SHIFT WORK: MANAGEMENT TECHNIQUES

by

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B.S., Shanghai Institute of Technology (1949)

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TECHNOLOGY

August, 1974

Signature of Author .

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ABSTRACT

Taiwan has built the second strongest economy in Asia with the GNP increased by an average of 10.1% from 1964 through 1973. As the result from the steadily increasing production, the spread of shift work to industries in Taiwan, Republic of China has been occurred rapidly in the past decade.

The effective use of expensive, usually automated, equipment and the reduction in hours of work for more leisure and rest have been important reasons for introducing shift work. Unfortunately, insufficient attention has been paid to its effects, while decisions on shift work have been made primarily by work rules, customs, and the general legislation on hours of work.

After reviewing a series of studies on shift work, the purpose of this thesis is to evaluate mainly the rotation systems and various problems of shift work, and to develop practical applications for industries in Taiwan at present and for the future. Some frequent disputes on shift work are also described, and their effects on shift systems are discussed.

Thesis Supervisor: Charles A. Myers
Title: Sloan Fellows Professor of Management
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Chapter 1

INTRODUCTION

Millions of U.S. employees are working at night while the rest of the nation sleeps. A large proportion of U.S. labor force works actually during some span of time each day other than the usual hours from morning to evening. Shift workers maintain essential public services and keep things rolling in thousands of plants and offices.

The existence of shift work is a product of industrialization. Factory owners fully recognized that if they could keep their machinery going on a twenty-four hour basis, they could spread the cost of their investment over more units of production and thereby reduce their unit costs. Also, as equipment has become more expensive, there has always been increasingly heavier pressure to operate it around the clock. And finally, the trend toward a shorter weekday promotes the use of the shift system.

Most studies have been centered at the effects of shift work to the industrial organizations. Usually they have focused on the relationship between job hours and productivity, errors, absences and turnover. Only a few studies have focused on the effects of shift work on workers. Shift work does require individual workers to adjust physically, physiologically, socially, and psychologically. It affects the
totality of the worker's life and that of his family. International studies indicate that shift work will continue.

Chinese manufactures in Taiwan are expanding their search for markets overseas and thereby becoming much more cost-conscious. This focuses attention on the more intensive use of existing plants and equipment as a means of reducing unit costs and increasing output without a proportionate increase in fixed capital.

Shift work has become increasingly desirable from the point of view of both the individual firm and the national economy. More shift work will be needed if Taiwan is to succeed effectively in its international markets and thereby continue to enjoy a raising standard of living.
Chapter 2

REASONS FOR HAVING SHIFT WORK

After the Second World War, the need for Shift Workers has been growing among industrial and developing countries, both in services and in industry. The national defense requires constant operations of communication facilities, security and warning systems, missile bases, and the like. In industry, particularly the atomic, chemical, metallurgical, and oil industries, modern technology indicates the same necessity for round-the-clock, seven days a week operation. And recently, those offices equipped with computers and other facilities for high technology or expensive investments need shift work, too.

Firms have introduced shift systems for a variety of technical, service, economic, and social reasons, differing in both nature and importance according to each firm's circumstances. The major reasons brought out by firms included the need to make greater use of machinery to reduce overtime, to attract labor, and to meet the requirement of special processes. At the same time, most firms have hoped to achieve a reduction in unit costs.

Shift work has been introduced in firms mostly because of the installation of expensive new machinery. It enables the management to reach much higher production, and conse-
quently a higher rate of return on capital invested. This is particularly important where techniques and methods in the industry are subject to rapid change. Shift working systems have been introduced in some firms to get maximum output from a new plant before it became out-dated.

Some firms considered the need to raise output with existing machinery as one of the reasons for having shift work, and it has been thought that shift work could be the simplest way to achieve this where sufficient labor is available. Some few firms have tried to introduce a shift system to meet a sudden increase in demand.

Finally, some firms have had shift work to deal with the special demands of manufacturing processes. They are operating automatic machinery which was costly, inconvenient, or time wasting to close-down and restart. For example, a heat treatment plant is uneconomic to cool and reheat frequently.

It is not merely in the newly automated firms that shift work is found. The continuous process plants for making steel, producing pulp and paper, refining oil, and manufacturing synthetic fibers have long had to operate their plants round-the-clock. Neither is shift work restricted only to the factory; the installation of high-cost computers or large-scale electronic data processing equipment in the office has meant the introduction of multiple-shift operations for white-collar office workers, too.
And lastly, transportation, communications, and public utilities must clearly be kept going on a twenty-four hour basis. Thus, reasons for shift work may be classified as following:

1. Technical or Process Necessity — In continuous-flow plants like steel, oil, chemical, glass, plastics, paper-making, man-made fibers and atomic industries, it is costly and inconvenient to close-down and restart. And it is uneconomic to cool and reheat frequently in heat-treatment and metallurgical industries. Above all, in our textile industry, filling-bars and other imperfections in the fabric could be reduced to minimum by continuous operations.

2. Service or Market Necessity — Like nurses in hospitals, firemen in the fire-department, policemen and mill guards, taxi-drivers, and the like.


4. Economic Use of Expensive Equipment like Computers and Textile Machineries — Must fully utilize plant and equipment where the rate of obsolescence of equipment is rapid.

5. Transportation and Communication Requirements — Like railway signal-men and telephone exchange operators.

6. Reduction of Hours of Work — Reduction in excessive
hours of work due to the overtime in weekdays and over week-ends.

7. Production Demand of War Time -- The immediate demand brought by the World War could only be met by the full use of plant capacity and by the introduction of shift work.

8. Attraction of Labor -- To tap an additional source of labor by providing part-time or double-day shifts to attract women workers who are not available for normal day working.

Past experience has illustrated the advantages and disadvantages of shift work. The advantage to the company is that it provides a means of satisfying workers' demands for shorter hours while at the same time it increases output and reducing fixed costs for the firm. The main disadvantages affecting to the workers, particularly those on night shifts, are in the form of disrupted family and social life and a marked susceptibility to nervous and digestive disorders.

Yet, should we have two plants instead of two shifts just to eliminate said disadvantages of shift work? The answer can easily be self-explained if we compare two shifts versus two plants. Supposing various plants are technically identical, the total output from two single-shift plants equals to the products of the double-shift plant, and depreciation charges for machines be the same, then the double-shift plant
will have lower capital stocks, interest charges, building maintenance cost, and overhead expenses, even though it bears higher transportation expenses and higher wages to compensate for inconvenience in shift work.

Still so many enterprises today use their fixed capital merely one quarter of the time. Such underuse of plant and equipment represents a large loss, economically and socially, particularly at a time when the rate of obsolescence of machinery is high and/or rapid.

Shift work may make it possible for workers to have their leisure time and living standard increased to a certain extent. Finally, if through the use of shifts, the physical output of industry increases faster than the money outlays accompanying it, the prices of the products made may then be lowered.
Chapter 3
SHIFT SYSTEMS

Shift systems can be classified in different ways, namely, continuous vs. non-continuous or semi-continuous systems, rotating vs. fixed or permanent systems, rapid change vs. weekly or monthly rotation systems, full-time vs. part-time work, even day vs. non-day work. No matter how we classify them, the commonly used systems are described briefly as follows:

1. **Seven Days Continuous Shift System** -- Company operates continuously without interruption 24 hours daily for seven days per week by consecutive teams of operators. Usually there are 8 hours in each shift, 3 shifts a day with 3 or 4 crews to complete the round-the-clock operations. Normally 6 a.m. - 2 p.m. or 7 a.m. - 3 p.m. for morning shift, 2 p.m. - 10 p.m. or 3 p.m. - 11 p.m. for afternoon shift, 10 p.m. - 6 a.m. or 11 p.m. - 7 a.m. for night shift and 8 a.m. - 4 p.m. or 9 a.m. - 5 p.m. for day shift. When there were 12 hour shifts in old days, only 2 crews or shifts were employed to complete the round-the-clock operations. On the other hand, if it is 6 hour shifts in future, then there must be 4 shifts with 4 or 5 crews to complete the 24 hour operations.

2. **Frequent Alternation or Swiftly Rotating Shift System** --
More frequent shift rotation than 7 days continuous shift cycle. Shift rotation always occurred after two consecutive shifts. Considering a week as three blocks from Monday through Saturday or Sunday, at the end of each block, change shifts forwards, giving a break of full twenty-four hours between mornings and afternoons, and between afternoons and nights. There is a 2 or 3 day rest period, following the night shift block. The rotating cycle is to be completed in 4 weeks for 2-2-3 system or "Continental" rota and in 8 weeks for 2-2-2 system or "Metropolitan" rota.

3. **Non-Continuous or Semi-Continuous 3 Shifts System** -- Company operates 24 hours a day for 5-6 days a week with Saturdays and/or Sundays completely or partially off. Only 3 crews are needed to complete the round-the-clock operations. Usually 8 hours in each shift with a few $8\frac{1}{2}$ hours in morning and afternoon shifts and 9-10 hours for night shifts.

4. **Alternating 2-Shifts System** -- Working of alternate teams of workers on two shifts, either on morning (6 a.m. - 2 p.m.) and afternoon (2 p.m. - 10 p.m.) shifts or on day (8 a.m. - 4 p.m.) and night (4 p.m. - midnight) shifts. Two shifts alternating, usually working 4-6 consecutive shifts before change, with weekends off. 2 crews each working 8-12 hours a day.
Since the adjustments of sleeping time and eating habit at the beginning and end of the weekend are not easy matters, nobody likes the alternate day and night shifts.

5. **Double Day Shifts System** -- Company operates 2 shifts a day, normally 6 a.m. - 2 p.m. for morning shift and 2 p.m. - 10 p.m. for afternoon shift. Usually with weekends off and alternates weekly, bi-weekly, or monthly. Women workers often being out at the times of the day when their husband and children need them the most.

6. **Fixed or Permanent Night Shift System** -- Permanently working at nights to allow for adaptation of diurnal rhythms, shift time varying but all finished after midnight. Employee works 8-12 hours a night, 4-6 nights a week, mostly with weekends off. This has been more widely used in industry where male labor predominates, particularly the engineering and vehicle-making industries.

7. **Twilight Shift** -- Majority covering 4 hours a day between 5 p.m. and 10 p.m. from Monday to Friday. Attractive to women who are unable to work during the day for domestic reasons.

8. **Dawn Shift** -- Working in daybreaks from 2-6 or 4-8 o'clock in the mornings.

9. **Split Shifts** --
   
   (A) 4 hours Victory Shift System -- Working only 4 hours
per shift, time most suitable to housewives, providing sound resources of workers.

(B) With 4 hours break to split 8 hours work into 2 working periods. Most cases worked only by people on a voluntary basis. Very unpopular.

10. **Seasonal Variations** -- Varied in rotas to meet customer demand.

It is important to analyze the pros and cons of various shift systems before conclusions can be drawn on the evaluation of rotation systems. But to avoid duplication on the disadvantages of shift systems, which will be described in Chapter 5, Human Problems of Shift Operations, their cons will not be mentioned here in this chapter. Rather, the reasons for preferences are listed as follows:

1. **Day Shift** -- Day shift has always been preferred because it leaves workers free to do what they like in the evenings. Among them, the opportunities for recreation, amusement, home and social life must be mentioned particularly. It is the only shift that permits normal living patterns, and consequently it is the most popular. Undoubtedly, the day crew has the most satisfactory health schedule as well as the most complete and technical service. Last but not the least, high-potential and efficient employees have a much better chance for promotion on the day shift than on any other shifts.
2. Double Day Shifts -- Double day shifts are more likely to be popular with married women than with the single ones. Its advantages are as follows:

A. Less burden of housework than when they are working day shifts.
B. Providing longer break at weekend in alternate weeks.
C. Having greater opportunities for family life.
D. Could have husband cooperate in the care of children by working on the opposite shift from his shift.
E. Could have husband assist with shopping, cleaning, and preparing meals while she is out working.
F. Allowing husband more time for himself in gardening, decorating house and washing car.

3. Fixed Shifts -- Benefits resulted from fixed shifts are:

A. Performance improved as the men became familiar with the variations in work load peculiar to their shifts.
B. Workers became accustomed to eat at the same time every day.
C. Workers no longer have to worry about the exact days and hours they are scheduled to work.
D. Manpower shortage can be eased since the fourth shift crew could be abandoned.
E. It gives stability to the labor force.
F. It simplifies the administrative arrangements.
G. Employees prefer fixed shifts.
H. Women are protected from working late at night.

4. Night Shift -- Men who work on a permanent night shift are more likely to have a favorable attitude toward their job hours than rotating shift workers. Some people are naturally inclined toward night work. They reach the peak of their energies after the sun sets. Some have reason, other than physiological for liking night work. Among those are:

A. Feeling pleasanter at night than by day.
   a. Reduced amount of supervision and less interruption from technical staff.
   b. Fewer external disturbances from clerical staff, less formality.
   c. Less worry about urgent jobs, less pressure.
   d. Better team spirit.
   e. Suitable to lonely person's solitary habit.

B. Prefering daytime leisure in fishing, gardening, boating, hunting, and the like.

C. Free time during every day -- could help with children and housework while at home in the day.

D. Providing easier travelling time.

E. Having less difficulty in attending social events
and meeting friends.

F. Receiving higher rate of pay at night -- can earn enough money to support family for better living.

5. Rotating Shifts, especially Swiftly Rotating Shifts -- If continuous working is necessary, the Swiftly Rotating Systems are greatly preferred to the weekly rotating system. Advantages of these rapid change shift systems are as follows:

A. Having more time-off, providing more time for rest.

B. Providing varied time off, giving every sort of free time every week for banking, shopping, and the like. People like variety.

C. Allowing more time for leisure and hobbies.

D. Providing longer time, 24 hours break between shifts, for adequate rest.

E. Allowing ample time for recovery from fatigue resulted from arduous shifts, especially night shifts.

F. Breaking the week up and feeling fitter and fresher after 24-48 hour breaks.

G. Having opportunity to go out every week and enjoy more frequent, if shorter, time off from work.

H. Providing possibilities to enjoy some recreation at the normal times every week.

I. Permitting shorter day duties to compensate previous night shifts.
J. Allowing less scope for overtime as compared with discontinuous work.

Management found it easier to keep in touch with shift workers on the swiftly rotating systems, and supervisors found it much easier to maintain more frequent contacts with shop stewards, too.

For management, the rotating shift is not only the most efficient method to achieve production, but also can prevent employees from holding two jobs at same time.

Shift work has been more acceptable to married men with children under school age, especially with only one child aged 1 to 5 years old.

Many persons appreciate the obvious compensations they can get from winter daylight for gardening, or empty beaches and less traffic in summer. People can select shift work to fit their individual needs.
Chapter 4

SHIFT ROTATION AND SCHEDULING

Shift rotation imposes physiological problems for all workers every time the shift is changed and may lead to a general decrease in efficiency and production. Management must improve its technique in shift scheduling to secure the highest possible degree of workers' alertness.

In planning the rotation cycle, close attention must be paid to the social implication of shift work, or else there will be insufficient workers willing to work on shifts. Arrangement on shift cycles should be made to reduce the social and domestic inconveniences of shift work and to minimize any physical effects, particularly on workers at nights.

Forward shift change usually causes 8-hours lost in rotation timing. Backward rotation may be adapted to avoid this loss, but restarting just 8 hours after the worker has finished leaves an inadequate break for travelling and rest.

On arranging the break on continuous shift work, consideration ought to be given to the provision of adequate rest and recreation at normal times among other factors.

A week has been regarded as too short a period for the adaptation to the changed routine. Some people like a monthly change-over of shift for better adjustment, they might choose to work bi-weekly shifts as well.
The biological rhythms of the human body are accustomed to the day-activity and night-rest pattern. It takes time to adjust to a different schedule so that the longer a man is on night shift, the more adjusted his system should be. A monthly rotation cycle has been considered the best system for health because worker gets adjusted and steady. Yet social and domestic life do not agree and most people object to the isolation for an extended period.

Thus where continuous 3-shift working is needed, the speed of rotation of the shift cycle is an important factor in the acceptibility of shift working. It has been suggested that swiftly rotating systems are preferable to weekly rotation where a fortnight or a monthly alternation is not acceptable because they fit continuous shift workers best in physiological as well as social ways.

After some study, management should be able to design and arrange shift work schedules that will insure maximum efficiency and a minimum of personal hardships.

Successful continuous shift systems used world-wide are illustrated as follows: (All working only 5 days a week)

1. Swiftly Rotating Systems:

   A. 2-2-3 or Continental Rota System

<table>
<thead>
<tr>
<th>Shift</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>MTWTFSS</td>
<td>MTWTFSS</td>
<td>MTWTFSS</td>
<td>MTWTFSS</td>
</tr>
<tr>
<td>M: 6a.m.-2p.m.</td>
<td>AABBCC</td>
<td>DDAABBB</td>
<td>CCDDAAA</td>
<td>BBCCDDD</td>
</tr>
<tr>
<td>A: 2p.m.-10p.m.</td>
<td>DDAABBB</td>
<td>CCDDAAA</td>
<td>BBCCDDD</td>
<td>AABBCCC</td>
</tr>
<tr>
<td>N: 10p.m.-6a.m.</td>
<td>CCDDAAA</td>
<td>BBCCDDD</td>
<td>AABBCCC</td>
<td>DDAABBB</td>
</tr>
<tr>
<td>Rest Day</td>
<td>BBCCDDD</td>
<td>AABBCCC</td>
<td>DDAABBB</td>
<td>CCDDAAA</td>
</tr>
</tbody>
</table>
Note: On preceding chart, A, B, C, D = 4 crews.

Example of Work, break and rest for one man or one crew.

<table>
<thead>
<tr>
<th>Shifts</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>F</th>
<th>S</th>
<th>S</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>F</th>
<th>S</th>
<th>S</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>F</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>WW 0</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Afternoon</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
<td>WW 0</td>
<td>0</td>
<td>WWW</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>0</td>
<td>0</td>
<td>WWW</td>
<td>RR</td>
<td>0</td>
<td>0</td>
<td>WW</td>
<td>RR</td>
<td>0</td>
<td>0</td>
<td>WW</td>
<td>RR</td>
<td>0</td>
<td>0</td>
<td>WW</td>
<td>RR</td>
<td>0</td>
</tr>
</tbody>
</table>

Week 1  Week 2  Week 3  Week 4

Note: W = Working Shift
0 = Shift Change with 24 Hour Break
R = Rest Days

(Chart 1)

The 2-2-3 System works on the basis of a three-block week, the blocks being in this case: Monday and Tuesday, Wednesday and Thursday, and Friday, Saturday and Sunday. Shift workers move forward one shift at the end of each block, which gives a break of 24 hours at the changes from mornings to afternoons, and from afternoons to nights. A longer break of rest days, of 48 hours twice, and 72 hours once in a monthly cycle, follows the night shift block. At the end of the 28 day cycle, employees have worked 21 shifts and had 7 rest days, giving an average of 42 hours work a week.

B. 2-2-2 or Metropolitan Rota System

<table>
<thead>
<tr>
<th>Shifts</th>
<th>SMTWTF</th>
<th>SMTWTF</th>
<th>SMTWTF</th>
<th>SMTWTF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>DAABBBC</td>
<td>DDAABBC</td>
<td>CDDAABB</td>
<td>CCDDAAB</td>
</tr>
<tr>
<td>Afternoon</td>
<td>CDDAABB</td>
<td>CDDAAB</td>
<td>BCCDAA</td>
<td>BBCCDDA</td>
</tr>
<tr>
<td>Night</td>
<td>BCCDAAA</td>
<td>BBCCDDA</td>
<td>ABBCCDD</td>
<td>AABBCCD</td>
</tr>
<tr>
<td>Rest Day</td>
<td>ABBCCDD</td>
<td>AABBCCD</td>
<td>DAAABBC</td>
<td>DDAABBC</td>
</tr>
</tbody>
</table>

Week 1  Week 2  Week 3  Week 4

(cont.)
<table>
<thead>
<tr>
<th>Shifts</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>BCCDDAA</td>
<td>BBCCDDA</td>
<td>ABBCCDD</td>
<td>AABBCCD</td>
</tr>
<tr>
<td>Afternoon</td>
<td>ABBCCDD</td>
<td>AABBCCD</td>
<td>DAABBCC</td>
<td>DDAABBC</td>
</tr>
<tr>
<td>Night</td>
<td>DAABBCC</td>
<td>DDAABBC</td>
<td>CDAAABB</td>
<td>CDDAAB</td>
</tr>
<tr>
<td>Rest Day</td>
<td>CDDAABB</td>
<td>CCDDAAB</td>
<td>BCCDDAA</td>
<td>BBCCDDA</td>
</tr>
</tbody>
</table>

Week 5  Week 6  Week 7  Week 8

(Chart 2)

The 2-2-2 System, a variant of the 2-2-3 System, is based on regular two-day blocks. It takes 8 weeks to complete the whole cycle, and return to the starting morning shift on a Monday. Completely free weekends (Saturday and Sunday) only occur once in 8 weeks, compared with once in 4 weeks in the Continental Rota. Besides, the long weekend of 3 rest days does not occur.

2. 4 Crews - 3 Shifts - 5 Days Working System

A. Rotating Shift Schedule:

<table>
<thead>
<tr>
<th>Shift</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>AAAAABB</td>
<td>BBBCCCC</td>
<td>CDDDDDA</td>
</tr>
<tr>
<td>Afternoon</td>
<td>CDDDDDD</td>
<td>AAAAABB</td>
<td>BBBCCCC</td>
</tr>
<tr>
<td>Night</td>
<td>BBBCCCC</td>
<td>CDDDDDA</td>
<td>AAAABBB</td>
</tr>
<tr>
<td>Rest Day</td>
<td>DDCBBAA</td>
<td>DCCBBAD</td>
<td>DCCBAAD</td>
</tr>
</tbody>
</table>

A, B, C, D indicate 4 crews or teams of shift workers, 20 days cycle, 2 days off weekend occurs only once in every 20 weeks or 140 days.

Rotation pattern: 5 morning shifts followed by 2 days off; 5 afternoon shifts followed by one day off, 5 night shifts followed by two days off.

(Chart 3)
This could be arranged as a 21-day cycle by having 3 crews working 5 days a week for 2 weeks and 6 days for the 3rd week while the fourth crew still works 5 days a week for those 3 weeks. This system is acceptable to the Orientals as they compare it with the existing 6 working shifts a week.

B. Fixed Shift Schedules

<table>
<thead>
<tr>
<th>Shift</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
<th>SMTWTFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>DAAAAAA</td>
<td>DDAAAAA</td>
<td>DAAAAAD</td>
</tr>
<tr>
<td>Afternoon</td>
<td>BBDBBBB</td>
<td>BBDBBBB</td>
<td>BBDBBBB</td>
</tr>
<tr>
<td>Night</td>
<td>CCCCCDC</td>
<td>CCCCCDC</td>
<td>CCCCCDC</td>
</tr>
<tr>
<td>Rest Day</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Chart 4)

A, B, C indicate each of the 3 fixed-shift crews while D indicates the rotating break-shift crew. The employee works only one of the shifts: either mornings, or afternoons, or nights and usually 8 hours of work a day. The fourth crew must be a variation of rotating pattern called the "break" shift.

Three-shift crews have no complaints about working a 6-day week in every 3 weeks as compared with break-shift crew merely working 5 days in every week because they don't have to change shifts so often in the cycle.

Under the 4-crews -- 3 shift system, workers are entitled in principle to an average of one rest day in every four days. It has the great advantage of providing each crew with less night work and more days off than under the existing 6 working-day shift system in developing countries. So it has gained ground in industries where continuous operation
is needed.

3. Relief-Operator System

Continuous production around-the-clock, seven days a week can also be effectively maintained by the relief-operators system, i.e., by three crews with the aid of relief operators. Regular crews are working five (or six) days each week on a schedule fixed as to days. The relief operators are filling in for each worker during the two days remaining in the seven-day week and substituting for every work in the crew during the week. Since all the assignments are fixed, each person can work the same days every week. But, it is a draw back for those who have to work on Saturdays and Sundays.

40 Hour Week, 5 Workers Crew and 2 Relief Operators

<table>
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<th>W</th>
<th>T</th>
<th>F</th>
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<tr>
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<th>d</th>
<th>c</th>
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<td>d</td>
<td>c</td>
<td>b</td>
<td>a</td>
<td>r</td>
</tr>
</tbody>
</table>

Each letter represents one worker \((r_1, r_2)\) -- relief operators). The whole chart represents one crews.

(Chart 5)
The following 7-day Continuous Shift system used in different countries is also considered not difficult to manage.

Abbreviations: M = Mornings (usually 6 a.m.-2 p.m. or 7 a.m.-3 p.m.)
A = Afternoons (usually 2 p.m.-10 p.m. or 3 p.m.-11 p.m.)
N = Nights (usually 10 p.m.-6 a.m. or 11 p.m.-7 a.m.)
D = Days (usually 8 a.m.-4 p.m. or 5 p.m. or 9 a.m.-5 p.m.)

1. (A) 7 mornings, 2 off; 7 afternoons, 2 off;
7 nights, 3 off.
(B) 7 mornings, 2 off; 7 nights, 3 off;
7 afternoons, 2 off.

Length of cycle -- 4 weeks
M M M M M M M
Average Workweek -- 42 hours
- - A A A A A A
1 Sat. and 1 Sun off in cycle
A A - - N N N N
¾ of total no. of days off in cycle
N N N N - - -

Criticism: 7 consecutive shifts still demands so much from workers.

2. 6 mornings, 2 off; 5 afternoons, 2 off;
6 nights, 2 off.

Length of cycle -- 24 weeks
M M M M M M M -
Average Workweek -- 42 hours
- - A A A A A A
6 Sats. and 6 Suns. off in cycle
- - N N N N N N
¾ of total no. of days off in cycle
N - - M M M M M

Criticism: 24 weeks cycle is too long.

3. 5 mornings, 2 off; 5 afternoons, 2 off;
5 nights, 1 off.
4. 4 mornings, 2 off; 4 nights, 2 off; 
4 afternoons, 2 off. 
Length of Cycle -- 12 weeks 
Average Workweek -- 37½ hours 
4 Sats. and 4 Suns. off in cycle 
1/3 of total no. of days off in cycle 
Criticism: Much demand from management yet.

5. 3 mornings, 1 off; 3 afternoons, 3 nights, 2 off. 
Length of cycle -- 12 weeks 
Average Workweek -- 42 hours 
3 Sats. and 3 Suns. off in cycle 
1/3 of total no. of days off in cycle 
Criticism: Night and afternoon shifts should not be consecutive.

6. Mornings, afternoons, nights, rest days, rotating in the pattern of 3 x 3 x 3 
Length of cycle -- 12 weeks 
Average Workweek -- 42 hours 
3 Sats. and 3 Suns. off in cycle 
1/3 of total no. of days off in cycle 
Criticism: 9 consecutive shifts, too long for workers.
7. Mornings, afternoons, nights, rest days, rotating in the pattern 4 x 4 x 4
Length of cycle -- 16 weeks
Average Workweek -- 42 hours
4 Sats. and 4 Suns. off in cycle
¼ of total no. of days off in cycle
Criticism: 12 consecutive shifts, much too long for workers.

8. 6 mornings, 6 afternoons, 6 nights, with
1 day off in rotation each week
Length of cycle -- 7 weeks
Average Workweek -- 48 hours
1 Sat. and 1 Sun. off in cycle
1/7 of total no. of days off in cycle
Criticism: Should have 2 days off in each week.

There are many different ways to schedule as few as three workers on three shifts during a single week. If we need to have consecutive days off, then only the Seven Basic Work Weeks Method, which was described in William C. Healy's article in 1959 and is shown as Chart 6, is workable.

Mr. Healy mentioned that mathematically speaking, 127 combinations of the seven basic work weeks are possible. But practically, only 50 as shown in Chart 7 are really usable. Of the 50, these 18 marked with "yes" in Column 2 are the only ones suited to Symmetrical Shift Scheduling.
### 7 Basic Work Weeks for Scheduling Shifts

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<th>T</th>
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(Chart 6)

Mr. Healy has described a simple, efficient method of shift scheduling which yields the optimum returns from labor and capital. It is based on combinations of seven basic work weeks and can be arrived at simply and easily from a chart of possibilities. It can be applied both to even and uneven shifts.
<table>
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<th>Sym.</th>
<th>No. of Shifts produced by in Comb. Combinations</th>
<th>Types of Work Week Combinations</th>
<th>Sym.</th>
<th>No. of Shifts produced by in Comb. Combinations</th>
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Chapter 5

HUMAN PROBLEMS OF SHIFT OPERATIONS

The great unsolved problems of shift operations are human problems. They disturb shift workers so much in various ways. When most people are working, the shift worker is sleeping or at leisure, but when he is working, most people are enjoying leisure activities or sleeping.

If he is on rotating shifts, he has further problems, because he must constantly readjust his eating and sleeping habits. That means with each change of shift, he must reset his internal mechanisms that regulate important functions of his body.

These mechanisms run on a twenty-four hour cycle; they time daily cycles in body temperature and the output of adrenal hormones, disease-fighting white blood cells, and blood sugar (which influences fatigue and alertness). Body temperature usually reaches a peak in the afternoon and a low in the morning hours. But adrenal glands generally pour out the most hormones just before the normal morning waking hour to help people meet the demands of a new day.

It is desirable for most people to sleep at night and to work in the day time, and changes in this routine are often unpleasant. Making up lost sleep during the day, or taking a reserve sleep before a vigil, are never so successful. Above all, night work is always more fatiguing than day work.
Continuing fatigue, poor work, too much absence and frequent accidents are all unhealthy or dangerous signs that a worker is having trouble adjusting to shift work. He surely needs consultation or advice.

Before one is going to advise his fellow workers on human problems of shift operations, he must understand the physical and physiological effects as well as the effects on domestic routine and social life of shift workers. They are discussed below.

(1) Physical and Physiological Effects

It is a general opinion that ill-health is more frequent among shift workers than it is among day workers, particularly in the form of nervous diseases and gastric disorders including gastric and duodenal ulcers. It is also believed by many people that heart diseases, particularly coronary occlusion and angina pectoris, are more frequent among shift workers than among day workers.

Dr. Eyv This-Evensen in a 1958 article reported that a study of Scandinavian workers showed that duodenal ulcers had been more frequent in shift work occupations, because workers were unable to stand up to the strain of shift work. There had also been a decidedly higher frequency of nervous disturbances and digestive complaints among shift workers from the Danish investigations.

Habitual patterns of work, recreation, meals, and sleep
have developed a diurnal rhythm for most people. It is the common rhythm that has a day-night variation in the chemical constituents of the blood and in the activity of liver, kidneys, and endocrine glands recurring regularly. The rhythm achieves a degree of autonomy that makes it easier for people to stay awake during the day and harder for them to do so at night. Yet it is not something with which people are born, rather it is induced by their particular pattern of sleep and activity.

The need to respect the normal diurnal rhythm has been expressed forcefully by Pierach: "No organ or organ system is exempted from the 24-hour rhythm in its function...Continued activities contrary to rhythm make one weak and sick."

Mr. Wallace Bloom in his 1961 article concluded: "Most shift workers experience serious inconveniences of two kinds: disruption of their normal diurnal body rhythms and loss of sleep resulting in fatigue...The effects of fatigue are cumulative and frequently show no obvious sign, so that a man's performance may be severely impaired without his being aware of it." The prime factor in the failure of certain workers to survive in shift work have been the lack of sleep caused by the inability to alter their daily rhythms.

Unless adjustment of rhythm to a new routine due to shift change has been completed, shift worker will suffer a discrepancy between his accustomed sleep-wake cycle and the one
required by his new circumstances. This discrepancy has been called "cycle adaptation," and the length of the cycle adaptation varies with individuals. A British survey of shift workers has shown that individual workers varied in their speed of adjustment, but, interestingly, that the manual workers adapted more quickly than those whose work was primarily mental.

It is known that a flight across the Atlantic ocean, which gains or loses 5 hours, generally requires an adjustment period of a week. Thus, a change to a new shift eight hours earlier or later than one's previous shift must therefore impose a cycle adaptation period of at least several days, even if it is preceded by a twenty-four hour rest period.

Physiological and biological studies have shown that the majority of people who are able to make the physiological adjustment to shift work take several days to do so and will afterwards take one to three days to revert to their diurnal rhythms.

Studies have been made in Finland in 1967 to evaluate the adaptability of workers to shift work. By comparing the well and poorly adapted groups, it was discovered that the following conditions were there among the ones well adapted:

A. There was less than average number of small children at home.

B. They were less tense and more sociable than the poorly adapted.
C. Adaptability also appeared in the workers' attitude toward the environment.

D. More often, they belonged to associations and clubs, and complained less about the state of their health.

E. Their foremen gave them a high rating in efficiency of and responsibility toward their work.

Physiological studies also show changes to follow a typical pattern that on awakening in the morning, the body temperature is low, by mid-afternoon it may be as much as one degree higher, evening will show a slight drop, but the further decrease will occur from two to five o'clock after midnight. Mr. Bloom also mentioned that "When a worker is assigned to a new shift, we can expect that his body temperature curve will change, with the high point moving toward his activity period." Thus, the night worker will reverse his bodily rhythm as compared with his day working period.

Having to be awake during the usual hours for sleep poses a number of special problems. Perhaps the most obvious of these is the difficulty of obtaining enough sleep during the daytime. The difficulty of getting a full period of sound sleep during the night shift sequence has a cumulative effect and the disturbance of internal body rhythms inevitably leads to chronic fatigue, sleepiness and less concentration, accident proneness, and some medical problems. The high rate of digestive disorders among shift workers is
an example of the chronic effect of night working.

Dr. Kazutaka Kogi described in his article in 1971 that a survey carried out among hospital nurses in Japan in 1965 showed that: "Nurses on the twelve-hour or sixteen-hour night shift had a slower heartbeat and lower temperature at midnight than those on the ordinary eight-hour shift, and there was a reduction in alertness and other aspects of performance." Thus, we may expect less alertness in night workers if they work overtime.

In a study of errors made under a rotating three-shift system in a Swedish plant, it was found that a very high number of errors happened around 3 a.m. during night shifts. The number of errors did not vary so much either by season or by day of the week. It is obvious that night work does create more errors.

Deprivation of sleep in either the amount or the depth of sleep is the most important reason for sleepiness. Other causes of sleepiness during the night are lack of stimulation and complexity of the tasks. Any job that is boring, repetitive, inactive or unmotivated are all classified as lack of stimulation. The effect of moderate sleepiness will influence accuracy less than speed of operation and will create errors of omission rather than of overactivity.

It appears that the morning shift is a tiring shift, too. It also provides less sleep because workers have to
get up by 5 a.m. in order to meet the required early starting time of 6 a.m. Not only are there not enough hours of sleep, but also some workers start work with very little or even no breakfast.

Now let us talk about what causes night (and morning) workers inadequate sleep. The inability of workers to have sufficient sleep by day is mainly due to the disruption of the workers' sleeping habits and the disturbances from the extra noise and heat and the presence of daylight when they are trying to sleep.

Sleep habits are more easily broken than formed. Adjustment of sleeping times at the beginning and the end of the work-week is not an easy matter. Difficulties in falling asleep and awaking in the middle of the sleep are major problems causing sleep shortages during night shift sequence. As stated by Dr. This-Evensen: "Exhaustive investigations on sleeping habits were carried out by psychologists. The result of analyses are as follows: (A) The quality of sleep seems to be better at night than during the day. (B) Temperature conditions are of little importance. (C) It is of relatively little importance whether it is light or dark during sleeping hours. (D) Disturbance of the daily rhythm is of surprisingly little importance. But (E) Noise plays the most important part on the insomnia among shift workers."

It is the noise which particularly makes it difficult
for shift workers to sleep. During the day, the air is filled with the noise of traffic, trains and airplanes, factories working, children shouting at play, clattering dishes and running water from the kitchen, and noises in the house like washing and radio or television programs. It is really hard to live a night-shift life in a day activity environment and surroundings.

Nutrition also plays an important role in the night worker's morale and efficiency. Anyone who eats poorly and irregularly becomes more susceptible than others to illness. The night worker may have trouble eating properly because his mealtimes come at odd hours. The rotating shift worker may eat very little before he goes to work because he does not want to be lethargic on the job. And in some cases, he has neither time, nor opportunity, to get a hot meal at the plant. This is one of the reasons why shift workers have more digestive disorders.

So far we have talked about the bad effects of the night shift; now let's look at the physiological effects on night shift workers in terms of nervous symptoms and disease frequency. The results from the Finland studies have indicated that continuing fatigue, weakening of concentration, nervousness and difficulty in sexual intercourse happened to shift workers more severely than they did to day workers. And lack of appetite, pains in stomach, nausea or vomiting, and con-
stipation were those gastro-intestinal diseases found more often among shift workers.

In conclusion, shift workers under weekly rotation have complained of sleepiness, headaches, and less concentration, all of which finally caused errors and accidents. Others have suffered lack of appetite and digestive interruptions, often becoming ulcer patients. Because of this, some physiologists have been arguing that a permanent night shift, or at least a slowly rotating system is to be preferred for continuous shift operations.

(2) Domestic, Family and Social Effects

Equally disturbing many persons is the effect of shift working on their family and social life. Shift operations do not respect togetherness of companionship within the family. Usually workers on the afternoon or night shifts find their domestic routine and social life greatly upset.

A worker on a rotating shift with children of school age may never see them during the week, as he is sleeping when they leave for school and working when they return. He will see his wife only during part of the daytime when she is normally busy with her household. He may miss his favorite radio and/or television programs during evening shifts.

Social life outside the family is also disrupted by shift working. If a worker is on shift rotation, his recreation time keeps changing constantly, so that his friends
must put up with his uncertain appearances. He can't take technical or supplemental courses, or participate in social activities that are scheduled at the same time every week. If he is on a permanent rotating shift, his spare or recreation time will always come during the time when his friends, relatives and neighbors may be working. As a result, he has to give up many pleasant social engagements.

(A) Problems of Night Work

The dominant disadvantage of night work is being out-of-phase with the rest of the family and the society.

(a) Bad effects of night work on the domestic life:

(i) Wife feels nervous at being left alone at night.

(ii) Tends to disrupt sexual relations, especially during a long-lasting night shift.

(iii) Upsets wife's domestic activities (housewife can't get on her housework during the day if husband is sleeping).

(iv) Loss of appetite and indigestion complaints. — Little appetite for main meal when he gets up in the evening after a day in bed, and yet he doesn't want main meal in the middle of the night, nor when he comes off work early in the morning.
Almost every meal he has on night shift is like breakfast. It is even harder for shift workers to adjust to the change in mealtimes than to get enough sleep.

(b) Bad effects of night work on the social life

(i) Social life is restricted -- causes participation impossible.

(ii) Leisure time in the day is spent mainly at home doing housework, gardening, and watching television.

(B) Disadvantages of Double Day Shift Work:

The most severe problem of double day shift work for the woman worker is that she is out at the times of the day when her husband and children need her most.

(a) Undesirable effects on family life:

(i) Too early to give breakfast to children during her morning shifts.

(ii) Husband has to prepare his main meal when she works in the evenings.

(iii) Can not be with husband and children at home during afternoon shifts.

(iv) Difficult for school-age children coming home for their mid-day meal.

(v) Early rising in the morning shift spoils the evening's enjoyment in that week.
(b) Undesirable effects on social life:
   
   (i) Enjoyment of club life is restricted due to impossibility of attending regular meetings.
   
   (ii) Can never take a leading position in any social organization.
   
   (iii) Almost impossible to take educational courses.
   
   (iv) Feels cut-off from friends and as though living in a world apart.
   
   (v) Extra leisure in the morning just cannot compensate single men for the loss of social life in the evenings.

(C) Inconveniences for Continuous Shift Work:

   Night and weekend work rank as the number one source of dissatisfaction among the operators of continuous shift rotation. The curtailment of weekend leisure activities is a persistent complaint.

   (a) Impact of continuous shift change upon family life:

   (i) Meal preparation has been harder due to the change.
   
   (ii) Washing presents major problem.
   
   (iii) Difficulty of changing rota does affect shopping.
(iv) Difficult for wife to understand the rota scheme.

(b) Impact of the shift change upon social life:

(i) Can't get out at weekends. (Some people like the crowd associated with the weekend.)

(ii) Can't go out together now (wife likes company).

(iii) Visits to friends and relatives at their leisure time are reduced.

(iv) More difficult to attend the cinema over weekend.

(v) Regular Saturday night visits to club are now impossible.

(vi) Less attendance at church or chapel (wife doesn't like to go alone).

(vii) Unable to take advantage of a day off in the week because of the responsibility to other members of the family.

(viii) Unable to enjoy regular sporting and favorite hobbies.

(D) Draw-backs of Swiftly Rotating Shift Work:

(a) Length of long breaks has been shortened.

(b) Loss of the breaks at some weekends on dis-
continuous system.

(c) Workers have to be prepared on the preceding evening for early start at 6 a.m. after long break.

(d) It upsets trade union activities more than any other continuous shift system inevitably does.

Three times as many wives have stressed the impact of weekend work on their social life as the interference with their various household tasks. People usually consider the weekend as the proper time to be at leisure.

In conclusion, as Mr. Wallace Bloom expressed clearly, shift workers are "forced to live in a different time sequence from that of their community and of many people to whom they are ultimately related." The individual's adjustment to shift working also depends upon the length of residence, structure of family, and patterns of occupational and neighborhood mobility.

(3) Summary of Reasons Employees Don't Like Shift Work:

(A) Night work
(B) Working weekends
(C) Irregular hours of work
(D) Early start on morning shift
(E) Irregular sleep and meal times
(F) Spoiling social evenings
(G) Upsetting stomach and digestive disorders
(H) Sleepiness and fatigue
(I) Restricting technical studies
(J) Interfering with sports and church attendance
(K) Interrupting family life
(L) Disturbing personal hobbies and favorite T.V. programs
(M) Lack of sleep and loss of appetite
(N) Half a rest day is wasted when one comes to days off
(O) Against all the way of living, against nature

Most of the disadvantages of shift work accrue to the workers, particularly those on night shifts, in the form of disrupted family and social life and a marked susceptibility to nervous and digestive disorders. Shift work does increase the problems for the company, the supervisor, the individual and his or her family. The worker has to adjust his entire mode of living in terms of his domestic routine and social life.
Chapter 6

INTERSHIFT CONFLICT

One of the shift work problems most difficult to solve is that of a good relationship between crews on successive shifts. Getting cooperation among different shifts in a division is part of every supervisor's job. Ideally all shift crews should be integrated and function as a single and united working team. Unfortunately, many night shift workers often feel that they are special, and they think that they are separated and different from day workers entirely. This is one of the places where the intershift conflict started.

With multiple shift operations, it is rather difficult to ascertain who is to blame for defective work, spoiled materials, broken tools, damaged machinery and poor housekeeping.

Buck-passing and covering-up is the number one problem that deteriorates intershift cooperation. Sometimes one can hear shift supervisors saying "If it is wrong, the other crew or the night shift did it."

Sharing tools and machines will cause many problems. Tools may be hidden if a worker becomes possessive about his working equipment, especially if it is important and if he has used it for a long time.

Competition among shifts can be a stimulant or a deterrent
if carried to extremes. The worker on the next shift may be stuck with setting-up machinery due to incomplete set-up of equipment during shift change-over, as the preceding operator fears competition.

Poor planning for services can cause intershift problems as well as annoyance within a given crew. If cleaning the floor and equipment is the duty of operators from every shift, and if the inspection on cleanliness is only conducted once a day, then the operators of two shifts will be relaxed and will leave the third shift to do the entire cleaning-up. Thus, friction will be created simply by poor housekeeping arrangements.

Furthermore, inadequate supervision will produce both inter- and intra-shift difficulties. One of the most important of these is communication barriers between shifts.

The smoothness of operations, the production, the cost and quality of products, and the morale of both management and employees depends upon effective communication. Poor communication between shift supervisors is a frequent cause of misunderstandings, leading to production snarls.

Before thinking of how to improve the intershift communication techniques to be discussed in next chapter, some apparent barriers to effective intershift communication are analyzed as follows:

1) TIME: To do anything well requires time. But daily
meetings with counterparts at shift change time, providing only a few minutes of face-to-face communication, are not sufficient for a clear understanding of mutual objectives and special needs of each individual shift. Brief meetings cause confusion or misunderstanding, usually.

(2) **Fatigue:** When a supervisor is tired after working 8 hours, he is so anxious to finish his work-day. Naturally, his desire to go home and relax is much stronger than the desire to stay and brief his successor. Many important details can be overlooked in a hurry to leave. Consequently, the afternoon or night supervisors are inadequately informed.

(3) **Memory:** An incident early in the morning shift that will have carry-over effects to the afternoon and night can easily be forgotten during shift changes. By the end of the shift, the mind is turned homeward, details, incidents, and suggestions once thought important might be overlooked.

(4) **Distorted Instructions:** Instructions passed through several persons tend to be distorted. A statement of an incident that happened in the afternoon shift can be completely distorted by the time it passes through the night shift and finally reaches the appropriate person on the day shift.

(5) **Lack of Help:** Engineering design, production scheduling, quality control, major maintenance and warehousing services usually are not available in evenings and at nights. This makes the afternoon and night supervisors bearing greater
burdens than their morning shift counterpart.

(6) Improper Training: If training is not provided for the shift workers learning to adjust to a new living routine, but for them only to learn a new job, or if new teaching materials are given to learners too much at a time, the training effort will not be effective.

(7) Personality: Communication is a personal matter. To achieve better understanding, each must be in tune with the other. People between shifts, normally in competition with each other, often run things merely the way they themselves see fit.

Unless careful attention is paid to communicate effectively between shifts, the creation of three different divisions each going its own way is very likely to occur. Effective intershift communication is particularly important if a company is to achieve the very high degree of coordination needed in producing precision products of top quality.

To eliminate the duplication of work and facilities, to avoid the complaints from afternoon and night shifts that they get most of the difficult work, and to prevent the feeling that night workers are the forgotten few, each shift must understand what the other is doing and why.

No one on a manufacturing team can contribute his best without knowing the problem and the desired result. Team work plays a vital role in the successful operation of a
manufacturing company, but better understanding through improved communications is the vital requirement to develop this teamwork.

Every barrier to effective communication, such as semantics, poor listening, emotion, self-interest, as well as those already identified in this report, can be overcome by shift supervisors themselves.
Chapter 7

MANAGEMENT POLICIES AND REMEDIES

Human problems on shift work may be resolved, inter-crew conflicts among shift workers may be remedied, and finally the shift operations will be improved through following ways:

(1) Legislation and Regulations Governing Shiftwork:

A. Attention to limiting overtime work by shift workers.
B. Improvement of regulations governing days of rest in shift work.
C. Suitable breaks during shifts.
D. Longer breaks between shifts.
E. Welfare facilities for shift workers.
F. Medical examination of shift workers before and during employment.

(2) Better Management Techniques on Shift Working:

A. Having supervisors' and workers' time overlapping for 10 to 30 minutes during shift changes.
B. Rotation of project supervisors to all shifts for better understanding.
C. Having first-level supervisor attached to definite shift for the development of better teamwork.
D. Good planning and equal distribution of services.
E. Better inspection on all shifts.
F. Satisfactory control of tool-crib service for night shift.
G. Adequate supervision to maintain equipment in good condition.

H. Having skeleton maintenance gang attached to each shift.

I. Major maintenance team on roster for recall in case of emergency during evening and night shifts.

J. Ensure that the outgoing shift left the working place in proper condition.

K. Efficient supervision to maintain discipline and good relations between shifts.

L. Make periodic analysis of turnover and absence records of shift workers.

M. Improve shop environment to safer conditions.

N. Advise employees on how to avoid fatigue.

(3) Steps Toward Better Communications:

A. A shift overlap of half an hour precedes each shift change.

B. Provide a supervisor's log-book to jot down notes.

C. Check list provided for reviewing during shift change.

D. Communication at each level within the shift.

E. Have procedure manual, job sheets and change notes in writing to avoid confusion.

F. Pay supervisors to work on improving their writing skill.

G. Provide day-book and circulate notes for thorough communication.
H. Emphasize the effective use of telephone or interphone services.

I. If possible, provide tape recorder and/or electronic secretary services for busy supervisors.

J. Consult day-time working boss beforehand if necessary to anticipate problems in order to plan ahead for night shift.

(4) Steps Required of Supervisor for Better Coordination and Close Cooperation:

A. Arrive half an hour before shift change.

B. Receive suggestions from predecessor.

C. Read memos left by first shift supervisors.

D. Have weekly meetings among various foremen.

E. Have general supervisor discuss common problems.

F. Ask employees of own shift or from other shifts to help if necessary.

G. Cooperate with other shift supervisors. -- Cooperation is paid for with cooperation.

H. Avoid own prejudices toward other shift crews.

I. Sell the benefits of cooperation.

(5) Better Welfare Provisions:

A. Provide adequate feeding facilities -- arrange for the heating of food and making of coffee or tea.

B. Have crib-break of 20 or 30 minutes and be counted as working time.

C. Study existing transport arrangements and provide additional facilities if necessary.
D. Arrange with public transportation services for employees to pay only a nominal fare for daily use.

E. Special arrangement for shift workers to participate as much as they can in activities arranged by company social clubs.

F. Provide recreational facilities for all shift workers. Duplicate functions at times suitable to shift workers.

G. Provide medical clinic and nurse services to all shift workers.

(6) Consideration of Living Conditions of Shift Workers:

A. Find out what applicant's living conditions are before he commences work.

B. Reject workers living under unsatisfactory conditions for shift work.

C. Improve living conditions of continuous or rotating shift workers. House location, room insulation and fixtures, and location of bedroom must all be studied.

D. Transfer those who cannot adapt to shift work.

(7) Better Arrangements on Wages and Incentive Payments:

A. Night and evening shift premium must be awarded.

B. Time allowances for night shift must be provided -- have short day after the night shift.

C. Crews on all shifts in any one division should be
treated as a single pay-group in incentive payment plan.

(8) Application of Physiological Research Findings:
   A. Careful selection of individuals for rotating shifts.
   B. Provide special training for shift work.
   C. Employ fixed shifts instead of rotating shifts.
   D. Have fewer shift rotations.
   E. Provide longer rest periods between shift changes.
   F. Arrange shorter time for night shift.
   G. Pay more attention to personal problems, especially nervous symptoms and chronic diseases.

(9) Careful Selection and Training of Shift Workers:
   A. Tests made on the adaptability to shift changes.
   B. Careful pre-employment medical exams carried out.
   C. Do not employ those over 50 years of age without previous experiences on continuous shift work.
   D. Train the workers to adjust to a new living routine.
   E. Do not teach new employees too much material at one time.

(10) Good Labor Relations:
   A. Discuss shift time proposals with appropriate trade union as well as with workers themselves.
   B. Get employees' point-of-view on shift working.
   C. Require at least 48 hours notice before an operative is transferred from one shift to another.
D. Worker-management committees are valuable aids in a two-way communication system.

(11) Remedies for Moderate Sleepiness:

A. Have frequent short breaks.
B. Furnish tea or coffee during breaks.
C. Have frequent job changes during the night shift.
D. Introduce incentives by appraising job done.
E. Provide activities involving physical efforts, like sports, for frequent sleepiness.
F. Have adequate inspection and supervision.
G. Night workers must be kept active all the time.

(12) Patience and Fairness:

A. It is more efficient to promote cooperation one step at a time.
B. Tensions between crews can't be entirely eased in just one day. Conflict can only be remedied gradually.
C. Fairness is most important in gaining cooperation with employees. Both promotions and layoffs must be FAIR.
Chapter 8

CONCLUSION

The Republic of China is still a developing country, although its speed of progress is rapid. Shift work will continue to spread in Taiwan in the near future. We Chinese should pay close attention to the human problems of shift working and its management techniques listed in this report. In addition, it is my conclusion that continuous shift rotation systems we use must be carefully selected as follows to fit the situation of different stages in the future.

1. At present, it is better for us to use relief operator system with 6 workers crew and 1 relief operator to complete the seven-day work week cycle.

2. By 1985, we should use 4 crews -- 3 shifts, 5 days working fixed shift system. It will be similar to Chart 4 in Chapter 4, except that shift rotation will be 4 weeks in length instead of one week, and the number of rest days between afternoon and night shifts and between morning and afternoon shifts will be switched so that a longer rest period will be provided before the night shift.

3. By the 21 century, the Continental Rota system will be used because Chinese shift workers will also emphasize much social life by then.
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