



**European Foundation
for the Improvement of
Living and Working Conditions**

CONTINUOUS SHIFT SYSTEMS

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CONTINUOUS SHIFT SYSTEMS

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Contents

CHAPTER 1: INTRODUCTION	6
The mathematics of shift systems	7
Guidelines for a good shift system	8
CHAPTER 2: PREVALENCE (FREQUENCY) OF CONTINUOUS SYSTEMS	9
Italy	9
Belgium	9
Germany	11
Netherlands	11
France	12
United Kingdom	14
CHAPTER 3: SECTORS WITH CONTINUOUS SYSTEMS	17
Introduction	17
Changes and Trends	17
Textiles	17
Bridging shifts	19
Metallurgy	19
Chemical sector	20
Electricity-generating sector	22
Some general information about other work sectors	23
Transport	24
CHAPTER 4: WAYS OF MANNING CONTINUOUS SYSTEMS	25
Introduction	25
Four crews : rapid or slow rotating, or fixed	25
Five crews	27
Six crews	33
Twelve-hour shifts	35
Poor systems	37
CHAPTER 5: UNEVENLY MANNED CONTINUOUS SYSTEMS	40
Telephone call centres	40
Underlying principles	42
CHAPTER 6: CONCLUSIONS	43
References	44

List of tables and figures

Table 2.1 :	Population with a job: shiftwork, irregular hours, by economic sector: Belgium (1994)	10
Table 2.2 :	Frequency of shiftwork by size of enterprise (in %)	11
Table 2.3 :	Distribution of shiftworkers according to shift systems in France (1990)	12
Figure 2.1 :	Continuous shiftwork in different sectors in France (1990)	13
Table 2.4 :	Percentage of employees working shifts: UK	14
Table 2.5 :	Percentages of men and women in different types of shiftwork : UK, 1992 vs. -1994	14
Table 2.6:	3-shift workers in various industrial sectors (in thousands): UK (1992 vs. 1994)	16
Table 2.7 :	Continental shiftworkers in various industrial sectors (in thousands) : UK (1992 vs. 1994)	16
Table 3.1 :	Shifts in the textile industry in Belgium	18
Table 3.2 :	Continuous shift system in a steel company in Northern Italy	20
Table 3.3:	12-hour 5-crew system, with 4 consecutive shifts: UK chemical industry	21
Table 3.4 :	Variety in shifts in the Belgian chemical industry	21
Table 3.5 :	Six-crew shift rota in an electric plant in Italy	23
Table 3.6 :	Former five-crew shift rota in an electric plant in Italy	23
Table 4.1 :	Changes in shift patterns in a Belgian packaging company	25
Table 4.2 :	Continuous 4-shift system in the German chemical industry	26
Table 4.3 :	Continuous 4-shift system in a Swiss oil refinery	27
Table 4.4 :	Change from 4- to 5-shift system in the paper mill sector of Belgium	28
Table 4.5 :	Continuous 5-shift system in the German chemical industry	28
Table 4.6 :	Continuous 5-shift system in the chemical industry (additional shifts are necessary)	29
Table 4.7 :	Continuous 5-shift system in the Dutch, English, French and German chemical industry	29
Table 4.8:	Continuous 5-shift system in Dutch electrical plant	30
Table 4.9:	Continuous 5-shift system in the Dutch electrical sector	30
Table 4.10 (a) :	Typical 5-crew shifts in the Mars factory	31
Table 4.10 (b) :	5-crew shifts in the Mars factory during summer holiday period	31
Table 4.11 :	Continuous 6-shift system in a German nuclear power plant	33
Table 4.12 :	Summary table of the successive system (extract from the Report of the Walloon station)	34
Table 4.13 :	System of replacements (extract from the summary of the Report of the Flemish station)	34
Table 4.14 :	Continuous 2-shift system in the Belgian petroleum industry	35
Figure 4.1 :	Distribution of workers on continuous shift systems according to the number of crews	36
Table 4.15:	5-crew system with seven consecutive nights	37
Table 4.16:	Modification of 5-crew system above	38
Table 4.17 :	Alternative modification of 5-crew system	38
Table 4.18:	2-2-3 with 5th week free for Days/Training/Holidays	38
Table 4.19:	2-2-3 with 9th and 10th week free for Days/Training/Holidays	39

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Chapter 1: INTRODUCTION

Continuous shift systems - those that run 24 hours a day every day of the year – are the most intensive form of shiftwork. They inevitably involve night work, which is generally considered the hardest for the human body to tolerate; and necessarily involve work at weekends, which is, for most people, the most alienating from the social life of their community.

In many cases, too, they are used in situations where there is no choice. It can be argued that people working in sectors where there is no choice have a stronger commitment to shiftwork, so that they are more likely to adapt to it (or choose to work elsewhere).

In many service situations, such as law enforcement, medical services, and the provision of electricity, water and gas, the public expect a service that is always there. Of course, in remote parts of the country, such as the Scottish islands, there may not be a policeman or ambulance constantly in attendance; but even there, the public expect the service to mobilise itself when there is a call for it.

In several industrial processes, there is a “technological imperative”. It is not possible to switch off a chemical plant or steel furnace without going through a complex shut-down procedure, which is costly and therefore unthinkable in practical terms. However, other sectors that do not have the same service or technical necessity for shiftwork are increasingly moving to continuous shiftwork.

In the UK, the personal banking sector has been invaded by direct services, where the customer can carry out transactions by telephone at any time of the day or night and on any day of the year. The appeal of this type of service is obvious. The human consequence is that telephone lines must be manned constantly - but not, of course, in constant numbers. Some staff have to work at night and at weekends, but the size of workforce can be tailored to the varying demand at different times. Modern telephone systems also allow great versatility in their operation, so that there are possibilities for concentrating this workforce in one place to cover a large area of the country, or even of several countries. When the Dell computer helpline in Dublin is too busy, for instance, calls are transferred to Texas.

Some other examples of modern telework are less transparent: if you make a telephone booking to British Airways, your call is answered by a Briton, but they handle the booking through a computer system run in Bombay, India, for reasons of cost and efficiency.

In many other industries, the cost of equipment and its rapid obsolescence has driven management towards fuller utilisation of operating time. Whether this means continuous shift systems or some less intensive form of shiftwork has to be a calculated decision based primarily on costs, but also by looking at the risk of errors and accidents, space for warehouses to contain buffer stock, and the acceptability of different times of working to a workforce that may be hard to recruit and long to train.

One consequence of the expansion of shiftwork to more intensive forms, interestingly, has been a greater variety of forms of shiftwork. The old “week-about” system of one week on each shift is still remarkably common, but new

ways of creating continuous cover are only limited by the ingenuity of managers, their workforces, and (of course) of legislative and collective bargaining restraints, where these apply.

Most people assume that more intensive shiftwork is bound to create more problems for shiftworkers and their managers. Interestingly, van der Weerd and Jansen report that, in several projects, they found that traditional semi-continuous shift systems are more inconvenient for the workers than the modern full continuous systems.

This issue of BEST is therefore devoted to looking at the problems and solutions found in continuous shift systems, so that lessons learnt in one industry or country can be passed on to others.

Two postscripts to this introduction are worth adding.

The mathematics of shift systems

Some readers may find it helpful to be reminded that working out a shift system is the kind of problem that can sometimes be simplified by reduction to mathematical formulae. In BEST 7, a section from Knauth and Hornberger (1992) explained the principles, and parts of this are relevant to continuous systems.

Formula 1¹

$$N_c = \frac{OT}{IWT} \quad \text{or} \quad \frac{OT}{N_c} = IWT$$

where N_c = Number of crews

OT = Operational Time

IWT = Individual Working Time

In continuous evenly-manned systems, $OT = 168$ (i.e. 7×24 hours), so if a 42-hour week is worked, $\frac{OT}{IWT} = \frac{168}{42} = 4$, so 4 crews are required.

Most collective agreements have agreed working times of less than 42 hours. $\frac{168}{5} = 33.6$, so a five-crew system averages 33.6 hours of individual working time.

Allowing for annual and public holidays, training time and average absence levels, this IWT of 33.6 may in fact average out quite close to agreed working times of 37 or 38 hours a week. The next whole number of crews is 6, and $\frac{168}{6} = 28$. This, even with allowances for holidays, training and absence, is⁶ likely to average out below the limits of most collective agreements on individual working time.

Five other ways can be used to solve the problem, and also deal with the intermediate situations where the agreed individual hours do not match the needs of the system:

- Four crews work paid overtime to make up the difference.
- Four crews work overtime, but are compensated by additional free days. An increase in the number of workers is needed to achieve this in order to cover the extra free days.

¹ Formula 1 is correct only when the number of employees on each shift is the same.

- Five or six crews are used, but work less than their agreed working hours. If they do not want to work part-time, they have to work additional shifts to make up their agreed working hours. This is common with annual working hours agreements, where the company holds a “bank” of hours owed by individual workers, which it can call upon if needed – without extra payment, as the hours have already been paid for. The secret of annual hours agreements for changing a culture of overtime is that an organisation does *not* require all contracted hours to be worked, unless they are needed. This takes away the financial incentive for working overtime.
- A combination of 4-crew and 5-crew systems: During some months of the year the workers work in a 5-crew system (33.6 hours/week); during other months (e.g. holiday periods) the same workers change to a 4-crew system (42 hours/week). Over the year, the agreed working time is achieved. This is a commonly found solution in seasonal work; and many shift systems change patterns in the summer holiday period in a similar way.
- The crews are split into subgroups. Intermediate problems can be solved by using combinations of subgroups, assuming that the workforce is interchangeable. So $\frac{168}{4.5} = 37.333$. 4.5 crews are achieved by splitting the workforce into 9 half-crews, two of which work at any time. (The formula $\frac{168}{37.3} = 4.5$ is, of course, equivalent.)

Guidelines for a good shift system

Fourteen rules were given in BEST 3, Guidelines for shiftworkers, reprinted in Appendix 2 of BEST 7, and are worth repeating here.

1. Minimise permanent nights
2. Minimise sequence of nights: only 2-4 night shifts in succession should be worked
3. Avoid fast double-backs
4. Plan rotas with some weekends free
5. Avoid overlong work sequences
6. Fix shift length to task loads
7. Consider shorter night shifts
8. Rotate forward
9. Delay morning start
10. Make shift change times flexible if possible
11. Keep rotas regular
12. Allow some individual flexibility
13. Limit short-term rota changes
14. Give good notice of rotas

Guidelines 1,2,3,4,5,8 and 9 have been given particular emphasis by Knauth (1996) in more recent writing – with a limit of 3 on the number of nightshifts that should be worked in succession (point 2 above).²

The following sections go fairly rapidly into a huge number and variety of shift systems. It is hoped that these two pieces of general wisdom will help to throw light on the picture.

² It is well worth reading the full descriptions of the guidelines in BEST 3 to understand them, as this gives the evidence and argument that lie behind them.

Chapter 2: PREVALENCE (FREQUENCY) OF CONTINUOUS SYSTEMS

Italy

In Italy, there are no official statistics on the current prevalence of continuous shift systems among the various work sectors. (Costa, 1995)

Belgium

In Belgium, Léonard (1995) reports that a 1977 university survey (K.U.L., 1980) of 913 companies with more than 50 workers indicates that a shift system was used in 37% of those companies and that in 26% of these, several systems could be used at the same time, so that the frequency of continuous work was 24%. These figures should be compared to more recent data (National Institute of Statistics, 1994). That data is summarised in Table 2.1 and shows that, of 3,749,700 people, 562,341 (15%) worked shiftwork and 531,903 (14%) worked at night. The K.U.L. survey only takes into account industrial companies, whereas the data of the National Institute of Statistics concern all employed workers.

Out of 100 shiftworkers in 1977, the distribution of the systems is as follows :

- discontinuous : 31%
- semi-continuous : 40%
- continuous : 23%
- other systems : 6%

89% of shiftworkers were men and 11% women. This percentage is changing, and at present 16% of shiftworkers are women. Production workers work more often in shifts than management (38% compared to 7%, according to Mairiaux 1995), but those figures also date from 1977.

Continuous work is found mainly in the following sectors : textile industry, metallurgy, glass and ceramics, chemistry, metal manufacture, paper, oil industry, electricity works, and food. It is also found in health services, firefighting, and transport.

Table 2.1 : Population with a job: shiftwork, irregular hours, by economic sector: Belgium (1994)

Shiftwork irregular hours, work at home	Branch of economical activity											TOTAL
	agriculture, fishing	extractive industries	manufacturing industries	electricity, gas, water	construction	trade	hotels, restaurants	transport	finances, property, business	administration, education, health	domestic services	
Shiftwork:												
– usually	707	2,898	203,103	3,907	13,790	30,027	12,130	47,608	17,628	147,063	2,437	481,298
– sometimes	217	3	16,936	1,148	1,569	6,767	1,856	9,712	6,392	35,812	294	81,043
– never	107,343	40	556,570	24,828	249,004	519,327	102,109	202,678	345,916	1,053,566	17,108	3,187,360
		8,311										
Evening:												
– usually	29,254	1,879	114,334	1,369	5,831	52,505	63,394	38,552	34,049	135,857	1,834	478,867
– sometimes	41,880	1,982	138,032	5,540	30,500	112,198	23,853	59,498	71,122	66,355	3,345	754,305
– never	37,139	7,689	524,233	22,977	228,042	391,414	28,862	161,953	264,772	834,239	15,252	2,516,572
Night:												
– usually	2,090	1,413	61,601	954	1,111	12,737	17,877	25,939	5,259	61,255	671	190,907
– sometimes	38,978	1,213	59,874	4,123	6,005	16,611	19,783	40,436	16,591	135,341	2,041	340,996
– never	67,204	8,925	655,125	24,809	257,246	526,766	78,446	193,622	348,085	1,039,841	17,728	3,217,797

Source: National Institute of Statistics, Belgium (1994)

Germany

In Germany, Knauth and Hornberger (1995) report on a 1993 questionnaire completed in West Germany (Bauer et al., 1994), which indicated that the frequency of shiftwork had decreased from 14% (in 1989) to 12%. They suggest that this might be due to new “shiftlike” working time arrangements, such as staggered working time or the combination of full- and part-time regulations. However, there was no change in the number of employees working on Saturdays (29%) or Sundays (12%), and almost all employees (93%) who worked on Sundays worked on Saturdays as well. There were more male (14%) than female (9%) shiftworkers. As shown in Table 2.2, the bigger the company, the higher the frequency of shiftwork. In the smallest enterprises (i.e. those with less than 5 employees) the shiftwork rate is as low as 2%; in enterprises with more than 500 employees, 23% do shiftwork.

Table 2.2 : Frequency of shiftwork by size of enterprise (in %)

Frequency of shiftwork	Employees in companies with (%) working shiftwork				
	1 - 4 employees	5 - 99 employees	100 - 499 employees	500 and more employees	employees total
regularly	2	6	15	23	12
seldom/never	99	94	85	77	88

Source: Bauer et al. (1994)

42% of employees work in a 2-shift system and 31% in a 3-shift system. 7% of these work continuous shifts, and 39% work night shifts.

Netherlands

From the Netherlands, van der Weerd and Jansen (1996) report that, although working outside the usual “nine-to-five” routine is becoming more and more common, it is characterised not by a higher percentage of people working in round-the-clock systems but by an increase in the variety of such systems. One cause for this is the increasing need of trade and industry to utilise more flexible and efficient ways of employment, related, in turn, to an increasing social need to take into account employees’ preferences regarding their leisure time.

In Dutch industry during the period 1982-1988, the percentage of men working in 2- or 3-shift systems decreased by approximately 1% while the percentage working in round-the-clock shifts increased by about 2% (FNV, 1992). About 70,000 employees are working regular continuous shifts in the Netherlands (about 1.5% of the workforce). According to van der Weerd and Jansen, traditional forms of shiftworking in the Netherlands are going more and more out of fashion, and “tailor-made” solutions are becoming the rule, rather than the exception, both in daytime work and in 24-hour systems. “These arrangements are varying per sector, per company and per department and even sometimes per group of employees or per individual employee. This makes it hard to distinguish fully continuous from semi-continuous working hours...”

The most recent Labour Force Survey for the Netherlands (CBS, 1996) reports the following percentages of employees working shiftwork:

- regular 52%
- irregular 48%
- – night/evening 15%
- – evening 17%
- – weekends (daytime) 16%

Van der Weerd and Jansen also note that “the higher demands to which (flexible) working hour regulations are subject have been laid down in the *Arbeidstijdenwet* (Working Hours Act) (ATW) in the Netherlands, which came into force for most sectors on 1 January 1996, and in many recent collective labour agreements about the introduction of the average 36-hour week.” (Van der Weerd and Jansen, 1996)

France

In France, Gadbois and Dorel (1996) report that a national survey by the French Ministry of Labour has provided a precise and highly detailed measure of the practice of continuous shiftwork in the various economic sectors, and describes trends over the last decade (Bloch-London, 1992). Between 1981 and 1990, the prevalence of shiftwork in France increased from 11 to 12.5%, the greatest increase being among blue-collar workers (18.5 to 22.6%). In 1990, 21% of all shiftworkers were on continuous shiftwork. The percentages were lower among blue-collar workers (17%) than among other employees (40.2%) (Table 2.3).

Table 2.3 : Distribution of shiftworkers according to shift systems in France (1990)

	Discontinuous	Semi-continuous	Continuous
Blue-collar workers	54.7%	28.3%	17.0%
Other employees	39.0%	20.8%	40.2%
All employees	51.9%	26.9%	21.2%

Source: Bloch-London (1992)

The prevalence of continuous shiftwork varies greatly in different sectors. Figure 2.1 indicates the proportion of shiftworkers among all employees for each sector, and the proportion of continuous shiftworkers among all shiftworkers. Some sectors, such as energy and water, have few shiftworkers, but most of these work continuous shifts. Other sectors, such as rubber and plastics, have many shiftworkers, but few work continuous shifts.

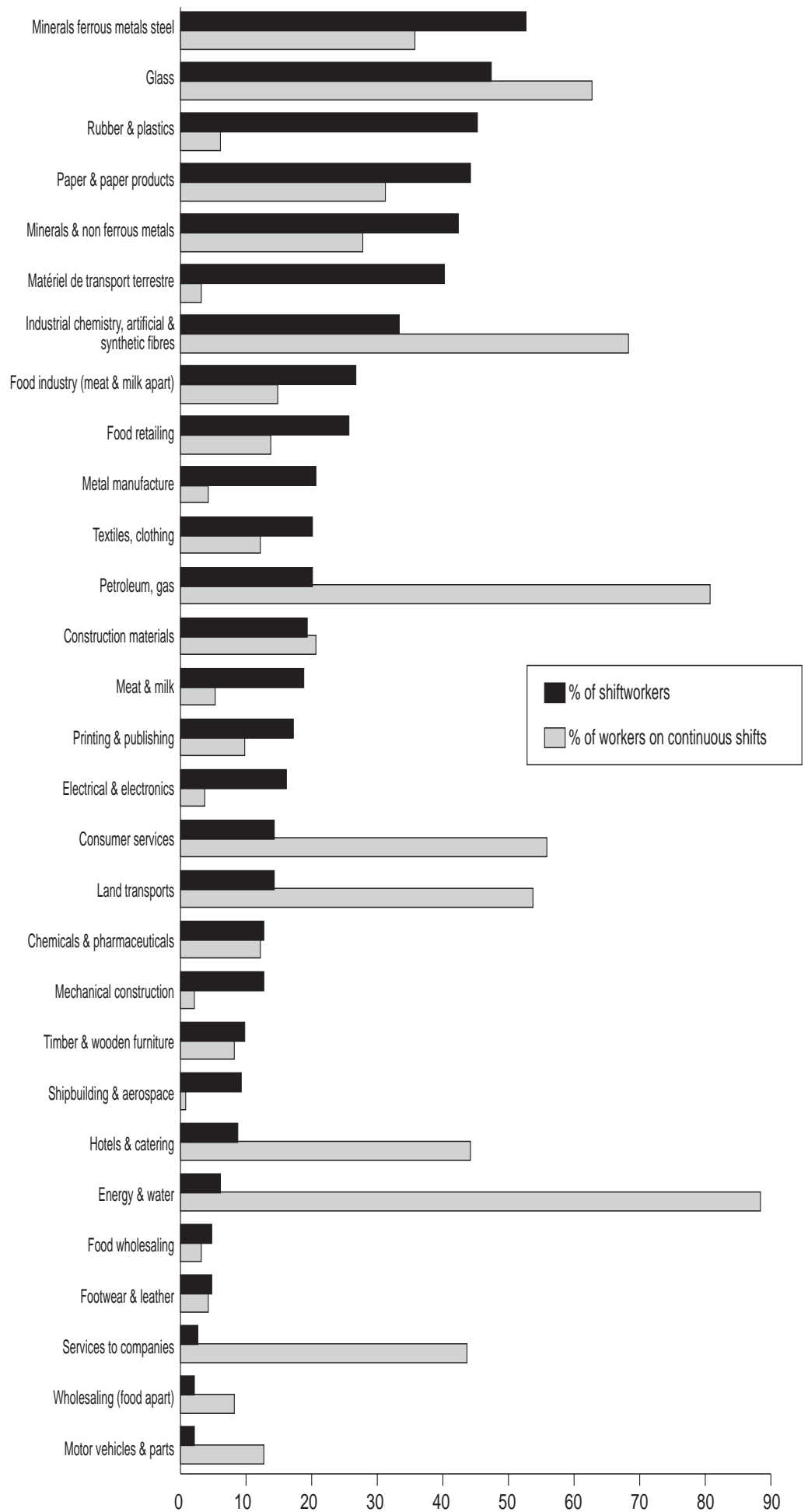
The following industrial sectors depend the most on continuous shiftwork:

- energy (petroleum, gas, electricity): 4 in 5 employees,
- glass, industrial chemistry (synthetic and artificial fibres): 2 in 3,
- steel, paper and paper products: 1 in 3,
- building materials and minerals: 1 in 5,
- food (except for meat and milk): 1 in 5 to 1 in 10,
- chemicals, textiles-clothing, printing and publishing: 1 in 5 to 1 in 10.

Outside industry, more than half of shiftworkers are on continuous shift systems in the health and transport sectors.

A detailed analysis of shiftwork in different specific industries can be found in Gadbois and Dorel (1996).

Figure 2.1 : Continuous shiftwork in different sectors in France (1990)



United Kingdom

In the UK, shiftwork questions are asked annually in the spring (March to May) Labour Force Survey. The questions are asked consistently from year to year, so that trends can be observed. However the main questions are not very informative for understanding key information about what is happening to shift systems generally.

The first question is simply: "Do you do shiftwork in your (main) job?" with answers of "usually, sometimes, never".

Results from this show that the percentage of employees defining themselves as shiftworkers has risen slightly each year over the 1992-1994 period (see Table 2.4, below). The main problem is in the ambiguity of the word "shift", as this means "a changing working time" to some people, but "non-daywork" to others. Thus there is 11% of the employed population that report working at night, but who do not describe themselves as shiftworkers.

Table 2.4 : Percentage of employees working shifts: UK

	March/May 1992		March/May 1993		March/May 1994	
	Usually	Sometimes	Usually	Sometimes	Usually	Sometimes
	%	%	%	%	%	%
male	8.3	2.2	8.6	2.2	8.9	2.3
female	5.6	1.0	5.9	1.2	6.2	1.2
total	13.9	3.2	14.5	3.4	15.1	3.5
M+F total	17.1%		17.9 %		18.6 %	

Source: Labour Force Survey (unpublished data)

The percentage working shiftwork "usually" appears to have grown by 7% for males and 10.7% for females between 1992 and 1994.

The second question asks shiftworkers what type of shiftwork they work. The problem here is the answer categories, and their definitions. Table 2.5 shows how these types of shiftwork vary for men and women; definitions of the shiftwork types, as coded by the Labour Force Survey, follow the table.

Table 2.5 : Percentages of men and women in different types of shiftwork : UK, 1992 vs. -1994

TYPE OF SHIFT	MALE		FEMALE	
	1992	1994	1992	1994
3-SHIFT	12.2	11.3	4.5	4.9
CONTINENTAL	3.5	3.2	0.3	0.4
2-SHIFT	16.3	16.7	14.5	13.8
NIGHT OR DAY	10.8	9.7	4.2	3.4
SPLIT SHIFT	2.1	2.1	2.4	2.4
MORNING SHIFT	0.8	1.0	0.6	1.0
EVENING/ TWILIGHT	1.3	1.6	2.0	2.8
NIGHT SHIFT	3.6	4.7	3.6	4.1
WEEKEND SHIFT	0.3	0.4	0.4	0.4
OTHER	10.1	9.3	6.5	6.8
TOTALS:	61%	60%	39%	40%

Source: Labour Force Survey (unpublished data)

NOTE: Figures given are percentages of all those working shiftwork "usually" or "sometimes".

Definitions:

<i>Three-shift working</i>	The day is divided into three working periods - morning, afternoon and night. This kind of shiftwork usually, but not always, involves one or more weeks of mornings, followed by one or more weeks of afternoons, followed by one or more weeks of nights.
<i>Continental shifts</i>	This is a continuous three-shift system that rotates rapidly, e.g. three mornings, then two afternoons, then two nights. Usually there is a break between shift changes.
<i>Two-shift system with earlies and lates or double day shifts</i>	This is normally two shifts of eight hours each, e.g. 0600-1400 and 1400-2200. Shifts are usually alternated weekly or over longer intervals.
<i>Split shifts</i>	These are full shifts divided into two distinct parts with a gap of several hours in between. Used in industries where peak demands are met at different times of the day, e.g. catering, passenger transport and service industries.
<i>Morning shift</i>	If this is full-time, most commonly 0600-1400. This code is used if the morning shift is the only shift worked or worked part time during the morning.
<i>Evening shift</i>	If this is full-time, most commonly 1500-2400. Also used for a part-time shift 1700-2100 or 1800-2200. Part-time evening shifts are usually called twilight shifts.
<i>Night shift</i>	If this is full-time, most commonly 1800-0600, and usually continuing after midnight. This code is used only for permanent night work.
<i>Weekend shift</i>	This code is used for work during Fridays, Saturdays, Sundays (0600-1800), when there is no other work.
<i>Other type of shift work</i>	This code is only used when none of the above apply.

Source: Labour Force Survey (Survey User's Guide: "Shiftwork & Weekend Working", unpublished instructions, March-May 1994)

It is not possible to be certain that respondents always follow the strict definitions of the interview schedule. For example, 4-crew 12-hour shift systems are now quite common in the UK: a respondent could call this "2-shift" (as they only work two different kinds of shift, 12-hour days or 12-hour nights), or "night or day" (which is strictly meant for the system of a day shift, a gap, a night shift, another gap, and then the next day shift) or even "continental". The curiosity about "continental" is that it originally appears to have been used to describe shift systems that ran through over the weekend - now commonly called "continuous shift systems", in the belief that this pattern was common on the mainland of continental Europe. The first "continental" shift systems tended to have 7 Mornings, 2 Off, 7 Evenings, 2 Off, 7 Nights, 3 Off. One of the first rapidly rotating shift systems, the 2-2-3, was also called "fast continental" and the definers of the survey questions and responses have picked on that as the "official" meaning of continental.

Thus the UK results are probably fairly comparable from year to year, but must be interpreted with caution, because of the possible random assignment of cases like the above, depending on the rapport of the interviewer and respondent. They are certainly not easy to compare with national statistics from other countries.

Within the UK, there appear to have been substantial increases in employees on certain shifts both between 1992-93 and 1993-94:

- Morning shifts - 42% increase;
- Evening or twilight shifts - 41% increase;
- Night shifts - 28% increase.

The figures for 3-shift working and continental shifts are shown below by industrial sectors. Neither of these is identified with continuous shiftworking. The most interesting point about these tables is the growth in sectors 5 and 10, combined with a decline in more traditional sectors, such as 2, 3, 4 and 8.

Table 2.6: 3-shift workers in various industrial sectors (in thousands): UK (1992 vs. 1994)

Industry	1992			1994			% Change
	Male	Female	Total	Male	Female	Total	
1	0	0	0	1.3	0	1.3	NA
2	50	0.4	50.4	24	0	24	-52%
3	53	1.3	54.3	45	3.4	48.4	-11%
4	75	8	83	86	6	92	11%
5	90	10	100	97	7	104	4%
6	5	0	5	2	0	2	-60%
7	20	18	38	26	26	52	37%
8	76	8	84	79	6	85	1%
9	11	4	15	23	9	32	113%
10	128	132	260	128	163	291	12%

Source: Labour Force Survey (unpublished data)

Table 2.7 : Continental shiftworkers in various industrial sectors (in thousands): UK (1992 vs. 1994)

Industry	1992			1994			% Change
	Male	Female	Total	Male	Female	Total	
2	13	0	13	10	0	10	-23%
3	43	0	43	38	2	40	-7%
4	25	2	27	24	0.4	25	-10%
5	30	2	32	35	3	38	19%
6	3	0	3	0.4	0	0.4	-87%
7	5	2	7	6	3	9	29%
8	7	0.8	8	6	0.9	7	-12%
9	1.7	0.4	2.1	3	0	3	25%
10	17	6	23	18	8	26	13%

Source: Labour Force Survey (unpublished data)

Key to industrial sectors:

- 1 – Agriculture, forestry and fishing
- 2 – Energy and water supply
- 3 – Minerals, ores, metals, chemicals
- 4 – Metal goods, engineering, vehicles
- 5 – Other manufacturing industries
- 6 – Construction
- 7 – Distribution, hotels and catering
- 8 – Transport and communications
- 9 – Banking, finance, business services, leasing
- 10 – Other services

Chapter 3: *SECTORS WITH CONTINUOUS SYSTEMS*

Introduction

Similar industrial sectors are compiled in this chapter, because there are probably underlying similarities in technology in Western Europe, and it may also be more interesting to some readers to jump straight to their own sector.

Changes and Trends

Knauth and Hornberger (1995) note two main trends in the development of continuous shiftworking in more and more companies in Germany:

- changes from slow- to fast-rotating shift schedules
- the introduction of flexibility in working time arrangements both for the company and employees, such as flexitime, individual working time arrangements, yearly working time or part-time work. This is partly due to the reduction of agreed working time, as companies are being forced to find ways to cover their operational time, which has remained constant.

Van der Weerd and Jansen (1996) report that, while “traditional” forms of shiftwork in the Netherlands are found mainly in the industrial sector, irregular shifts occur mostly in the services sector, which has seen a 15% growth in employment during the period 1987-1993. They note a two-stage development in round-the-clock systems generally:

- “Stage 1: broadening of working hours, increase of 24-hour working hour regulations in shift work, development from four- to five-shift systems;
- Stage 2: switching from round-the-clock shift systems to more irregular/flexible 24-hour systems.”

Two other developments seen from the mid-70's have been (1) a reduction of working time in full, continuous operations (down to 33.6 hrs/week) and, as in Germany, (2) changes from slow- to fast-rotating shift schedules.

Textiles

In recent years the need for increasing productivity and reducing labour costs has forced the extension of working days. In Italy, the textile sector has seen the most extensive changes in working time organisation.

During the late 70's and the early 80's many companies that had operated using classical working times based on day work (normal day or 2 shifts) on 5 days per week (from Monday to Friday) took their first step towards semi-continuous shift systems based on three 8-hour shifts on 5 days, or on four 6-hour shifts on 6 days per week. This extended productive time to 4,500-6,000 hours per year. In the case of 3x8 shift systems, workers operated for 40 hours per week, whereas, in the case of 4x6 shift systems, working hours were reduced to 36, but with the same salary. The extra four hours' pay was justified by the elimination of meal breaks, and by the necessity of making one extra commuting journey to work each week.

Interestingly, the Netherlands has had some experience with 6-hour shifts in the banking sector, which reduced the working week to about 28 hours/week; they were enjoyed by the workers.

These 6-hour shifts were in many ways quite revolutionary, and are well worth more study and widespread discussion.

In the late 80's and early 90's, many firms took a second step towards continuous shift systems by including Sunday work, which raised the total to

8,000 hours per year of plant utilisation. The shift schedules were mainly organised with 3 or 4 shifts per day, of 8 or 6 hours respectively, but the workers obtained a further reduction of their working hours to 34, 32 or even 30 hours per week, paid as 40.

The distribution of working days has been arranged mainly on 3 or 4 days according to the length of shifts (6 or 8 hours) and the contracted length of the working week. According to a recent study of 42 companies (Ravasio and Zanzottera, 1991) the shift rotas adopted are:

- 3 days on / 1 or 2 days off: 57.1%
- 4 days on / 1 or 2 days off: 28.6%
- 5 days on / 2 or 3 days off: 7.1%
- 6 days on / 2 or 3 days off: 7.1%

There are also some cases of faster rotating shift schedules with 3 days on and 2 days off, and there is one factory that adopted 12-hour shifts, so that people work 32 hours per week (paid as 40) on 3 days (12h-12h-8h), then have 4 days off.

In a few cases, part-time work has been introduced, integrated with full-time work on continuous shift systems. Full-time workers are employed from Monday to Friday, while part-time workers are employed on two 12-hour shifts on Saturday and Sunday plus 8 hours on one normal day every two weeks.

These shift schedules, after initial opposition connected with the introduction of night and/or Sunday work, are now particularly appreciated by women, because of the increased free time they can spend on their family commitments.

From the labour market perspective, despite a 25% reduction of the workforce suffered during the 80's, this re-organisation of working time was one of the main factors that allowed the Italian textile sector to maintain competitiveness and to sustain job losses 3-4% lower than in other industrial sectors. This sector now accounts for 1/3 of the total European workforce. (Costa, 1995)

Léonard (1995) reports different patterns in the textile industry in Belgium: 2 shifts of 8 hours a day each, 2 shifts followed by a night shift, 3 shifts and 4 shifts (no work on Sundays), and 5 shifts. The typical company works every day of the year. While 3 shifts are at work, two are at rest. (Table 3.1)

Table 3.1 : Shifts in the textile industry in Belgium

Cycle	Mon	Tue	Wed	Thu	Fri	Sat	Sun	
1st week	M	M	M	R	R	A	A	= 40 hours
2nd week	A	R	R	N	N	N	R	= 32 hours
3rd week	R	M	M	M	M	R	R	= 32 hours
4th week	A	A	A	A	R	R	N	= 40 hours
5th week	N	N	N	R	R	R	R	= 24 hours
								=168 hours =33.6 hours/week
Totals³	MAANR	MMANR	MMANR	MANRR	MNRRR	ANRRR	ANRRR	

Key: M = morning, A = afternoon, N = night, R = rest

³This is, obviously, not the complete rota, as the column totals do not produce balanced manning, but this is all that Blanpain and Kohler (eds.) show.

In one of the textile plants a full continuous shiftwork system has been introduced for manual workers ensuring full production every day of the year (including Saturdays, Sundays and public holidays, with the exception of Christmas and New Year's Day). To that end six shifts operate in such a way that while three shifts each perform 8 hours, the three other shifts are at rest. Each worker works 26 weeks a year (7 days of 8-3/4 hours; one week work, one week rest, while during the third week the worker can be called up); and each worker has three weeks of paid holidays. Work on Saturdays is rewarded with an extra 25% premium payment during the day (until 7.30 p.m.) and 64% at night (9.30 p.m. - 5.30 a.m.); 100% for work on Sundays, and 200% on public holidays.

Bridging shifts

Special shifts work on Saturdays, Sundays and public holidays, while other shifts do not work during these days. These special shifts do not work on Saturdays and Sundays during their annual holidays, of course.

In other textile plants of the same enterprise, bridging shifts have been introduced, assuring the continuity of the activities on 49 Saturdays, 49 Sundays and the 10 legal public holidays (the other Saturdays and Sundays are part of the 3 weeks' paid vacation). Two shifts, each of 12 hours, have been introduced. Participation in the bridging shifts is voluntary.

The dates and spread of the annual holidays are determined by the joint committee for the branch of the industry. If the joint committee fails to decide, the decision will be taken by the works council. Since 1975, Belgian employees generally have enjoyed four weeks' vacation and 10 paid public holidays. The enterprise is closed for at least two weeks during the summer, and rest days can be added on to these holidays.

Metallurgy

In Belgium, Léonard reports that one company in the steel industry has adopted a 7-7-7-7 system: 7M/7A/7N/7R. The only change consists in the fact that the shifts start at 7 a.m.-3 p.m.-11 p.m. instead of the classical 6 a.m.-2 p.m.-10 p.m. During the holidays, they call upon personnel of other departments or from outside.

Costa (1995) reports that an important steel company in Northern Italy has recently made an agreement on the extension of continuous shift systems in some departments of a large steel factory. This has been done by introducing a fifth crew, combined with some solidarity contracts for young people (see BEST 9), which allowed a reduction of weekly working hours of shiftworkers to as little as 30 hours.

The adoption of the fifth crew led to a re-organisation of shift schedules: the previous shift rota cycle was 20 days long, having two periods of "5 days on / 2 days off" alternating with one period of "4 days on / 1 day off". The new shift cycle was reduced in length to 13 days, including one period of "4 days on / 3 day off" alternating with one period of "4 days on / 2 days off" (Table 3.2). Consequently, the shiftworkers benefit by 18 more days off per year. (This is, strictly speaking, a semi-continuous shift system, with free weekends.)

Table 3.2 : Continuous shift system in a steel company in Northern Italy

Shift Cycle	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa
1	M	M	M	M	M	R	R	R	A	A	A	A	R	R
2	N	N	N	N	Sn	R	R	R	M	M	M	M	R	R
3	A	A	A	A	R	R	R	N	N	N	N	Sn	R	R

Key: M = Morning A = Afternoon N = Night
R = Rest Sn = "Smonto Notte"

Interestingly, the first day off after night shift is not counted as a rest day. In Italian, it is called "smonto notte", meaning "dismount from night". As the first recovery day is often felt to be a wasted day because it is partly spent asleep, this system of computation may have wider appeal.

Another important metallurgical company adopted a continuous shift system on a 3x8 shift schedule, with four crews and fast rotation, alternating "4 days on / 3 days off", "3 days on / 2 days off" and "2 days on / 1 day off" shift rotas. The compensations for shiftworkers were: a reduction of 266 hours per year; 60.4% higher pay for night hours, and a further 39.3% for weekend work; 18 minutes of overlap between the shifts, paid as overtime; and arrangement of staggered holidays from June to September. Two 10-hour weekend shifts were introduced for part-time workers.

Furthermore, exemption from nightwork was agreed to for women with children under 6 years of age, unmarried women, women with old parents or handicapped relatives requiring assistance; and women with more than 26 years' service. It was also agreed to give particular consideration to women whose husbands were shiftworkers.

Another company producing presses asked for an extension of working time to Saturday and Sunday using two 10-hour shifts. The management proposed keeping present shiftworkers on a 3x8 shift system from Monday to Friday and starting two weekend teams working 20 hours in two days, paid as 32 hours. The unions opposed this on the ground that the people engaged in weekend teams were not sufficiently protected. Their proposal was to extend working time to Saturday only by increasing the number of the full-time workers and adopting a 6x6 shift system (four shifts of 6 hours on 6 days) with 34.5 working hours per week.

In another factory, extension to Saturday and Sunday work (but without night work) has been made possible by making the individual's weekly working hours "flexible": these ranged from 32 to 48 hours on a 6x6 shift system. A maximum of sixteen 48-hour weeks are allowed per year, and these must be balanced by the same number of 32-hour weeks. The eight hours above 40 (which is contractual weekly working time) are paid as overtime.

Chemical sector

In general, in Italy continuous shift systems are organised on a basis of 244 individual working days per year (37h 20m per week on average). Most companies in Italy adopt the 3x8 shift system with "4 days on / 2 days off" or "2 days on / 1 day off" shift rotas; normally they have four ordinary crews plus some "floating" workers, who also alternate on to daywork. This permits the reduction of annual working days to 240.

In some oil refineries a fifth crew has been introduced (in some cases permanently; in others, only seasonally), thus reducing individual working hours to 33h 36m per week on average. This is also true of most oil refineries in the Netherlands.

In a large rubber company in Northern Italy, the introduction of the continuous shift system (3x8 shifts on a 4/2 rota) has been accompanied by a reduction of annual working days to 214.5 instead of 229 (as it was in semi-continuous shift systems), together with an increase in salary for Saturday and Sunday work.

In another important rubber company in Southern Italy, extension to Saturday and Sunday work was carried out through the engagement of more than 300 young people working only during weekends. (Costa, 1995)

The rota in Table 3.3 basically uses four consecutive 12-hours shifts, followed by 4 days off. In every 60 days each crew has an extended break of 16 days - see Crew B at the end of the diagram in Table 3.3.

Table 3.3: 12-hour 5-crew system, with 4 consecutive shifts: UK chemical industry

	smtw	tfss	mtwt	fssm	twtf	ssmt	wtfs	smtw	tfss	mtwt	fssm	twtf	ssmt	wtfs	smtw
M	A	C	B	D	A	E	B	D	C	E	B	A	C	E	D
N	B	D	A	E	B	D	C	E	B	A	C	E	D	A	C
O	D	A	C	B	D	A	E	B	D	C	E	B	A	C	E
o	C	B	D	A	E	B	D	C	E	B	A	C	E	D	A
B	E	E	E	C	C	C	A	A	A	D	D	D	B	B	B

Source: Chemical works in the U.K.

Note: As each crew always works 4 of each shift, days of the weeks are grouped in fours, with only one crew shown against each block of 4.

Key: M=Mornings (or Days), N=Nights, O=Days Off after Days, o=Days off after Nights, B=extended Break

From the chemical industry in Belgium, Léonard (1995) reports briefly on increasing variety. "The system which is often chosen is the following : a cycle of 25 days with 5M/3R/5N/4R/5A/3R. We also find the system 7M/2R/7A/2R/7N/4R/4D/2R, or the system with fast rotation, 2M/2A/2N/4R. Another system is 5M/3R/5A/3R/5N/4R." (Table 3.4)

Table 3.4 : Variety in shifts in the Belgian chemical industry

(a) 5M/3R/5N/4R/5A/3R

WK	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S									
1	M	M	M	M	M	R	R	R	N	N	N	N	N	R	R	R	R	A	A	A	A	A	R	R	R	M	M	M	M	M	R	R	R	N	N		
2	N	N	N	R	R	R	R	A	A	A	A	A	R	R	R	M	M	M	M	M	R	R	R	N	N	N	N	N	R	R	R	R	A	A	A		
3	A	A	R	R	R	M	M	M	M	R	R	R	N	N	N	N	N	R	R	R	R	A	A	A	A	A	R	R	R	M	M	M	M	M			
4	R	R	R	N	N	N	N	R	R	R	R	A	A	A	A	A	R	R	R	M	M	M	M	M	R	R	R	N	N	N	N	N	R	R			
5	R	R	A	A	A	A	A	R	R	R	M	M	M	M	M	R	R	N	N	N	N	N	R	R	N	N	N	N	N	R	R	A	A	A	A	R	R

Total of each column: MANRR

(b) 7M/2R/7A/2R/7N/4R/4D/2R

WK	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S							
1	M	M	M	M	M	M	R	R	A	A	A	A	A	A	A	R	R	N	N	N	N	N	N	N	N	R	R	R	R	D	D	D	D	R	R
2	R	D	D	D	D	R	R	M	M	M	M	M	M	M	R	A	A	A	A	A	A	A	A	R	R	N	N	N	N	N	N	N	N	R	R
3	N	N	N	N	R	R	R	R	D	D	D	D	R	R	M	M	M	M	M	M	M	R	R	A	A	A	A	A	A	A	R	R	N	N	N
4	A	A	R	R	N	N	N	N	N	N	R	R	R	R	D	D	D	D	R	M	M	M	M	M	M	M	R	R	A	A	A	A	A	A	
5	R	R	A	A	A	A	A	A	R	R	N	N	N	N	N	N	N	R	R	R	R	D	D	D	D	R	M	M	M	M	M	M	M		

Total of each column: MANRR or MANDR

(c) 2M/2A/2N/4R

WK	M	T	W	T	F	S	S	M	T	W	T	F	S	S
1	M	M	A	A	N	N	R	R	R	R	M	M	A	A
2	N	N	R	R	R	R	M	M	A	A	N	N	R	R
3	R	R	M	M	A	A	N	N	R	R	R	R	M	M
4	A	A	N	N	R	R	R	R	M	M	A	A	N	N
5	R	R	R	R	M	M	A	A	N	N	R	R	R	R
Total of each column: MANRR														

(d) 5M/3R/5A/3R/5N/4R

WK	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S														
1	M	M	M	M	M	R	R	R	A	A	A	A	R	R	R	N	N	N	N	N	N	R	R	R	R	M	M	M	M	R	R	R	A	A	
2	A	A	A	R	R	R	N	N	N	N	N	R	R	R	R	M	M	M	M	M	R	R	R	A	A	A	A	A	R	R	R	N	N	N	N
3	N	R	R	R	R	M	M	M	M	R	R	R	A	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R	R	M	M	M	M	M	
4	R	R	R	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R	R	M	M	M	M	M	R	R	A	A	A	A	A	R	R		
5	R	N	N	N	N	N	R	R	R	M	M	M	M	M	R	R	R	A	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R		
Total of each column: MANRR																																			

Over the last five years Knauth and Hornberger's research team has tracked changes in shift schedules in 29 production units in various branches of German industry, most of which changed to (new) continuous shift systems. One group of shiftworkers in a chemical company changed from a continuous 4-shift to a 5-shift system, because a reduction in the agreed working time (from 39 to 37.5 hours per week) necessitated a new system in order to manage the planning of these employees' working time. The company used this opportunity to introduce more ergonomically favourable shift schedules, all of which were approved by the shiftworkers' vote. The additional shifts that must be worked to achieve contracted weekly working time can be used in a flexible manner, in order to adjust working time volume to the fluctuation of work volume.

Electricity-generating sector

The continuous shift systems adopted in power stations in Italy are based on six crews, with fairly rapid rotation, and completing their full cycle in six weeks (Table 3.5) This replaced a 5-week 5-crew cycle, and is generally more popular.

It is worth noting that there are only 7 night shifts in each six week cycle (3 consecutive nights once, and 2 consecutive nights twice). There are 12 Rest days in each 6 weeks, including one weekend with both Saturday and Sunday off, and a total of 3 of the Saturdays free and 3 of the Sundays free. There are also 9 Day shifts in each cycle, in one case from Monday to Friday, and in the other from Tuesday to Friday.

The previous five-crew rota (Table 3.6) had 7 night shifts in each five weeks (4 consecutive nights once and 3 consecutive nights once); 10 Rest Days in 5 weeks and no weekends with both Saturday and Sunday off; and 4 Day shifts in each cycle, from Tuesday to Friday.

Compared with the old rota, the new rota also gives

- better opportunities for planning holidays without incurring overtime, and
- longer periods of Rest days, which is better for those commuting a long distance to work.

Table 3.5 : Six-crew shift rota in an electric plant in Italy

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	R	D	D	D	D	R	N
2	N	A	A	R	R	A	A
3	A	R	M	M	M	M	R
4	R	N	N	A	A	R	M
5	M	M	R	N	N	N	R
6	D	D	D	D	D	R	R
Totals	MANDRR	MANDDR	MANDDR	MANDDR	MANDDR	MANRRR	MANRRR

Table 3.6 : Former five-crew shift rota in an electric plant in Italy

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	R	A	A	A	A	R	N
2	N	N	N	R	R	A	A
3	A	R	M	M	M	M	R
4	R	D	D	D	D	R	M
5	M	M	R	N	N	N	R
Totals	MANRR	MANDR	MANDR	MANDR	MANDR	MANRR	MANRR

Key: D = Daywork (0800-1230; 1330-1730)

M = Morning shift (0800-1600)

A = Afternoon shift (1600-2400)

N = Night shift (2400-0800)

R = Rest day

Some general information about other work sectors

In the graphics sector in Italy, workers involved in continuous shift systems have a reduction of working hours from 40 to 36 hours per week, plus 4 extra days off per year.

In the paper sector in Italy, the mean working time is 37h 20m per week with "2 days on / 1 day off", "4 days on / 2 days off" or "6 days on / 3 days off" shift rotas.

In the broadcasting sector in Italy, shiftworkers have a contractual working time of 35 hours per week in state companies, and of 38.5 in private ones.

In the food sector in Italy, the national work contract foresees a reduction of 84 hours per year for continuous shiftworkers, of 76 hours for 2-shift workers and of 80 hours for 3-shift workers on semi-continuous shift systems. (Costa, 1995)

In the hospital sector in Belgium, Léonard has recently carried out a survey for the ONEM (National Service for Employment and Labour). His team found 142 different schedules for 356 persons questioned.

He reports the following distribution:

- 1 shift : days: (~ 8 hours) 20 schedules for 14% of the personnel. Mainly reserved for the heads of department or superiors. 5 days worked on average and 2 days rest.
- 1 dayshift of 12 hours. 12 different schedules for 8% of the personnel : 3 to 4 days worked for ~ 3 days rest. Employees can work a full week and accumulate rest days.

- 2 shifts: morning-afternoon. 68 schedules, 48% of the personnel. Various systems coexist of 5, 7, 10, 12, 15 and even 18 days of work. In this latter case, the work period is followed by a week of rest.
- 3 shifts : rotation M-A-N. 33 schedules for 23% of the personnel. Often 10 days work and/or 7 consecutive nights.
- 1 permanent fixed night shift : 9 schedules for 6% of the personnel. Generally 7 nights followed by 7 days' rest. Part-timers work one week of 4 nights and one of 3 nights per month.

Transport

Another sector affected by continuous duty is public transport: in Belgium, it is noted that 44% of employees in this sector work some nights. 27% of the personnel of the railway company work continuous shifts. (Léonard and Vandeville, 1994)

Chapter 4: **WAYS OF MANNING CONTINUOUS SYSTEMS**

Introduction

The variety of ways of manning continuous shift systems, outlined in chapter 1, are shown in detail in practical examples from companies in this chapter.

Four crews : rapid or slow rotating, or fixed

In a packaging company in Belgium, Léonard (1995) reports that the extrusion department, on continuous working shifts, changed from a 4-crew, long cycle discontinuous system of 5M/2R/5A/2R/5N/8R to a system of 2M/2A/2N/4R to the great satisfaction of the workers. The duration of work is 37 hours. There are 9 days off at the end of December. The shift patterns are disrupted from 1 July to 31 August so that personnel can take 20 days of holidays. During these summer holidays, a sixth shift is created, formed by three persons coming from the five other shifts of the extrusion department and other people from outside or other departments (4M/2R/4N/1R/4A/1R). (Table 4.1)

Table 4.1 : Changes in shift patterns in a Belgian packaging company

a) Before: Semi-continuous -- 5M/2R/5A/2R/5N/8R

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	M	M	M	M	M	R	R
2	A	A	A	A	A	R	R
3	N	N	N	N	N	R	R
4	R	R	R	R	R	R	
Totals:	MANR	MANR	MANR	MANR	MANR		

b) After: 2M/2A/2N/4R

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	M	M	A	A	N	N	R
2	R	R	R	M	M	A	A
3	N	N	R	R	R	R	M
4	M	A	A	N	N	R	R
5	R	R	M	M	A	A	N
6	N	R	R	R	R	M	M
7	A	A	N	N	R	R	R
8	R	M	M	A	A	N	N
9	R	R	R	R	M	M	A
10	A	N	N	R	R	R	R
Totals	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R

c) After: Holidays -- 4M/2R/4N/1R/4A/1R

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	M	M	M	M	R	R	N
2	N	N	N	R	A	A	A
3	A	R	M	M	M	M	R
4	R	N	N	N	N	R	A
5	A	A	A	R	M	M	M
6	M	R	R	N	N	N	N
7	R	A	A	A	A	R	M
8	M	M	M	R	R	N	N
9	N	N	R	A	A	A	A
10	R	M	M	M	M	R	R
11	N	N	N	N	R	A	A
12	A	A	R	M	M	M	M
13	R	R	N	N	N	N	R
14	A	A	A	A	R	M	M
15	M	M	R	R	N	N	N
16	N	R	A	A	A	A	R
Totals:	4M4A4N4R	4M4A4N4R	4M4A4N4R	4M4A4N4R	4M4A4N4R	4M4A4N4R	4M4A4N4R

Knauth and Hornberger (1995) note that, on a continuous shift system, four crews would have to work an average of 42 hours per week to cover the 168 hours in a week. However, as the agreed weekly working time in most sectors and countries is less than 42 hours per week, overtime has to be paid or compensation has to be given in the form of additional days off. In a 4-shift system, if overtime is not paid, every worker must be given an additional day off almost every week, and this generally proves too difficult for the supervisor or crew to handle. Therefore, the shorter the agreed weekly working time, the stronger the pressure to change from four shifts to other types of shift systems.

Tables 4.2 and 4.3 demonstrate two examples of continuous 4-shift systems. The shift system in Table 4.2 has 8-hour shifts from Monday to Saturday and 12-hour shifts on Sunday to obtain one additional free Sunday. The forward rotation of the shifts (M/E/N) is favourable but, from an ergonomic point of view, the four consecutive night shifts are not. The advantage of the system in Table 4.3 is the regular blocks of free days, in particular the two long free weekends. However, more than two 12-hour shifts in a row are not recommended if the work involves heavy physical or difficult mental tasks (Knauth, 1993).

Table 4.2 : Continuous 4-shift system in the German chemical industry

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	M1	M1	A	A	A	A	
2	N1	N1	N1			M1	M2
3	A	A		N1	N1	N1	N2
4			M1	M1	M1		

= day off
 M1 = morning shift (06.00 - 14.00) N1 = night shift (22.00 - 06.00)
 M2 = morning shift (06.00 - 18.00) N2 = night shift (18.00 - 06.00)
 A = afternoon shift (14.00 - 22.00)

Table 4.3 : Continuous 4-shift system in a Swiss oil refinery

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	D	D			N	N	N
2			D	D			
3	N	N			D	D	D
4			N	N			

☐ = day off

D = day shift (06.30 - 18.30)

N = night shift (18.30 - 06.30)

In the German chemical industry, one company uses a 4-shift system which is composed of the following regular subcycles: one 12-hour day shift, one 12-hour night shift, followed by two days off, and so on.

The above rotas assume that constant manning is necessary. But van de Weerd and Jansen (1996) remark on the importance of remembering the following points when scheduling shifts for continuous systems:

- If night shifts are inevitable, one should aim at keeping the night staffing as small as possible.
- The following universal rules apply:
 - the work supply determines the staffing needs, but:
 - the work supply should be directed towards convenient hours as much as possible.

As Gadbois and Dorel (1996) note, such scheduling depends on the degree of specialisation of the tasks being performed. Scheduling constraints are much greater in sectors requiring a high degree of specialisation, where a suitable number of operators qualified for each task are required in the crew at all times (e.g. nuclear power stations). In contrast, there is much more flexibility if there are a large number of employees with the same qualifications and a number of positions requiring essentially similar skills (e.g. hospital nursing departments).

Five crews

In Belgium, Léonard (1995) reports on a move from four crews to five in the paper mill sector. A four-shift system (7M/2R/7A/2R/7N/3R) was replaced by a continuous five-shift system for 1/3 of the personnel on one of the three production lines (5M/3R/5A/3R/5N/4R) (Table 4.4). The working week was reduced by two days (from 7 consecutive shifts to 5) and the rest periods were lengthened by one day. The duration of the cycle is 25 days. After 7 cycles (175 days), the cycle starts again on the same day. 105 days x 8 hours = 840 hours : over 25 weeks = 33.6 hours/week. To bring the total up to 36 hours, staff will have to work 13 additional days, determined in advance and distributed over the whole year. The company closes five times per year for two days for holidays, and there is a shut-down of five days for Christmas. The other days are taken between June and September, when the company employs external personnel.

Table 4.4 : Change from 4- to 5-shift system in the paper mill sector of Belgium

a) Before:

7M/2R/7A/2R/7N/3R

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	M	M	M	M	M	M	M
2	R	R	A	A	A	A	A
3	A	A	R	R	N	N	N
4	N	N	N	N	R	R	R
Total	MANR	MANR	MANR	MANR	MANR	MANR	MANR

b) After:

5M/3R/5A/3R/5N/4R

WK	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S						
1	M	M	M	M	M	R	R	R	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R	R	M	M	M	M	R	R	R	A	A	
2	A	A	A	R	R	R	N	N	N	N	R	R	R	R	M	M	M	M	M	R	R	R	A	A	A	A	A	R	R	R	N	N	N	N
3	N	R	R	R	R	M	M	M	M	R	R	R	A	A	A	A	R	R	R	N	N	N	N	R	R	R	R	M	M	M	M	M		
4	R	R	R	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R	R	M	M	M	M	M	R	R	A	A	A	A	R	R		
5	R	N	N	N	N	N	R	R	R	M	M	M	M	M	R	R	R	A	A	A	A	A	R	R	R	N	N	N	N	N	R	R	R	
Total of each column: MANRR																																		

In West Germany, a five-crew system changes the scenario to fewer working hours per week than generally agreed upon (168 hours/5 = 33.6 hours). Thus, additional days have to be worked on days which are characterised in the basic shift system as “free” days. Although in four- and five-crew shift systems the agreed working time may be identical, from a psychological point of view, workers would rather have additional days off than additional working days.

A few progressive companies offer part-time contracts in connection with the introduction of a 5-shift system. A German company in the chemical industry offers the choice between 33.6, 35.0 and 37.5 hours per week. If, for instance, a shiftworker chooses 33.6 hours per week (with a correspondingly reduced income), he does not have to work any additional shifts. About 20% of the continuous shiftworkers have chosen to work less than 37.5 hours per week. Younger and older shiftworkers, in particular, are interested in reduced weekly working hours.

A simple way of changing from a four- to a five-shift system is to add a free week to the old four-shift system, which has been done in Table 4.5. However, during the “free” week, additional shifts have to be worked to reach the agreed weekly working time. The lesser this agreed weekly working time is, the fewer additional shifts have to be worked.

Table 4.5 : Continuous 5-shift system in the German chemical industry

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	M	M	A	A	N	N	N
2			M	M	A	A	A
3	N	N			M	M	M
4	A	A	N	N			
5							
Total cover:	MAN	MAN	MAN	MAN	MAN	MAN	MAN

☐ = day off A = afternoon shift
 N = night shift M = morning shift

If shiftworkers are allowed to participate in the design of a new shift system, the acceptance of this new rota is much higher. The five-shift system in Table 4.6 was designed by shiftworkers after receiving intensive information on ergonomic recommendations. As with every shift system, it has also negative aspects; e.g. it looks very irregular and has no forward rotation. The positive aspects are short blocks of morning, evening and night shifts, a maximum of five working days in a row and two longer free weekends.

Table 4.6 : Continuous 5-shift system in the chemical industry (additional shifts are necessary)

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	M1	M1	N1	N1			
2	A	A	A		M1	M1	M2
3	N1	N1					
4			M1	M1	N1	N1	N2
5				A	A	A	
Total cover:	MAN	MAN	MAN	MAN	MAN	MAN	M2N2

□ = day off
 M1 = morning shift (8 hours)
 M2 = morning shift (12 hours)
 N1 = night shift (8 hours)
 N2 = night shift (12 hours)
 A = afternoon shift

The five-shift system in Table 4.7 has a very regular pattern, forward rotation, short blocks of morning, evening and night shifts and some longer free weekends. If an additional morning is added before the first morning shifts in the plan, or if an additional night shift is added after the second night shifts, the block of working days increases to seven days. As mentioned above, some companies offer part-time work of 33.6 or 35.0 hours per week, which reduces the amount of necessary additional shifts to zero or to one in five weeks.

Table 4.7 : Continuous 5-shift system in the Dutch, English, French and German chemical industry

Week	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
1+2	M	M	A	A	N	N					M	M	A	A
3+4	N	N					M	M	A	A	N	N		
5+6			M	M	A	A	N	N					M	M
7+8	A	A	N	N					M	M	A	A	N	N
9+10					M	M	A	A	N	N				
Totals	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN	MAN

□ = day off
 M = morning shift
 A = afternoon shift
 N = night shift

The continuous 5-shift system shown in Table 4.8 has two features of special interest: (1) to compensate employees on the morning shift for the inconvenience of its heavy workload, the shift is shortened to 7 hours; and (2) the employees work a 12-hour shift on Sundays to gain an extra Sunday off.

Table 4.8: Continuous 5-shift system in Dutch electrical plant

WEEK	Mo	Tu	We	Th	Fr	Sa	Sun
1	M	M	M	M	M		
2	N	N	N	N			
3	A	A	A			M	M ₁₂
4					N	N	N ₁₂
5				A	A	A	
Total	MAN	MAN	MAN	MAN	MAN	MAN	M₁₂N₁₂

Table 4.9 shows another continuous system, the core of which is a regular 5-shift system, worked in a cycle of 15 weeks (3x5). Each crew totals a number of (K-L) shiftworkers. The L workers have a daytime schedule to do a project for 15 weeks; after this period they return to the regular shifts, and another group of shiftworkers starts or continues a project (multicraft system).

Table 4.9: Continuous 5-shift system in the Dutch electrical sector

Week	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
1	M	M	M	-	-	A	A	D	D	D	D	D	-	-
2	A	A	-	-	N	N	N	D	D	D	D	D	-	-
3	-	-	-	M	M	M	M	D	D	D	D	D	-	-
4	-	-	A	A	A	-	-	D	D	D	D	D	-	-
5	N	N	N	N	-	-	-	D	D	D	D	D	-	-
Total	MAN	MAN	MAN	MAN	MAN	MAN	MAN	5D	5D	5D	5D	5D	-	-

Table 4.10 (a and b) below demonstrates how the summer holiday season is handled by a 5-crew shift system working in the Mars factory in Slough, England. During non-holiday months, each crew works 3M/3A/3N/6R. During June, July and August, each has a block of 17 days in which to take their holidays. The remaining crews work a shorter cycle which contains only 2 or 3 rest days instead of 6 and keeps alternate Saturday/Sunday blocks together. These coincide with the end of one group's holiday and the start of the next group's.

Table 4.10 (a) : Typical 5-crew shifts in the Mars factory

Week	M	Tu	We	Th	F	S	S
1	M	M	M	A	A	A	N
2	N	N	R	R	R	R	R
3	R	M	M	M	A	A	A
4	N	N	N	R	R	R	R
5	R	R	M	M	M	A	A
6	A	N	N	N	R	R	R
7	R	R	R	M	M	M	A
8	A	A	N	N	N	R	R
9	R	R	R	R	M	M	M
10	A	A	A	N	N	N	R
11	R	R	R	R	R	M	M
12	M	A	A	A	N	N	N
13	R	R	R	R	R	R	M
14	M	M	A	A	A	N	N
15	N	R	R	R	R	R	R
Totals	3M3A3N6R	3M3A3N6R	3M3A3N6R	3M3A3N6R	3M3A3N6R	3M3A3N6R	3M3A3N6R

This is essentially a 15-day cycle, made up of 3 mornings, 3 afternoons, 3 nights, and 6 rest days. So this moves on one day every fortnight, and the block of 3 mornings changes from starting on Monday in week 1 to starting on Tuesday in week 3, achieving a full cycle at the start of week 16.

Table 4.10 (b): 5-crew shifts in the Mars factory during summer holiday period

Week	M	Tu	We	Th	F	S	S
1	M	M	M	A	A	A	N
2	N	N	R	R	M	M	M
3	A	A	A	N	N	N	R
4	R	R	M	M	A	A	A
5	N	N	N	R	R	R	R
6	R	R	R	R	R	R	R
7	R	R	R	R	R	R	M
8	M	M	A	A	N	N	N
9	R	R	R	M	M	M	A
10	A	A	N	N	R	R	R
Totals	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R	2M2A2N4R

In the holiday period, each shift in turn gets a break starting with their normal rest days but running on for 17 days instead of 6, and to accommodate this, the other shifts change to blocks of 3 (and occasionally 2) rest days, instead of the block of 6. The big blocks of 15 (to get round from starting mornings to starting mornings again) change to a block of 12 followed by a

block of 11, thus making a bigger block of 23. This is done by making the Wednesday-Thursday of every second week into a run of 2 on the same shift, rather than a run of 3. The system does not run a full cycle until 10 weeks have elapsed, by which time each of the five shifts has had its holiday break, by adding 8 days in the middle of their normal rest days.

This is an elegant pattern, whose full symmetry with variations shows up more clearly below when the interlocking patterns of all 5 shift crews are shown:

Typical working month, e.g. April 1996

	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
M																															
A																															
N																															
O																															
O																															

Holiday schedule: June 1996

	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
M																															
A																															
N																															
O																															
O																															

Holiday schedule: July 1996

	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
M																																
A																																
N																																
O																																
O																																

Holiday schedule: August 1996

	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
M																																
A																																
N																																
O																																
O																																

Six crews

Knauth and Hornberger (1995) note that, in cases where there is a great need for regular training (e.g. nuclear power stations), it is useful to build training days into the shift system. The 168 hours in a week are divided by six, so that on average each crew works only 28 hours per week. The difference between the agreed weekly working time may be covered by additional training days. Table 4.11 shows a continuous 6-shift system, which is used in a German nuclear power plant.

Table 4.11 : Continuous 6-shift system in a German nuclear power plant

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	M1	M1	A	A	N1	N1	
2	D	D	D	D	D		
3	N1	N1				M1	M2
4	A	A	N1	N1			
5		D	D	D	A	A	N2
6			M1	M1	M1		
Totals:	MAND RR	MAND R	MANDD R	MANDD R	MAND RR	MAN RRR	M2N2 RRRR

☐ = day off

M1 = morning shift (8 hours)

M2 = morning shift (12 hours)

N1 = night shift (8 hours)

N2 = night shift (12 hours)

A = afternoon shift (8 hours)

D = day shift (training: 8 hours)

A power station in Belgium, alongside a reduction of working time, went from 4 to 5 and finally to the current number of 6 crews. This has been achieved by adding a week of day shift to the block of five-week rosters. Table 4.12 demonstrates what has been realised by these changes, while Table 4.13 gives an idea of the replacements.

Table 4.12: Summary table of the successive system (extract from the Report of the Walloon station)

		MTWTFSS	MTWTFSS	MTWTFSS	MTWTFSS
		48 h	MMMMMM°	AAAAAA	NNNNNNN°
4 shifts	46 h	MMMMMM°	AAAAAA	NNNNNNN°	DD
	44 h	MMMMMM°	AAAAAA	NNNNNNN°	D

		MTWTFSS	MTWTFSS	MTWTFSS	MTWTFSS
		42 h	MMMMMM°	AAAAAA	NNNNNNN°
5 shifts	40 h	MMMMMM°	AAAAAA	NNNNNNN°	DDDD°

		MTWTFSS	MTWTFSS	MTWTFSS	MTWTFSS	MTWTFSS	
		40 h	MMMMMM°	AAAAAA	NNNNNNN°	DDDD	DDDD°
		38-3/4 h	MMMMMM°	AAAAAA	NNNNNNN°	DDD	DDDD°
6 shifts	38 h	MMMMMM°	AAAAAA	NNNNNNN°	DDD	DDDD°	

Source: Haumont and Gobert (1979)

Key:

- M = morning 1: 7 am - 2 pm
- M° = morning 2: 7 am - 6 pm
- A = afternoon: 2 pm - 10 pm
- N = night 1: 10 pm - 7 am
- N° = night 2: 6 pm - 7 am
- D = day 1: 7.15 am - 3.45 pm
- D° = day 2: 7.15 am - 3 pm
- d = work one Saturday morning out of two
- = the days of rest are left blank

Table 4.13: System of replacements (extract from the summary of the Report of the Flemish station)

	S S M T W T F	S S M T W T F	S S M T W T F	S S M T W T F	S S M T W T F	S S M T W T F
A	6 ₁ 6 ₂ 6 ₃ 6 ₄ 6 ₅ 6 ₆ 6 ₇	R - 14 _a 14 _b 14 _c 14 _d 14 _e	14 ₁ 14 ₂ 22 ₃ 22 ₄ 22 ₅ 22 ₆ 22 ₇	22 ₈ 22 ₉ R R R R R	R - R 8 8 8 8	R - 8 8 8 8 8
	↑	↑	↑	↑		
B	R ¹ - ² 8 ³ 8 ⁴ 8 ⁵ 8 ⁶ 8 ⁷	6 6 6 6 6 6 6	R - 14 14 14 14 14	14 14 22 22 22 22 22	22 22 R R R R R	R - R 8 8 8 8
C	R - R 8 8 8 8 8	R - 8 ^a 8 ^b 8 ^c 8 ^d 8 ^e	6 6 6 6 6 6 6	R - 14 14 14 14 14	14 14 22 22 22 22 22	22 22 R R R R R
D	22 22 R R R R R	R - R 8 8 8 8 8	R ¹ - ² 8 ³ 8 ⁴ 8 ⁵ 8 ⁶ 8 ⁷	6 6 6 6 6 6 6	R - 14 14 14 14 14	14 14 22 22 22 22 22
E	14 14 22 22 22 22 22	22 22 R R R R R	R - R 8 8 8 8 8 ⁷	R ^a - ^b 8 8 8 8 8 8	6 6 6 6 6 6 6	R - 14 14 14 14 14
F	R - 14 14 14 14 14	14 14 22 22 22 22 22	22 22 R R R R R	R - R 8 8 8 8 8	R - 8 8 8 8 8 8	6 6 6 6 6 6 6

Source: Haumont and Gobert (1979)

Key:

- 6: morning shift - 6 am to 2 pm
- 8: day shift - 7.55 am to 4.10 pm
- 14: afternoon shift - 2 pm to 10 pm
- 22: night shift - 10 pm to 6 am
- R: rest
- 8: day shift - 7.55 am to 3.25 pm

superscript: Superscripted worker replaces correspondingly subscripted worker in row above.
subscript

Twelve-hour shifts

A system of 2 shifts of 12 hours succeeding each other from 6 a.m. to 6 p.m. and from 6 p.m. to 6 a.m., with sequences of 2 or 3 days work interspersed with 2 or 3 days rest, is reported by Léonard (1995):

Table 4.14 : Continuous 2-shift system in the Belgian petroleum industry

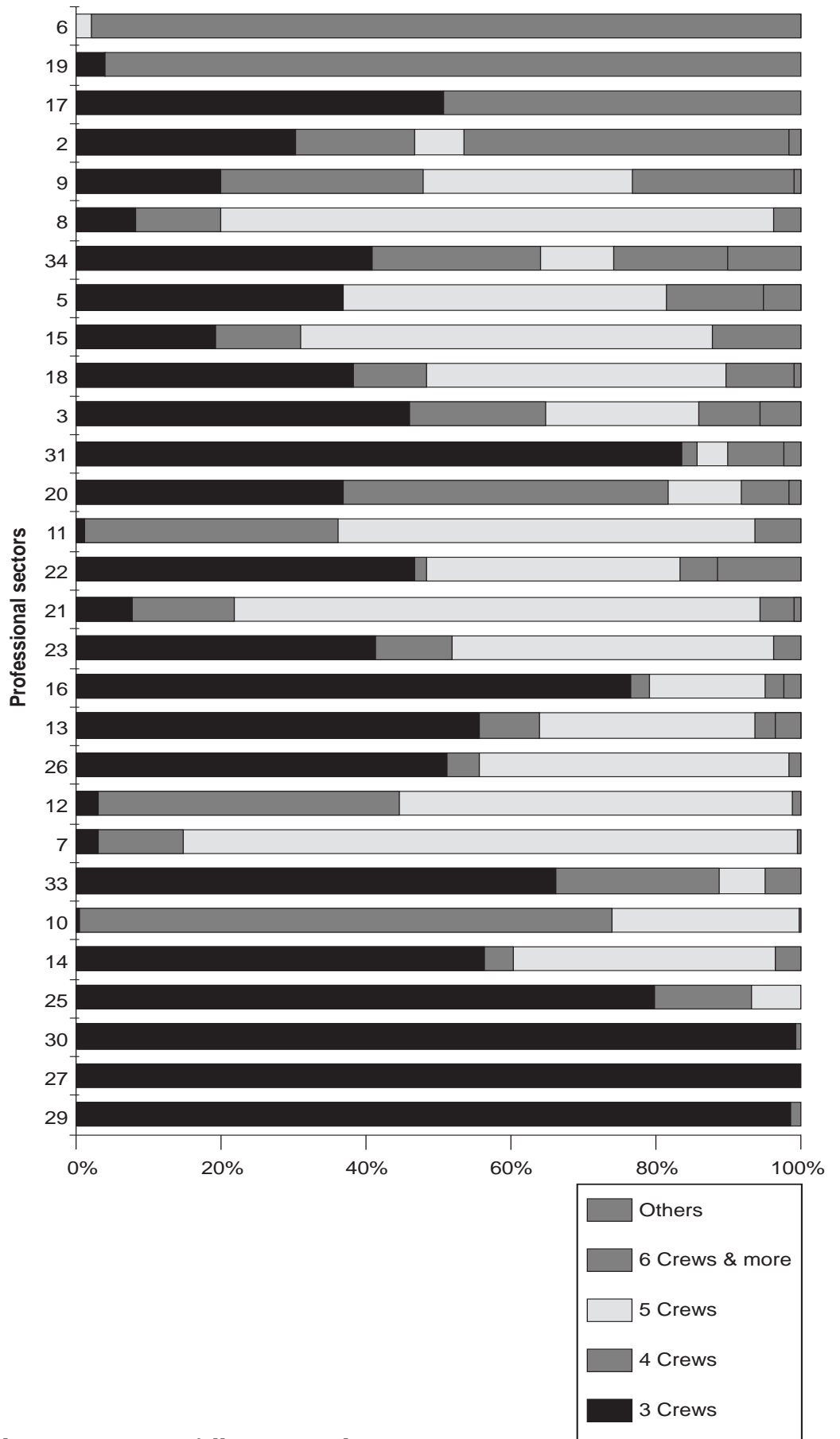
	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
Team 1	–	D	D	–	–	N	N	N	–	–	D	D	D	D
Team 2	N	–	–	D	D	–	–	–	N	N	–	–	D	D
Team 3	–	N	N	–	–	D	D	D	–	–	N	N	–	–
Team 4	D	–	–	N	N	–	–	–	D	D	–	–	N	N
Totals:	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DDN	DDN
and for the two following weeks:														
Team 1	–	N	N	–	–	D	D	D	–	–	N	N	–	–
Team 2	D	–	–	N	N	–	–	–	D	D	–	–	N	N
Team 3	–	D	D	–	–	N	N	N	–	–	D	D	–	–
Team 4	N	–	–	D	D	–	–	–	N	N	–	–	D	D
Totals:	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN	DN

Key: D = Day N = Night

Léonard reminds his readers that there have been some negative reports about 12-hour shifts (see also BEST 10, Compressed Working Time). Changing from 8 to 12 hours can have a negative influence on performance and alertness, as in the example reported by Rosa (1993) of the night shift in a public natural gas utility company.

Gadbois and Dorel report that the number of crews on continuous shiftwork varies considerably with the work sector (Figure 4.1), but the 3-crew system is used by half or more workers in many sectors.

Figure 4.1: Distribution of workers on continuous shift systems according to the number of crews



[Key to sectors on following page]

Key to Sectors, Figure 4.1:

- | | |
|---|---------------------------------|
| 2 - Meat and milk | 17 -Shipbuilding and aerospace |
| 3 - Food industry (meat and milk apart) | 18 -Textiles, clothing |
| 5 - Petroleum, gas | 19 -Footwear and leather |
| 6 - Energy and water | 20 -Timber and wooden furniture |
| 7 - Minerals, ferrous metals, steel | 21 -Paper and paper products |
| 8 - Minerals and non-ferrous metals | 22 -Printing and publishing |
| 9 - Construction materials | 23 -Rubber and plastics |
| 10 -Glass | 25 -Food wholesaling |
| 11 -Industrial chemistry, artificial and synthetic fibres | 26 -Wholesaling (food apart) |
| 12 -Chemicals and pharmaceuticals | 27 -Food retailing |
| 13 -Metal manufacture | 29 -Motor vehicles and parts |
| 14 -Mechanical construction | 30 -Hotels and catering |
| 15 -Electrical and electronics | 31 -Land transports |
| 16 -Land transport materials | 33 -Services to companies |
| | 34 -Consumer services |

Poor systems

Some companies change to five-crew systems with little understanding of how shift systems can be best constructed. One recent example, on which a shiftworker made contact, is shown in Table 4.15.

Table 4.15: 5-crew system with seven consecutive nights

Week	S	M	T	W	T	F	S
1	R	A	A	A	R	M	M
2	M	M	R	R	A	A	A
3	A	R	M	M	R	N	N
4	N	N	N	N	N	R	R
5	R	D	D	D	M	D	R
Totals	MANRR	MANDR	MANDR	MANDR	MANRR	MANDR	MANRR

Key: M: Morning/ A: Afternoon/ N: Night/ R: Rest Day/ D: Normal Day

The most serious criticism of this rota is the sequence of 7 consecutive night shifts in weeks 3 and 4. In the past, BEST had recommended a maximum of 4, and some authorities (e.g. Knauth 1995) now recommend a maximum of 3.

The reason for this is that most people do not sleep for long enough during day-sleeps, and so accumulate a sleep debt that increases the longer the sequence goes on. There is an argument the other way, that people get used to night shift if there are more consecutive ones, but measurements on real shiftworkers tend to show that this is very slow, and takes 21 nights.

It is possible to modify this rota to avoid this problem, as shown in Table 4.16 below. The shifts that have been exchanged are in italics.

Table 4.16: Modification of 5-crew system above

Week	S	M	T	W	T	F	S
1	R	A	A	A	R	M	M
2	M	M	D	R	A	A	A
3	A	R	M	M	R	N	N
4	R	D	N	N	N	R	R
5	N	N	R	D	M	D	R
Totals	MANRR	MANDR	MANDR	MANDR	MANRR	MANDR	MANRR

The rota in 4.16 is simply a “tweaked” version of 4.15, and gives the same totals for each day of the week. Night shifts are now in blocks of 2, 3 and 2. Of course the Day shifts may be in the same week in order to make it easier to fit in holiday weeks, so that this may not be the perfect answer. It is also a very irregular rota, which may be because there are some other purposes that it fulfils, or possibly because it has simply evolved from earlier rotas.

Another alternative is shown below in Table 4.17.

Table 4.17 : Alternative modification of 5-crew system

Week	Mo	Tu	We	Th	Fr	Sa	Su
1	D	M	M	A	A	N	N
2	R	R	D	M	M	A	A
3	N	N	R	R	D	M	M
4	M	D	A	N	N	R	R
5	A	A	N	R	R	R	R

This has the following advantages and disadvantages:

Advantages:

- forward rotation
- maximum length of nightshift period 2 days
- no unfavourable shift sequences
- improved freetime on weekends
- improved clarity

Disadvantages:

- maximum length of working period 8 days

Another alternative, shown below as Table 4.18, would be to use a variation of the 2-2-3, which started off as a 4-crew rota, with a 5th week added that can either be used for normal Dayshift, for training or for holidays (marked “dr”).

Table 4.18: 2-2-3 with 5th week free for Days/Training/Holidays

Week	M	T	W	T	F	S	S
1	M	M	A	A	N	N	N
2	R	R	M	M	A	A	A
3	N	N	R	R	M	M	M
4	A	A	N	N	R	R	R
5	dr	dr	dr	dr	dr	dr	dr
Totals	MANRdr	MANRdr	MANRdr	MANRdr	MANRdr	MANRdr	MANRdr

If holidays are important for the rota, it is possible to double the first 4 weeks and then have 2 of the 5th line, giving 2 weeks free for one person's holidays every 10 weeks, but otherwise used for day shift (or covering absence), shown in Table 4.19 following:

Table 4.19: 2-2-3 with 9th and 10th week free for Days/Training/Holidays

Week	M	T	W	T	F	S	S
1	M	M	A	A	N	N	N
2	R	R	M	M	A	A	A
3	N	N	R	R	M	M	M
4	A	A	N	N	R	R	R
5	M	M	A	A	N	N	N
6	R	R	M	M	A	A	A
7	N	N	R	R	M	M	M
8	A	A	N	N	R	R	R
9	dr	dr	dr	dr	dr	dr	dr
10	dr	dr	dr	dr	dr	dr	dr
Totals	2xMANRdr	2xMANRdr	2xMANRdr	2xMANRdr	2xMANRdr	2xMANRdr	2xMANRdr

The advantage of a regular rota like this is that it is much more systematic. Although it may look confusing at first, once the underlying pattern is understood, it is really very simple.

UNEVENLY MANNED CONTINUOUS SYSTEMS

Many long-standing shift systems require continuous cover, but not evenly manned continuous cover. This is obviously true of police, medical, and transport systems, some of which have operated uneven continuous cover for hundreds of years. They tend, on the whole, to use “traditional” systems, developed over time, which have become strongly entrenched as custom and practice. Relatively recent arrivals in the world of unevenly manned continuous systems, often associated with the development and use of modern technology, are less constrained by tradition, and are in some ways more interesting.

Modern technology makes it possible for telephone calls to be transferred locally, nationally and even globally, and to incorporate pictures as well where necessary. So one answer to night shift manning of a technology control centre is to divert the system to another country where it is not night. This makes it possible to reduce to a minimum the number of people working at night, which is one of the basic principles for the design of shift systems.

It is difficult to give concrete examples of systems like this, but a world-wide news service is believed to transfer overall control so that the manager in charge is always a day worker. A system for the surveillance of supermarkets in the US is reported to be controlled from South Africa at night. It is thought that many world systems, such as military and air traffic control, use similar transfers of responsibility.

In contrast, there are sometimes advantages in retaining control within one country, where there is only a national organisation. Most people lose credit cards during their waking hours, so that the service to receive reports of this, and take appropriate action to stop fraudulent use of a lost credit card, is mainly day-active. However, credit card holders from one country travel the world for business and pleasure, so small numbers may need to report a loss during daytime in Australia. In this case, it makes sense to maintain a minimum staffing during night shift.

Telephone call centres

So one area where the flow of work is not even, but is to some extent predictable, and where continuous customer service is required, is on “telephone help lines”, which have expanded considerably in the UK in the past five years.

The National West Bank Action Line customer telephone centre is based at Harrogate in Yorkshire, but receives calls from all over the United Kingdom for the price of a local call. Past trends are used to predict the volume of calls, and are reviewed on a monthly basis. The call centre is set up so that voice-activated routing answers most customer queries, but a human help line is available all the time.

This is achieved by a combination of full-time and part-time staff, who are recruited for their flexibility. The full-time Monday to Friday day staff work in teams of about ten for three weeks of 0900-1700, one week of 1000-1800 and one week of 1200-2000. Night shifts, after 2000, are covered by volunteers, most of whom prefer to work permanent night shifts, although

they may also choose to alternate this with some day shifts. Part-timers are considered ideal for covering the “twilight” shifts from 1800-2200, and also for Saturdays and Sundays. Very little is paid as an “unsocial hours” night or weekend premium, so that by and large, people choose the shifts that suit them best anyway. When trends show that the work load has changed, management requirements are put to groups of staff, who are free to discuss and decide the way they want to staff the system.

Another telephone banking and credit card centre has some full-time staff, mainly at the management level. Three shift controllers work one week from 0800-1600, one week from 1600-2400 (including Saturday and Sunday), and the third week as a combination of Rest Days, to compensate for working the weekend, and 0800-1600. Three shift administrators work a similar morning and evening rota. Six trainers work a rota working afternoon shifts one week in six, and working one in six weekends. Team leaders work 35 weeks of mornings and 15 weeks of evenings. Night shift has to be covered, so that credit card holders worldwide (and bank customers, too) can always access somebody.

The core of the night shift is staffed by six people, who work in 3 teams of 2. However it is only during the period from 0100 to 0600 that staffing falls to two, as some of the part-time staff work on shifts that end at 0100.

A third telephone and credit card banking centre employs 240 staff, 90% of them female, and about 60% part-time and 40% full-time. The majority of staff are on a contract to work flexible hours, either from 0800-2000, or 2000-0800. The maximum contract is for 35 hours, but many staff are on 20-hour contracts, to work a shift of 4 hours on 5 days out of 7.

The company collects the top four working hour preferences from staff, and injects that every month into a computer programme that also works out the likely work-demand pattern, based on previous patterns and trends: about 97% of staff get either their first or second preference. This is normally done one month ahead, and staff have freedom to swap shifts after that. It is possible to override the programme to give staff fixed shifts, if there is some vital personal reason for it. The computer programme is not only excellent for time-saving in working out rotas, but is also accepted as fair by the staff. If there are short-term changes in the apparent work-load, the company just ask whether staff are willing to adjust to it.

A relatively small staff of three (to allow for breaks) cover the core 1600-2400 and 0000-0800 period, all working fixed shifts. The vast majority of the work is covered on day shifts, either between 0800 and 1600 or 0900 and 1700.

Such systems do not, on the whole, result in simple printable rotas that could be used by other companies. It is clear from these examples that many of the choices of how to man an uneven system are in many respects based on local considerations, and may not be easily exportable to other places.

Almost all banking systems, credit card providers, and many insurance companies operate systems like this. Cable and satellite television providers also offer continuously manned telephone help, partly to solve problems of customers, and partly to stimulate sales. So do many computer hardware and software companies. Currently telephone sales call centres are experiencing considerable expansion in the UK.

International airlines also man 24-hour reservation systems. British Airways operates an unusual system, using modern telephone routing systems to avoid

having to man a night shift for reservations in the United Kingdom. After 10 p.m., inquiries are routed to the US.

Underlying principles

Some underlying principles can be seen in these arrangements. This is not to say that these principles are overtly stated, but drawing them out may help to make the lessons more generalisable:

1. The use of night shift should be minimised where this is possible.
2. If only small numbers of staff are required for night shift, it may be possible to find people who would positively prefer to work at night.
3. If only small numbers are required at weekends, it may be possible to find volunteers who prefer to work at weekends.
4. Management has a responsibility for working out the pattern of staff load that will be needed. In most modern computer-controlled telephone systems, for example, it is fairly simple to request a count of the demand hour by hour and day by day, and estimate the regularity of recurrence of this pattern.
5. Advance notice of working hours is highly valued by most staff.
6. It is possible to survey staff preferences and take them into account in generating rotas.
7. A facility to exchange shifts is highly valued by most staff.
8. Consultation with staff when exceptional circumstances arise can lead to a positive and helpful response.

Some qualifications to these principles should also be made plain:

1. Great care should be taken if staffing on night shift is reduced to a single person. Human company is one of the best antidotes to the drowsiness that affects most people when working at night. If the consequences of error are anything more than trivial, at least two people should always be there, to allow for personal natural breaks of one kind and another.
2. The use of permanent fixed night shift staff can easily lead to less than adequate communication with daytime management, and steps may need to be taken to counteract this.
3. It is important that a set of principles be developed and adhered to that is both efficient at meeting demand and fair and humane in dealing with human operators, with important aspects of their lives outside work.

Chapter 6: **CONCLUSIONS**

The prevalence figures for shiftwork in general support the impression that shiftwork is on a slow but steady increase, probably as a result of increasing world-wide competitiveness.

Even more interesting is the impression that continuous shiftwork is increasingly occurring in sectors where it was formerly uncommon: financial services, most obviously, but also many working situations where there is pressure for longer operating time, to spread out the overheads of capital investment, or to provide continuous customer service.

Often these business pressures require considerable flexibility in response, and achieving this without damaging the lives of the staff involved is a major challenge for management. How can an uneven work demand be shaped to provide some kind of regularity and predictability in working time schedules?

A further stimulus to change in countries of the European Union has been the steady impact of the EU Directive on the Organisation of Working Time. This required member states to review their national legislation on working time by November 1996, three years after the Directive was approved. This target for completion has been met in some states, and has stimulated consultation and discussion in all states. Not all states had previous legislation that could provide a framework for change. In the case of the United Kingdom, where there was no existing legislation, the government raised a case against the validity of the Directive, and only began the consultative process after this case was lost in 1996; a general election in 1997, and the change to a new government with many other priorities for inclusion in the legislative programme, have caused further delays. In several other states – Ireland, for example – the legislation has been prepared, but has not yet come into force. In general, the directive is likely to continue to have a major impact on working time in the European Union, and beyond as other countries watch these developments with interest.

All these stimuli to creative and intelligent organisations, trying to adapt lessons from the past to their own particular situations, locations and work forces, generate continuing questions and interest in approaches to solving shiftwork problems. We hope that this collection helps to contribute to this process.

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