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The Effects of a Shift-System Innovation on Turnover and Absenteeism: A Naturally Occuring Field Experiment

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ABSTRACT

The impact of a participatively designed 12-hour shift system on employee turnover and absenteeism was examined in a naturally occurring field experiment. Turnover at the experimental site dropped over 55 percent following implementation of a new shift while control plants showed no decline. Absenteeism was unaffected by the new shift.

THE EFFECTS OF A SHIFT-SYSTEM INNOVATION ON TURNOVER AND ABSENTEEISM: A NATURALLY OCCURRING FIELD EXPERIMENT

Shiftwork is receiving increased attention from practitioners and researchers in a number of fields, including management and organization (Dunham, 1977), psychology (Frese & Okonek, 1984; Staines & Pleck, 1984), ergonomics (Knauth et al, 1983), industrial and labor relations (Northrup, Wilson & Rose, 1979), and health and safety (Gould, 1989). It is estimated that 25 percent of the total workforce in the United States works on a shift system (Schacter, 1989; Zedeck, Jackson & Summers, 1981) and that this number can be expected to grow as automation and computerization spur further movement toward 24-hour facilities (Gould, 1989; Polakoff, 1989). Continuous operation facilities are widely used in capital-intensive industries where a greater return on investment can be achieved, and in a variety of service industries where 24-hour is vital or enhances customer service (Mellor, 1985).

Operating a 24-hour facility is inevitably problematic. Research has shown that employees generally respond less favorably to non-day and weekend work than regular day-work (Agervold, 1976; Dunham, 1977). In addition, 24-hour schedules present a set of unique scheduling problems. For example, staffing three 8-hour shifts for continuous operations requires a minimum of four employees to staff each position (Stafford, Sherman & McCollum, 1988). The logistical problems of staffing for continuous operations have typically been addressed by employing variations of a traditional 8-hour shift schedule. Recent research, however, indicates that this traditional shift system may not be the best system for all organizations and people (Dunham, 1977; Knauth et al., 1983). It is associated with a number of adverse effects on employees' health, sleep patterns, absenteeism, satisfaction, and family and social lives.

An increasingly popular alternative to an 8-hour schedule for continuous operations is a 12-hour work shift and its variations. The 12-hour shift system requires employees to work

more hours each day yet fewer days per week than a traditional 8-hour schedule. For example, people may work 4 consecutive days then have 4 consecutive days off. This reduction in work days affords employees more whole days for leisure and family activities. It also reduces the number of shift rotations from three to two each day, thus reducing the likelihood of coordination problems across shifts.

Although industrial usage of the 12-hour shift system has been increasing over the past two decades, current knowledge of its effects is incomplete. Most reports of 12-hour shifts have appeared in the popular literature and have included anecdotal evidence suggesting positive results, such as improved satisfaction and morale, and decreased fatigue and extra-work conflicts (Northrup et al., 1988; Verespej, 1990). These findings are limited mainly to individual reactions to work hours while neglecting organization-level results, such as productivity, turnover and absenteeism. The anecdotal data also do not permit strong causal inferences of the effects of 12-hour work schedules. Moreover, the few empirical studies of these systems tend to have similar methodological problems (Jamal, 1981; Stafford et al, 1988). They emphasize reactions to work schedules and report mainly correlational data.

This paper attempts to resolve those problems. It reviews the existing literature on shiftwork with special attention to 12-hour work schedules and presents data on a naturally occurring field experiment where an 8-hour shift system was replaced with a 12-hour plan. The study focuses on organization-level outcomes--turnover and absenteeism rates--and uses a quasi-experimental design that allows for reasonable causal inference of the effects of the 12-hour schedule.

LITERATURE REVIEW

There is a rich body of literature on shift systems and their effects. Researchers have studied the reactions of employees on different shifts (e.g., day vs. night shift workers) as well

as the results of different shift systems (e.g., 8-hour vs 12-hour shift schedules). Although this research has contributed to our understanding of shift work, it has two major limitations which impede knowledge in this area: (1) it focuses mainly on individual-level outcomes and neglects organization-level results and (2) it is primarily anecdotal or correlational, rendering weak causal inferences of the findings.

Outcome Findings

Research on shift and shift systems has shared a common concern for the potentially deleterious effects of work schedules on a number of individual-level variables including: general health (Angersbach et al., 1980; Frese & Okonek, 1984; Polakoff, 1990), physiological adaptation (Dunham, 1987), sleep patterns and circadian rhythms (Colquhoun, 1970; Gould, 1989), satisfaction (Zedeck, Jackson & Summers, 1983), absenteeism (Fitzgibbons & Moch, 1980; Price & Mueller, 1986), and family and social relations (Dunham, 1977; Staines & Pleck, 1984). This research has been aimed primarily at specifying relationships between shift or shift systems and individual-level responses as moderated by individual and contextual variables. It is proposed that organizational needs and constraints affect the selection of particular shift systems, and these in turn, differentially affect employee responses depending on certain individual and contextual contingencies.

Findings supporting various effects of shift system on individuals have varied in consistency. There is considerable agreement that people generally prefer day work over non-day work, although this finding may be moderated by the degree to which the local community is oriented toward shift work (Dunham, 1977). Employee reactions to shift work may also vary depending on job satisfaction, satisfaction with the effects of job on personal life, and perceptions of the work environment (Zedeck et al., 1983). There is also general agreement on the influence of shiftwork on social and family life. Shift workers (in contrast to day workers)

tend to spend less time in family roles and experience higher levels of family conflict, such as sexual problems, divorce, and difficulties in performing the parental role (Dunham, 1977; Staines & Pleck, 1984). Relationships between shiftwork and health problems are mixed. In comparing rotating and fixed shift schedules, some researchers have found that shift workers were more prone to mental and emotional problems than day workers (Taylor, 1967; Jamal, 1981); others have found the opposite effect (Mott, Mann, McLaughlin & Warwick, 1965); while still others have discovered no significant relationship between fixed, rotating or day shifts and employee health (Aanonsen, 1964; Koller, Kundi & Cervinka, 1978). Similarly mixed results have been found for relationships between shiftwork and employee absenteeism (Fitzgibbons & Moch, 1980; Markham, Dansereau & Alutto, 1982; Latack & Foster, 1985; Price & Mueller, 1986).

Specific research on 12-hour shift schedules generally shows positive individual reactions to such systems. They have been found to be more attractive to most employees than 8-hour schedules (Northrup, Wilson, & Rose, 1979; Zedeck et al., 1983). Employees having direct experience with 12-hour systems rated them as less fatiguing, providing more regular sleeping patterns, allowing greater use of personal time off of work, and saving more on commuting time and cost than traditional 8-hour systems (Breaugh, 1983). A Survey of 50 firms that had adopted 12-hour schedules found only one instance in which a plant reverted to its previous schedule (Northrup et al., 1979). A comparative study of different shift systems suggested, however, that the positive effects of 12-hour schedules are limited to work situations where mental and physical demands are light to moderate (Knauth et al., 1983).

Review of the literature suggests that research on the effects of shift and shift systems has concentrated almost entirely on individual-level variables, with the exception of a few studies that have included absenteeism measures. Comparatively little research has investigated the relationships between shift systems and organization-level outcomes, such as productivity,

and rates of turnover and absenteeism. This review of the literature, for example, could not find a single study examining actual turnover rates associated with alternative shift systems. Yet, the popular literature strongly proposes that innovative shift systems such as 12-hour shifts can significantly improve organization-level variables including productivity, accidents, absenteeism, and turnover (Northrup et al., 1979; Stafford, Sherman & McCollum, 1988; Verespej, 1990).

Causal Validity of Findings

The literature on shift and shift systems is heavily oriented to anecdotal and correlational data. This makes it difficult to draw strong inferences about the causal role of shift and shift system in producing the outcomes described above. Most of the popular literature includes post-hoc testimonials about the positive consequences of shift system innovations such as a 12-hour schedule. Although this information can help practitioners to consider alternative shift systems, it can be misleading concerning the actual outcomes of those innovations. The empirical literature is dominated by correlational findings. Researchers have tended to categorize employees by shift or shift system (e.g., night vs day; fixed vs rotational), and then to assess for outcome differences across those categories. Although these studies have identified a number of possible shift effects, it is open to question whether those results were caused by shift schedules or other uncontrolled variables. The few quasi-experimental field studies that have recently appeared in the literature have focused mainly on individual-level outcomes (Peacock, Glube, Miller & Clune, 1983; Dunham, Pierce & Castenada, 1987). The findings of the one field experiment that included organization-level variables were difficult to interpret because changes in shift schedules were accompanied by extensive job redesign (Latack & Foster, 1985).

The literature review shows a clear need for research on the causal effects of shift system on organization-level outcomes. As mentioned earlier, this paper presents a naturally-occurring field experiment that examines the influence on turnover and absenteeism rates of a change from an 8-hour shift system to a 12-hour plan in a continuous-operations facility. The study employs organization-level measures of turnover and absenteeism, and includes time series data from both experimental and control sites.

METHODS

Research Site

The research reported here was conducted as part of a larger, on-going action research project being conducted during the start-up and early operation of a new flat glass plant in the western United States. The plant was part of a larger company that operated other flat glass plants and distribution centers mainly in the eastern United States. The new, continuous-operation facility was designed as a high-involvement organization with the continuous-operation facility was designed as a high-involvement organization with the following features: work was organized around self-regulating teams composed of multi-skilled members having the skills, information, and autonomy to control their own task activities without high levels of external supervision; selection practices included realistic job previews and a pre-employment assessment program designed to capture characteristics of work in a high-involvement, flat glass factory; reward systems included both a skill-based pay system intended to reward people for learning multiple skills and a plant-wide gainsharing program that rewarded employees for measurable gains in plant performance; the plant promoted an egalitarian culture with few artificial status differences among members and open sharing of economic and task-relevant information; social and technical training were extensive and on-going.

Top management's decision to design the plant as a high-involvement organization derived mainly from the plants continuous-flow technology. Relatively high levels of task interdependence and task uncertainty made it imperative that employees work as teams and control technical variances as quickly and as close to their source as possible. Corporate executives were also committed to getting employees more involved in running the plants, and the new plant afforded an opportunity to break the traditional mold and try out more participative organizing methods. Two authors of this paper worked with management and employees to design and implement high-involvement features.

In addition to unexpected technical difficulties, one of the major problems that the new plant faced after start-up was an unusually high voluntary turnover rate of about 20 percent. Preliminary diagnosis suggested that this problem was caused primarily by the workforce unfamiliarity with shiftwork. The plant was located in a semi-rural community that had few industrial plants and limited experience with continuous-operation facilities. Like other plants in the company, the new facility operated a traditional 8-hour, 3 shift rotational system. It was initially hoped that workers would adjust to the system after a breaking-in period. However, turnover did not decline and fourteen months after the plant opened in late 1987, the annual turnover rate was slightly less than 20 percent--considerably higher than local, organization and industry norms. This high turnover rate was seen as particularly costly because of the new plants heavy investment in employee selection and training and the need for relatively stable membership to foster team identity and commitment.

The Shift System Intervention

An employee retention task force composed of supervisors and employees from the different areas of the plant was assembled to address the turnover problem. With the help of a facilitator from corporate headquarters, the task force conducted an initial diagnosis to uncover

the causes of the high turnover rate. Based on interviews with selected employees, the task force concluded that the major factor in producing the high rate of turnover was the existing shift system. It led to high levels of fatigue in the later days of the shift cycle, coordination problems because of three changes each day, and disruption of personal time off of work.

As a result of its analysis, the task force recommended a more intense study of alternate shift systems. Variations on a 12-hour shift, involving a trade-off between longer work hours and larger blocks of off-time, were discussed as promising options. The plant manager agreed to sanction the study under several conditions: (1) that at least 80 percent of the plant employees were willing to support the study, (2) that the alternative shifts investigated would not involve a substantial increase in total labor costs, and (3) that the plant members would have to be re-polled prior to implementing any new shift and the same 80 percent acceptance requirement would be employed.

Employees were informed of the task force's interest in investigating alternate shifts as a means of reducing turnover, and asked if they would support such a study. They were also told that they would have an opportunity to vote on any recommendations that the task force might make. A formal poll indicated over 80 percent of the employees were in favor of conducting the study.

The task force then conducted a review of the literature on alternative shift systems and visited several companies that had adopted twelve-hour shifts. Members felt that the twelve-hour shift system would address many of the problems with the current 8-hour plan: because the shifts are shorter-4 days on/4 days off, 4 nights on/4 days off-fatigue would be reduced in the latter days of a shift; reducing the number of shift changes from three to two per days would improve shift coordination; and, the schedule would allow for longer blocks of off-time including a larger number of weekends.

The initial results of the study were reported back to all plant employees and an implementation feasibility study was conducted. During this period, intensive meetings were held with plant administrative and staff personnel to determine potential procedural problems. After the financial and administrative feasibility of the 12-hour shift was established, plant employees received a detailed presentation of the recommended 12-hour shift system. Eighty-six percent of the employees were in favor of the system and it was implemented on October 1, 1989, five months after the task force was initially formed.

Sample

During the two-year study period (1989-1990), the experimental plant varied in size from 215-235 employees, with a mean size of 225. The plant was not unionized and experienced no layoffs. Seventy-six percent of the workers were male, and the average age was approximately thirty-two.

Three other flat glass plants within the same company were used as a non-equivalent control group. The control plants were non-union, geographically dispersed, and had all been fully operational for a number of years prior to the opening of the new plant. They used technology similar to that at the experimental plant, but differed in their demographics. Approximately the same percentage of workers were male, but the average age was estimated at forty years. In addition, all of the control plants were larger than the experimental plant, with means sizes: Plant A: 306; Plant B: 350; and Plant C: 710 employees. Because the control and experimental plants were different from each other, it should be emphasized that the primary function of the control groups in this study was to rule out potential external causal explanations (e.g., changing employment trends and environmental conditions).

Measures

The initial measure for turnover was collected from company records kept at each plant. Because the plants did not distinguish between voluntary and involuntary turnover, interviews were conducted with the personnel managers at each of the plants to separate voluntary resignations from involuntary terminations. Voluntary turnover rates were calculated monthly as the percent of the total plant population that left during the month for voluntary reasons other than retirement.

Although absenteeism was not addressed by the task force, the possible effects of the shift system on absence behavior was of interest for the present study. A measure of absenteeism was taken directly from company records. All unscheduled absences, not including long term absences after the first four days, vacations, holidays or other scheduled leave, or absences of less than a full day, were included to calculate the absence rate (BNA, 1990). Absenteeism was calculated monthly as the number of worker-days lost due to absence divided by the average number of employees on the company payroll during the month times the number of work days during the month multiplied by 100. Although this measure may not distinguish well between certified and uncertified absences, it has been used by a number of researchers (Markham et al., 1982; Miner, 1977). In addition as Markham et al. (1982) noted, the use of an absence measure commonly used by organizations may enhance the practical value of research investigating absence rate as a dependent variable.

RESULTS

Baseline turnover data were collected from all plants for the nine months preceding the introduction of the twelve-hour shift at the experimental factory. Annualized turnover at the site, calculated from the nine month baseline period, was 19.6 percent. The comparison plants were markedly lower, with annualized turnover rates of approximately 3.1 percent for each plant. The experimental facility's absenteeism rate, annualized at 1.9 percent was comparable to

the rate at two of the comparison plants. Data on absenteeism was unavailable for the third plant, so it was not included in the absenteeism comparisons.

The turnover and absenteeism rates for the pre and post conditions are shown in Figure 1. A median test was used to analyze the significance of the changes from pre to post conditions. First, median tests were conducted on the turnover and absenteeism rates before and after the implementation of the 12-hour shift at the experimental plant. This procedure used the plant before the shift change as a control group for itself after the shift change. The median test yielded a chi-square statistic of 10.755 (df=1) for turnover (significant at $p<.005$). The direction of the result was as expected, turnover was significantly reduced following the change in shift. The chi-square for absenteeism was not significant at .398 (df=1), suggesting no decline in absenteeism following the implementation of the new shift system.

Insert Figure 1 about here

Separate median tests were then conducted on the turnover and absenteeism rates of each of the three control plants. Chi-square statistics from the median test (df=1) at each plant were: Plant A: .064 turnover, 3.646 absenteeism; Plant B: .175 turnover; Plant C: 2.291 turnover, 4.073 absenteeism. None of these values were significant except for the absenteeism rate at the plant C ($p<.050$), which actually increased slightly during the study period. Overall, there was no significant change in rate of turnover at the control plants.

DISCUSSION

The results of the study strongly suggest that the change from an eight-hour to a twelve-hour work schedule contributed to a significant decrease in turnover at the experimental site. Following the shift change the turnover rate dropped from 19.6 percent to 8.5 percent (a reduction of more than 55 percent). The magnitude of the reduction, combined with the lack of any decline in turnover at the control plants over the same time period, make a strong case for the positive effects of the shift schedule intervention. Furthermore, during the time period over which the data was collected, there were no other significant changes or forces that could plausibly account for the results.

Previous research has suggested that shift schedules positively influence organization and personal outcomes only to the extent that the schedules meet organizational needs and constraints and employee needs and preferences (Dunham et al., 1987). Consequently, the effects of a particular shift-system change need to be understood within the context of the needs, preferences and constraints salient to the situation studied.

Members at the experimental plant identified the existing eight-hour shift as causing a number of personal and organizational problems contributing to excessive turnover. Moreover, they lived in a community that was unaccustomed to shiftwork and that was not oriented to the lifestyles of the shiftworkers. Plant members participated in the design of a new 12-hour shift system aimed at better meeting their needs while satisfying certain organizational constraints. Members' votes favoring the new shift system both before implementation (86 percent) and several months after the change (94 percent) attest to the extent to which it satisfied their needs and preferences. Thus, in this situation, it can be expected that the shift system change would have the greater influence on turnover, the underlying problem that the change was intended to

resolve. Because absenteeism was not considered a problem at the experimental plant, it is not surprising that the shift innovation did not affect absenteeism rates.

The strong results of this study suggest that shift systems, more particularly 12-hour schedules, can significantly influence organizational-level outcomes, such as turnover. The magnitude of the positive findings, however, are probably atypical and limited to situations where existing shift systems are causing major organizational problems. Moreover, the findings may be applicable to sites where employees are involved in designing and implementing shift system changes. Both the popular and research literatures have argued for the need to involve employees in designing shift-schedule innovations (Latack & Foster, 1985; Stafford et al., 1988). This is purported to increase the likelihood that the changes will meet employee needs and preferences and enhance commitment to implementing the changes. It would be surprising if the participative change process in this study did not influence the strength of the positive results.

FUTURE RESEARCH DIRECTIONS

There is clearly a need for further research on the influence of shift systems on organizational-level outcomes, such as productivity, coordination costs, absenteeism, and turnover. The present study as well as existing research described above suggest the importance of accounting for both organizational needs and individual preferences in the selection of shift schedules. Management and employee involvement in the design of new shift systems can be a powerful method for meeting these needs and preferences.

Figure 2 presents a preliminary model for guiding future research along these lines. The model contrasts with current conceptions of shift system effects by changing emphasis away from individual responses to shift systems and the variables traditionally assumed to moderate those responses and placing greater emphasis on individual shift preferences and organization

outcomes. The model provides an explanation for the role of participation in shift-system change. It suggests that when employees are involved in shift changes, the variables that most researchers treat as moderators of individual responses directly influence individual preferences for shift schedules. Consequently, anticipated satisfaction with the new shift system, is a function of the degree to which it reflects employee preferences. Similarly, actual satisfaction after implementing the changes is related to anticipated satisfaction to the degree that employees are able to predict their responses to the new system. Finally, improvements in organization outcomes can be expected to result from the new system to the degree that it responds to the organizational problems caused by the old system.

At least three major assumptions underlie the relationships proposed in the model: (1) Employees can accurately identify those aspects of shift systems that they experience as noxious; (2) They can accurately predict their actual satisfaction with possible alternative shift systems; 3) Employee involvement in the design and implementation of new shift systems assures that their preferences will be accounted for by the new system. Although the present study suggests that these assumptions are realistic, considerably more research along the lines proposed here is needed to understand the organization effects of shift systems and the role of employee involvement in causing them.

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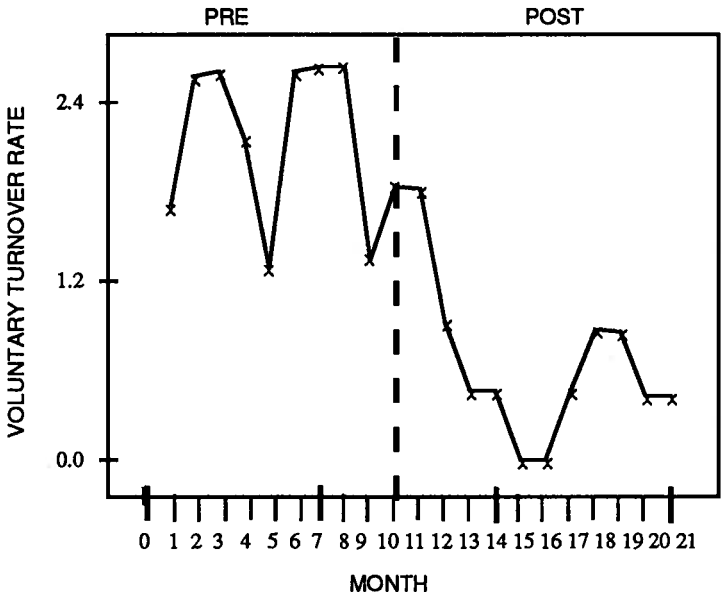
TURNOVER RATE AT THE EXPERIMENTAL PLANT



TURNOVER RATE AT THE CONTROL PLANTS

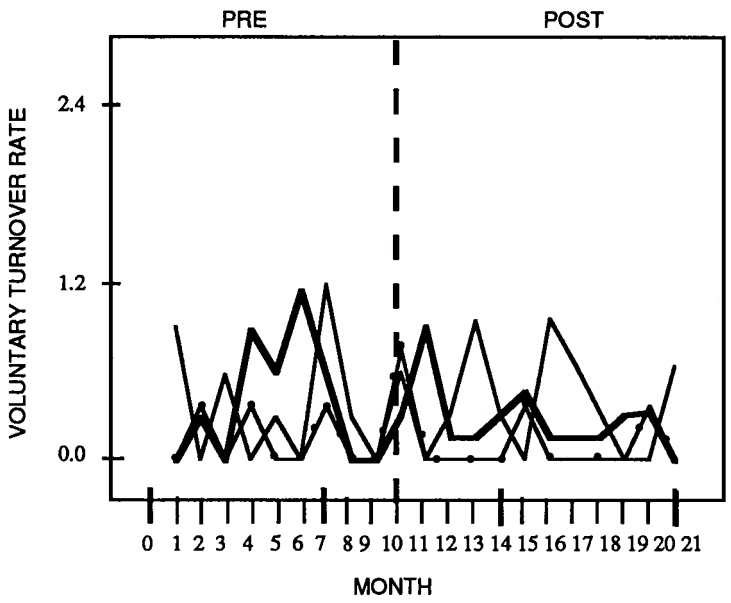
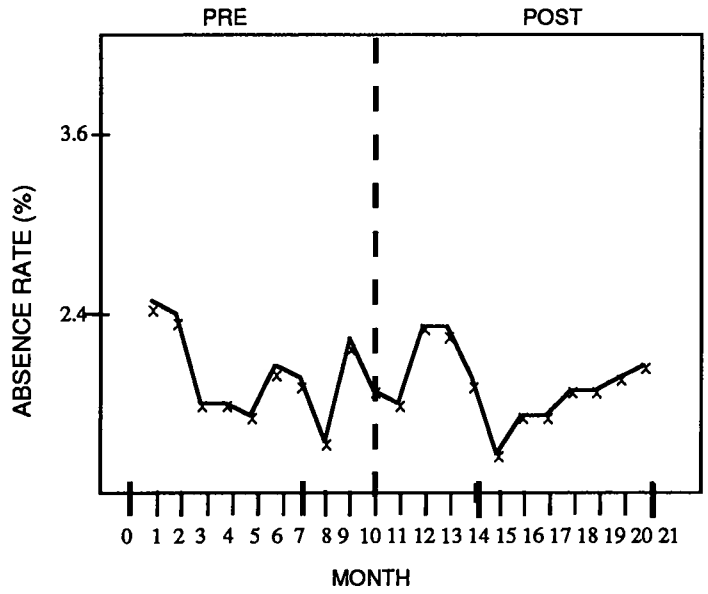


FIGURE 1

ABSENCE RATE AT THE EXPERIMENTAL PLANT



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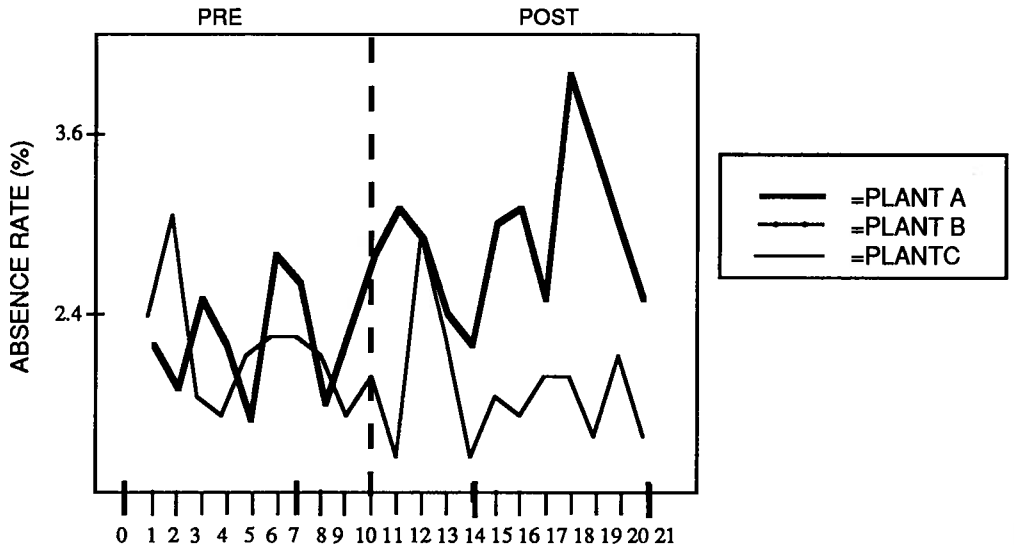
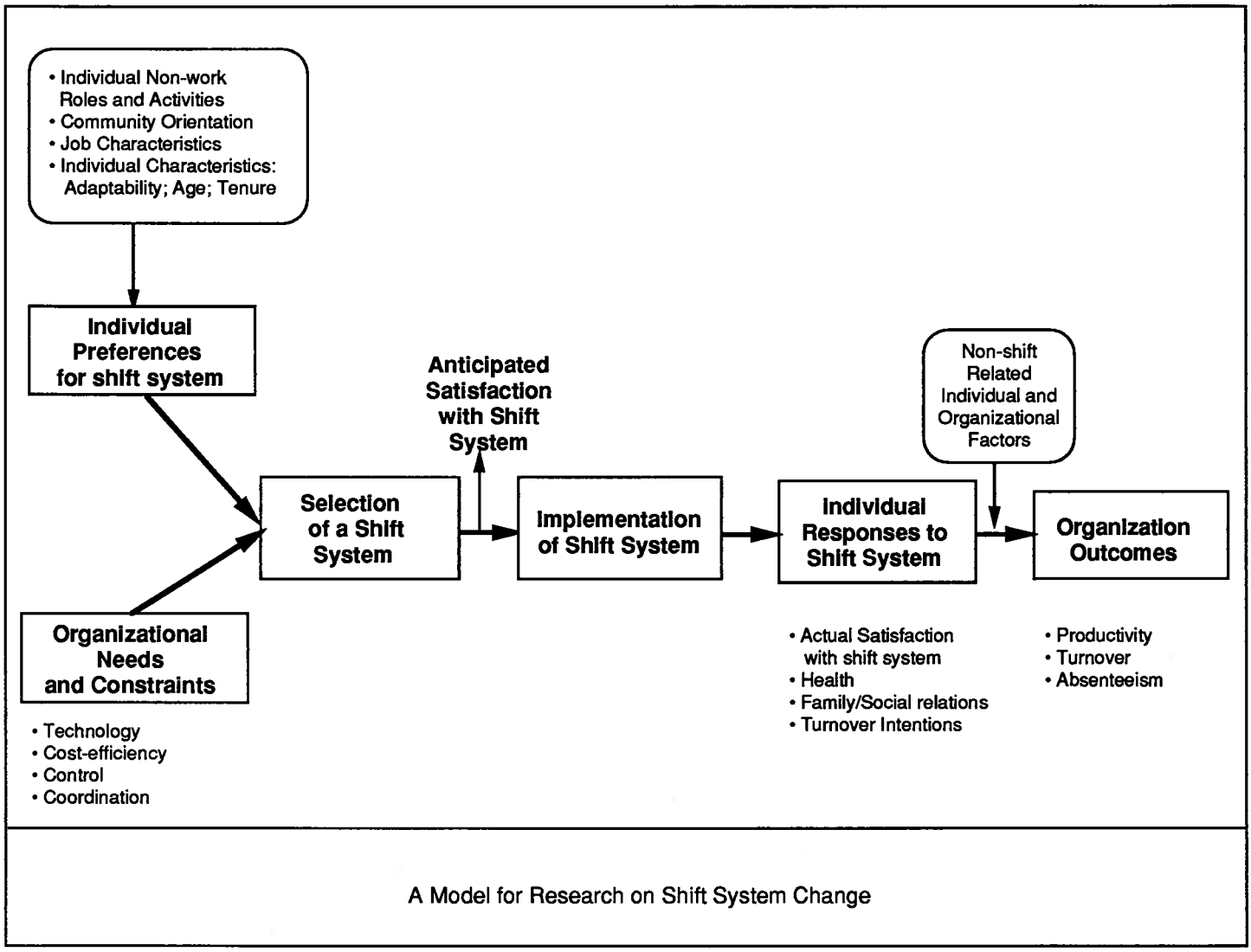


FIGURE 2



A Model for Research on Shift System Change