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Multiskilled Work Teams: Productivity Benefits

There is strong behavioral evidence that work teams offer an attractive alternative to individual specialized tasks. Studies such as the classic works of Rice,[1] Trist,[2] and Bavelas and Strauss[3] indicate that the use of work teams has increased quality and decreased such factors as absenteeism and employee turnover. While these benefits are important, there may be far more value to management in the direct effect of such groups on productivity and the indirect effect on the scheduling function.

The introduction of work groups into one service facility did, indeed, show benefits in productivity, quality, and scheduling, as well as in other respects. This article reports the experience of installing work groups into the service and repair operation of a medium-to-large-sized franchised automobile dealership. As an alternative to the usual specialized individual repair operation, multiple-skill work teams were formed. Scheduling of vehicles to the teams was performed by a dispatcher using closed circuit television transmission. The teams were eventually disbanded through management's decision, in part because of the "oversuccess" of team productivity.

Background

Historically, job design efforts began when job specialization was introduced to take advantage of the economies of division of labor. This approach ran its course through the industrial revolution and met with a great deal of success. Emphasis in recent years has been more behaviorally oriented, concerned with motivation and job satisfaction for reasons other than increased productivity.

In order to lessen the monotony of the repetitive task performance which often results from job specialization, there has been recent stress on job enlargement and job enrichment. Job enlargement is a lateral spread to encompass a greater portion of the number of tasks at the same job level; in the extreme, one person may perform a complete assembly. Job enrichment is the vertical assimilation of such elements as method of performance, quality, and rate into the job description. Other methods to improve job satisfaction are the use of work groups, cost centers, and decision centers. This article concentrates on the use of multiskilled work teams and the benefits they can offer in practice.

Work Teams

The work team concept used here is that of a multiskilled group in which each member is capable of performing two or more tasks. Further, members cooperate and jointly perform work tasks. This definition is in agreement with the original concept of a sociotechnical work group[2,4] but contrasts with some recent applications, in which workers participate in the decision making or rotate jobs to relieve monotony.

Most recent literature dealing with the sociotechnical team approach to job or task performance has been related to management and worker behavioral problems. With few exceptions, the reported sociotechnical applications show that quality of output has increased but quantity has decreased. In this study, however, both quantity and quality increased. The significant benefit of work teams stressed here is the potential savings to a firm resulting from reduced capital needs. Savings in space and equipment requirements can each be in the 50 percent range. Additionally, the scheduling function is greatly eased.

The case reported in this article was the result of the author's having been called in as a consultant by the automobile dealership to simplify the extremely difficult function of routing vehicles through the system. Work teams were initiated as part of the solution to the scheduling problem.

The Firm

The agency has 235 employees, of whom about a third classified as mechanics or body men, working directly in repair on an incentive pay plan. A full range of services was offered—tune-ups, general repairs, brake adjustments, a diagnostic center, a quick service facility (where activities were limited to oil changes, lubes, shocks, mufflers, and similar tasks), and a body and paint shop.

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Major difficulties were a shortage of space and a critical problem of scheduling. The shop facilities were cramped. The main shop contained seventy-five stalls (four committed to alignments and brake repairs). Quick service had eight stalls and the body shop used eighteen for repair and ten for painting. Each man was usually assigned two stalls so that while he waited for parts on one vehicle he could work on another.

The Scheduling Problem

Between 200 and 250 vehicles were worked on daily, and because each required several services it was necessary to move every car from five to eight times between the writing of the work order and delivery to the customer. The dispatcher assigned each vehicle to a specific mechanic, attempting to keep track of each car at all times and locations. The dispatching operation was a formidable job, resulting in problems such as late completions, failure to notify customers of delays or overnight requirements, and an occasional "lost" vehicle somewhere in the system.

Operation of the scheduling function used one of a variety of available Gantt charts. Each worker was shown as an entry on the vertical axis and job time was recorded on the horizontal axis. When a vehicle was put into the system (or when an inquiry was made by a customer about how long it would take for his car to be finished) the dispatcher looked at the possible routing through the system and predicted the time of completion. Most dispatchers allowed a wide margin for error. For example, three actual labor hours on a vehicle in four different areas might require an eight-hour day for completion. Further, the schedule would have to be revised any time a change occurred in the existing schedule because a problem proved more serious than originally presumed or parts were not available. A large portion of the task was retained in the memory of the dispatcher and not committed to paper.

Queuing Theory Support

Of the many benefits of applying the work team concept to this service facility, the major reward was in the resulting higher output per unit of space. This increased utilization can be best demonstrated through a simplified queuing example.

A service facility having a single waiting line and high arrival and service rate has a great advantage over several separate lines having slower service rates. Workers cooperating as a team are more efficient in utilizing this space than several individuals working alone.

At the auto shop described, each individual previously worked independently in his own channel. Figure 1 shows the situation: each of five mechanics had his own waiting line and his own service facility, with work assigned by the dispatcher. Each mechanic had two bays or stalls in which he could work. The second bay was used to store the next vehicle to be worked on, to hold a vehicle waiting for repair parts, or to park a completed vehicle temporarily.

Figure 2 shows the procedure and layout for a work team. The dispatcher schedules jobs for all members of a work team through a single channel. Members of the team accomplish the work assigned to them as they deem appropriate. Aside from greatly simplifying the work of the dispatcher (which will be explained later), to point out the benefits of space and equipment utilization the following example holds the average productivity of each worker constant.

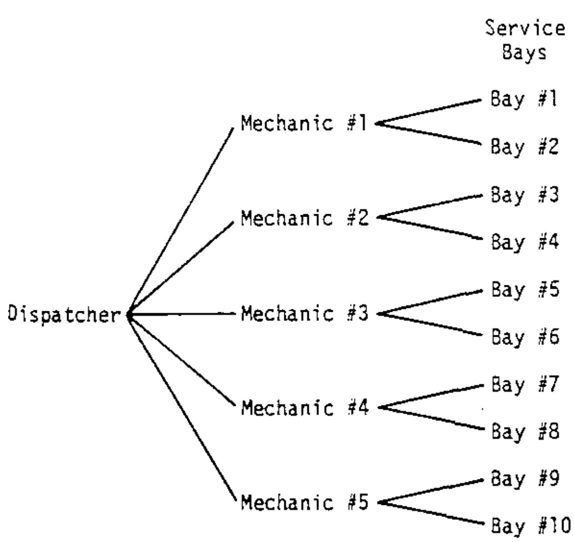

Figure 1. Typical service facility with dispatcher assigning work to independent workers each with two work stations.

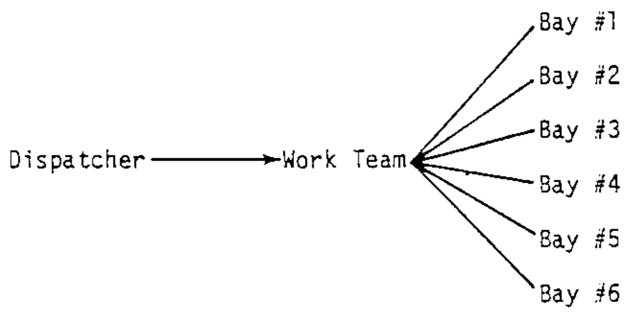

Figure 2. Dispatcher assigning work to a work group consisting of several workers and work stations.

Example. Assume that vehicles arrive at a service facility at the rate of 0.7 per hour per worker ($a = 0.7M$), and that each mechanic can service a vehicle at the rate of one per hour ($\mu = 1$).

The objective in this example is to compare the utilization of each work bay for three cases: Case I, a mechanic working alone and assigned two bays; Case II, four workers of equal capability working as a team in six assigned bays; and Case III, a five-man team working as a team assigned to six bays.

Since these situations reasonably fit Poisson arrival and exponential service time conditions, simple waiting line formulae may be applied.

Case I. One mechanic working alone in two bays.

The utilization of the mechanic $(\rho_m) = \frac{\lambda}{\mu} = 70\%$

With two service bays assigned, the productive utilization of each bay (the time the mechanic is actually working) is:

Utilization of each space $(\rho_m) = \frac{70}{2} = 35\%$

The average number of vehicles in his system

$= \frac{\lambda}{\mu - \lambda} = \frac{0.7}{1-0.7} = 2^1/_3.$

Case II. Four workers ($M = 4$) assigned to six work bays.

Arrival rate $(\lambda) = 2.8$ (0.7×4)

Service rate $(\mu) = 1$ (each worker)

If each worker has the same service rate, then the team rate is $M\mu$ or 4.

Utilization $(\rho) = \frac{\lambda}{M\mu} = \frac{2.8}{4(1)} = 70\%$

If assigned six stalls will result in utilization of (70% x 4 men)/six stalls = 45 percent per stall. This is a 29 percent increase in utilization over the single worker case.

Using standard formulae[5] or a graphical table,[6] the average number of vehicles in the system is about four.

Case III. Five workers (M = 5) assigned to six work bays.

$\lambda = 3.5\ (.7 \times 5)$

$\mu = 1$

$$\rho = \frac{\lambda}{M\mu} = \frac{3.5}{5(1)} = 70\%$$

With six stalls assigned to these five men, the average utilization is (5 x .7)/6 = 58.3 percent. This is a 67 percent increase in utilization over the single worker assigned to two bays (Case I). Similarly to Case II, the average number of vehicles in the system is found to be about 4.5.

It is not unreasonable to assign six stalls to a team of five since, on the average, there will be 2½ stalls in which work is not being done. (The five men working 70 percent of the time equates to full utilization of 3½ stalls.)

It is interesting to note the effect of the random arrivals on each of the three case situations. When one man is working alone, he has an average of 2⅓ in this system at any time. When four men work together, they have only about four cars in their system; five men working together have about 4½ cars in their system. The increase in the number of workers decreases proportionally the average number of cars. This is because an individual line will have periods of high loads and also periods of emptiness. When several lines are combined and merged, the period of high load in one line is offset by a low load in another such that the average flow through a merged system of channels is much smoother, eliminating the high and low peaks of a single line.

Delays Preventing Service

There is a simplifying assumption in the previous example—that a vehicle may be worked on while it is in the system. There are occasional delays, however, times when the mechanic is waiting for parts to arrive or for a customer to be contacted to discuss additional work. The extra stalls assigned over the theoretical minimum number allow for this wait. The precise number of spaces allowed depends on the specific team members, a facility's quickness in supplying parts, and its experience in other work delays. Even taking into consideration variations in these elements, it appears that productivity of each stall can be increased by 50 percent with a work team approach for the conditions of the example.

Installation of the Work Team

To test whether organization of work teams would actually result in more efficient utilization of space and ease pressure on the dispatcher, three trial teams were introduced into the automobile dealership—two in the main repair facility and one in the quick service area.

The quick service facility provided job service requiring short time periods, such as oil changes, lubrications, and shock absorber installation. Customers would drive in and wait for the service to be performed, as opposed to the main shop which usually required customers to leave their vehicles and pick them up at a later time.

Each main shop team was made up of four mechanics whose combined skills could provide most of the services which might be required on any vehicle. One team had an apprentice as one of the mechanics. To save valuable time, a fifth man was added to each team, a young man to move vehicles between the parking area and the work bays, saving the mechanics time for actual work on cars and to serve as a parts runner. He also changed oil, performed lubrications and assisted as a helper when needed by the mechanics.

Scheduling for the work teams was much easier than for the previous system of individual assignments. Rather than having to route a vehicle which needed a tune-up, a brake adjustment, and transmission work to three different areas the dispatcher simply routed it to a work team. Only services such as radio repair, brake overhaul, and front-end alignment, which required special equipment, were excluded from the team approach.

Scheduling vehicles to each of the two teams in the main facility was accomplished by closed circuit television. A camera in the dispatcher's area was focused on a simple Gantt-type chart which identified each vehicle, the type of work it required, the time when it would be available to be worked on, the estimated work time required, and planned time of completion (such as time promised to the customer). An intercom system was used for communication between the dispatcher and members of the team. Only one television camera was necessary because the TV receivers were adjusted so that team 1 received only the top half of the schedule and team 2 only the bottom half. Thus, each team saw only the work assigned to it. Acetate film was used for the scheduling chart so that completed work could be easily erased. Neither the schedule sheet nor the camera had to be moved.

Expected Results

The anticipated benefits of the work team method were as follows:

1. Reduction in the number of times a vehicle had to be moved to about four (from the driveway to the parking area, to the work group, back to the parking area, to customer pickup).
2. Better utilization of expensive mechanics' time by having a lower paid helper move vehicles.
3. Provision of an excellent training opportunity for apprentices or helpers.
4. Reduction in the number of work stalls required for the same number of mechanics.

Actual Results

Over a period of nine months, the benefits proved to be as follows:

1. The same output was produced with less physical space (six stalls were adequate, for the five-man teams, compared with two per man under the previous system).
2. Mechanics reported they enjoyed the wider variety of work they did and the extension of their skills it permitted.
3. The dispatcher's job was made easier. All or most of the work on vehicles assigned to a team could be completed by that group. There was little need for the dispatcher to make subsequent reassignments for additional work.
4. Customers' records showed fewer complaints and returns for follow-up work, implying an improvement in quality.
5. Promised completion times were more consistently met. In addition, members of the quick service group greatly increased their earnings. This facility had previously been unable to handle customer demand. The work team succeeded in almost doubling its output.

Dissolution of the Teams

After the conclusion of this experiment and completion of the consulting agreement no attempt was made by management to put the rest of the service facility staff into teams. Conflicts arose and accusations were made that partiality was being shown to members of the work groups. This was especially critical during seasonal declines in work, because mechanics' pay was determined by an incentive plan.

The "oversuccess" of the quick service team created friction with other service personnel. It was a pleasure to watch them work as they made a game of it. They were so successful as a team that they added alignments and minor tune-ups to their original charter of oil changes and lubes. This took work away from other personnel in the main shop. When these services were taken away from the quick service personnel, members lost the team spirit. Eventually, the teams were disbanded and output of the shop returned to the previous level.

Conclusions

The case cited in this article demonstrated that multiskilled work teams can increase productivity and decrease capital equipment needs and space requirements. In this application, as in many service operations, there is idle worker time; that is, in order to offer a reasonable service time, the servers (mechanics in this case) are not fully utilized but rather have periods during their working shift waiting for work. The same is true for the productive facilities. The reasonable level of service requires overcapacity to satisfy the higher demands for service, with the consequence of idle facilities during lower service demands.

Superimposed on this fluctuating workload for workers and facilities is the compounding effect caused by the needs for specific services. Even when the aggregate demands for service may vary only moderately, when stated, say in man-hour requirements, the demands for specific work specialties cause idleness for some workers and a backlog for others resulting in late completions.

The work team smoothes the marked fluctuation in demands for specialized service because of larger numbers of units available to the worker. This gives him greater capacity through reduced waiting time. (We know from basic production-line theory that the greater the number of units available to the worker to work on, the higher will be his utilization through permissible higher line speeds.)

The uneven demands for productive facilities are also smoothed when units requiring service are routed to a service area with a broader range of capabilities. The occasional high demands for one service are offset by simultaneous lower demands for others. Routing to an area containing several services (as in the team work approach) reduces the productive facilities needed. For the work teams in this case, five workers found six work bays adequate rather than the ten bays previously assigned as two per worker.

The work team was also a training ground for both new workers and older workers in broadening their skills. One of the potentially difficult areas for management to cope with is the social unit that is created with the work team. Service managers are more experienced in dealing with individual workers; managing a work group requires different skills.[7,8] Thus, managers must become familiar in these techniques.

From the experience gained in this study, it appears that multiskilled work groups could beneficially be used in a wide variety of areas, especially those with underutilized facilities and workers caused by varying demands on the system, such as in service type industries. Undoubtedly there are many applications in manufacturing job shops also, since the characteristics are similar.

The managerial implications of this study are that the work team concept could be very valuable, but that caution should be used because of the behavioral factors within the group and in managing the group.

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