briefly summarized the main elements of office systems.

The best-known element, of course, is *word processing,* for the creation, change, and print-out of textual information. It has been viewed mainly as a tool for secretaries and typists. In fact, it has a much broader potential than that, as we have discussed and will continue to discuss in future issues of EDP ANALYZER.

The next step that user organizations most likely will take is to allow these word processors to intercommunicate. From there, it is a short step to the installation of a true *computer message system,* by which people can inter-communicate from their terminals. Systems of this type provide many benefits over the telephone and over drop-in casual meetings, for the exchange of information.

At about this stage, companies will begin storing their reports in *electronic files,* instead of printing them out on paper. Users will be able to access the information from terminals, rather than searching through printed reports. This access will be made easier and more efficient by the use of *query packages.* And the retrieved data can be put through a choice of *analysis routines* for determining trends, deviations, averages, and so on. Finally, the information can be presented in graphical form, on a *graphics terminal,* for better comprehension.

These are only some of the elements of the new office systems. Moreover, all of these already are in use at pioneer organizations. We have been reporting on user experiences with such systems for the past several years, in EDP ANALYZER.

Distributed systems. With all of today's discussion of distributed systems, notice how many of these other technological developments are essentially on a par with them. And as with other computer field developments, there are almost as many definitions of "distributed

systems" as there are writers and public speakers on the subject.

One form of distributed system, of course, is a *network* of computers. The network may have the structure of a hierarchy, with the company's main data processing center at the top of the hierarchy. This is the structure you are most likely to see offered by the major computer manufacturers; the IBM 8100 is based on this concept, for example.

Or the network structure may be that of a peer network, where all of the computers are essentially equal in status and co-operating with each other. This structure is what you are most likely to see associated with office automation systems.

Another form of distributed system, pioneered by Citibank in New York, includes a number of *stand-alone departmental* computers. Each such computer handles the workload of its department, but it can also communicate with other departmental computers and with the company's main data processing computers. They will have network capabilities but may not operate in a hierarchical network.

Much of the discussion to date on distributed systems has been concerned with one or the other of the network structures, and mainly the hierarchical structure. But the stand-alone departmental computer concept may, in fact, become the more popular approach.

Why? Because departmental mini-computers are already on the market that offer *both* data management capabilities and office automation capabilities. User departments will be saying more and more, "Give us our own departmental computer. With it, we can set up and run a lot of the things that we want to do, things that data processing assigns a low priority to. And we can also get going with office automation in a hurry." So far, at least, the computers offered for network distributed systems do not offer the same features to the end users. Top managements might well side with the department managers who make such requests.

Other developments. As we indicated at the outset, there are so many new developments that are just now reaching the market and that will impact data processing, it is hard to single out the ones to discuss. For instance, we have not discussed the important subjects of the new network technology or direct computer support for managers.

Much is happening in the *network* area. Application-independent private networks (such as IBM's SNA) are replacing the older single application networks. Public data networks, such as GTE Telenet in the U.S., Datapac in Canada, and Transpac in France, offer users an alternative to (or an adjunct to) companies' private networks. Then there are the new wideband offerings of Satellite Business Systems, and eventually the Bell System's ACS and Xerox's XTEN. These three systems have different user bandwidths and other dissimilar characteristics. But users will be asked to use them for voice, data, facsimile, and even video. The management of the whole telecommunications function will become complex indeed.

Then there are the local computer networks, such as Xerox's Ethernet and Network Systems Corporation's HYPERchannel, for connecting computers together. But local networks probably will do even more in the not-too-distant future. We see these local networks carrying data, voice, text, video, and facsimile signals within a building, and used for data processing, office systems, life safety systems, energy management systems, and so on. They may become very important networks indeed.

In the area of direct computer support for managers, the data management systems will provide an easy way for answering many queries, and office automation systems will provide management calendar facilities, message services, electronic files, etc., discussed above. Tied in with these will be computer graphics, for showing managment report data in graphical form. You will be seeing (and, in fact, can see today) all of these capabilities tied together in managerial work-stations, which were discussed in our December 1980 issue.

Another technological development that is almost here is *plug-compatible micro-computers.* It is evident that, by the mid-1980s, micro-computers will be available that have the power of the IBM 370/158, operating in the range of one million complex instructions per second; the technology is reaching that point. It would be technically possible for micro-computer designers to make them plug-compatible with, say, the IBM products—370s, 30XXs, 4300s, etc. What will be the implications if some of the big mainframes can be replaced by quite inexpensive micros?

In addition to the promised benefits of these new developments, there is the other side of the coin—the problems they are going to bring with them. Data processing management—nay, management

in general—needs to know what to expect when these new systems are installed. For instance, office systems and distributed systems open up a whole range of new security and privacy problems, backup problems, standardization problems, and so on.

And then there are the *people* problems. One, of course, is how will the end users react to some of the new systems? If new systems are designed by system analysts, with relatively little user participation, and then in essence forced on the users (as is often the case), there is sure to be some resistance. But if employees help re-design their own jobs, and are encouraged to make more use of the computer in these new jobs, acceptance will be better.

Also, where will the user companies get the data processing people who are trained in the new technologies and qualified to develop and install these systems? Those people really have to be available *before* such projects are started. (When it comes to that, where are these companies going to find *any* additional development staff members? These people are getting in very short supply.)

In EDP ANALYZER, we do all we can to alert management to the problems that the pioneer users have encountered. And where effective solutions have been developed, we describe them.

The need for staying ahead

As we say, we expect that both competitive pressures and the pressures of inflation will spur many organizations to install these new developments, in an attempt to improve productivity.

But these systems are not as easy to install as photocopy machines! All levels of company management must gain an understanding of what they are undertaking, when they decide to install these systems. In the past, computers have been installed mainly within the data processing department. Now, and in the near future, computers (in various guises) are being installed almost throughout organizations—as word processors, intelligent terminals, intelligent photocopiers, and so on.

When things go wrong with these new systems (and they will!), management is sure to turn to the data processing department to put things right. So data processing management can play an important role in advising on the installation of new technology, to try to prevent some of the common troubles from occuring. It is important to be prepared on these!

Then, too, executive management one of these days will see that the present organizational structure for the handling of the company's information resources is not adequate. Gaps and overlaps in responsibilities may begin to occur—among the data processing, tele-communications, and office administration departments, to name a few. Executive management will see that some re-organization of responsibilities is required, to get these people to work together, not against each other. But what should this new organization look like? Who will be in charge? Where will data processing fit?

With all of these technical innovations, it should come as no surprise that data processing will be subjected to a barrage of pressures. There really is nothing new about this; data processing management has been a pressure position for years. Introducing these new technologies should be an extremely interesting, challenging—and possibly frustrating—experience. There should be no end of excitement in the data processing department.

Yes, the next five years will bring huge changes in the data processing and computing environment, we think. And EDP ANALYZER can help data processing management keep ahead of these changes.

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