REPORT

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JOB-ROTATION ROSTERS FOR MECHANISED OPERATIONS

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There is no universal work-shift schedule for a mechanised logging crew. There are many different needs which make it essential to draw up several schedules. With a continuous job-rotation roster it is possible to utilise the most expensive machines more effectively. Job rotation, involving both machine work and manual work, also benefits the health of the machine operators by reducing the risk of getting occupational overuse syndrome. When formulating shift schedules, it is crucial that all members in the crew give their opinions on preferred working hours. Experience has shown that it is best to continue the discussions until all in the crew agree with and accept the new work-shift schedule.

This report will help you to create job-rotation rosters which will give a high and sustainable performance in mechanised logging operations. Start with the goals of your business and discuss them with your crew and your family. It will take time to find the optimal schedules. It is a process that also develops the crew, as high performance rosters involve work enlargement, multi-skilling and increased responsibility taken by each member of the crew.

A good shift schedule prevents turnover and sick-leave. To achieve this, each crew member must have the opportunity to adjust their work load and working hours to suit their situation.

The report consists of:

- A guide for designing work-shift rosters.
- A method to assess the work load in different shift schedules.
- Examples of continuous job-rotation rosters.

When formulating the work-shift schedules, it is important to have accurate key figures for your machinery's utilisation per annum and productivity per hour. Another important issue is to exchange experiences with other logging crews. This will give you more ideas and motivation to keep on developing your work or your business.



Valmet forwarder working in Kaingaroa Forest

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A checklist for designing job-rotation rosters

This checklist will help you to formulate continuous job-rotation rosters. Hopefully, these rosters will give a higher and more sustainable performance than those used previously.

Goal

What goals do the contractor, each crew member and the principal employer have?

Machine utilisation

How many hours do the machines need to be in use per day, week and year? Calculate the capacity of each machine and the manual operations for the most common haul distances and situations.

Can you increase the productivity and productive time per hour instead of working more hours? Can you avoid working at early and late hours through working a continuous day time job-rotation roster?

Job rotation

How can a productive and fair job-rotation roster be achieved? There may be a need for motivation, training and education. The principal employer must actively contribute when the crew is enlarging the work-tasks.

Make a list of each worker's skills. Multi-skilling benefits everyone and allows for more sustainable production. Initiate rotation between machine work and manual work such as felling, logmaking and audit. What is the minimum time requirement for the manual work? Make a list of all these tasks.

Work enlargement and job rotation are easier to implement when the same contractor owns all the machines involved in a logging operation.

Division of labour, the contractor's role

Decide who has responsibility for each work-task. Determine the division of labour between the contractor and the crew. What kind of administrative work can be done at the work site? What information and support do the crew need?

Machine maintenance

Plan for maintenance to be done in pairs during the middle of the day. It is important to decide who has responsibility for maintenance, especially when there are several operators using the same machine. Is there a system for assistance and spare parts at night and during weekends?

Leave

Include planned leave in the schedule. How is sick leave to be adapted into the schedule?

Solitary work and travelling

Plan to have breaks together with others in the crew. Plan for crew members to travel together wherever possible and avoid solitary work.

Work at weekends, early and late hours

Working at an early or late hour of the day is more fatiguing and requires more rests to stay healthy. It also impacts on family and social life. Travelling distance, weather conditions and spare time activities are other aspects to be considered. Does the crew prefer to work at weekends instead of at night? What does each member require?

Safety and health

Decide on routines for safety at night and during weekends. Technical improvements, exercise and better nutrition alone are not sufficient to solve the health problems associated with machine operation. One way of reducing these health problems is by working the continuous job-rotation roster involving completely different uses of the body.

A fair and productive pay system

Should employees' pay include the costs of maintenance and a share of the profit? How is work at nights and on weekends to be paid? How is it best to motivate multi-skilling? How is training to be paid?

Economic, safety and health audit

How can efficient crew meetings be held to monitor the business and give feed back continuously? Find simple methods for monitoring production and work load.

The role of the principal employer

When tendering out forestry work, the forest owner, as the principal employer, sets the standard for the work environment. Does the forest owner incorporate that in the tender information by giving both production and work environment goals?

The crucial element when creating a happy and profitable crew is to carry through an open and respectful communication. To achieve a sustainable high production in logging operations, investment needs to be put into building mutual trust between all parties concerned.

Assessing the work load in different work-shift schedules

Here is a way of assessing different types of work-shift rosters. It is a rough and easy guide to give you an understanding of how to achieve a sustainable high level of production. The aim is to stimulate discussion to help you find the optimum shift schedules for your crew. With this simple method you can follow your work load portion during the day, the week and the year. If you are a contractor, you can use this model to assess the efficiency of your crew's work-shift schedule.

The origin of this idea of work-load assessment is from the forest company STORA in Sweden. The method is based on years of experience with mechanised logging operations [1] [2]. It is used by Swedish logging crews when planning work-shift schedules.

How to use it

Work load points are accumulated during work; more points mean more effort and fatigue. The model considers the following factors (Table 1):

Table 1 - Workload point per hour

Work Task	Worked Hours			
	1	2	3	4
Harvesting	0	1	2	3
Forwarding	0	0	1	1
Break	0	-1	-2	-3
Light work	0	0	0	0
Heavy work	-2	-1	0	1

- The first hour in a feller-buncher or harvester or processor gives 0 points, the next hour 1 point, the next 2 points, and so on.
- The first and the second hours in an extraction machine give 0 points, the third and fourth hours give 1 point each, the fifth and sixth 2 points each, and so on.
- One hour with a break or light manual work, such as log making and maintenance work, reduces the following machine hour work load by 1 point. Two hours of light manual work reduces the following machine hour by 2 points, and so on. However, after light manual work, or a one-hour break, you will still keep your accumulated points from the previous work. To recover from machine work you need heavy manual work, a longer break or sleep. So do not count the number within the brackets.
- Experience has shown that a short period of heavy manual work is good for the body after sitting in a machine. One hour of heavy manual work (such as felling and trimming), after working in the cab, counts as minus 2 points, the next hour gives minus 1 point, the third hour 0 points, the fourth hour plus 1 point.

Adapt it to your situation

You and your crew must adapt the calculation of work load points to your work situation. Some crews multiply the hours in darkness with a factor, for example by 1.2 between 6 pm and 6 am. Other crews give thinning more points than clear felling, as their experience is that thinning is more demanding. An issue to consider is the slower work rates towards the end of a long shift, as a slower rate will produce a lower work load.

Another question is what the points stand for; how many points can you have before you get sick? Everyone has different tolerances to workloads. There are also a number of ways to cope with high work load, one way is job rotation.

This method also considers job rotation if you calculate the average work load points for the persons involved. In Scandinavia it is common to rotate, not only between different machines, but also with manual work. Every third day or every third week the machine operators undertake manual work. This job rotation increases the operators productivity when operating the machine, as they become less strained. Job rotation has also improved the operators' skill and knowledge, giving them a better position on the labour market.

Go over it now

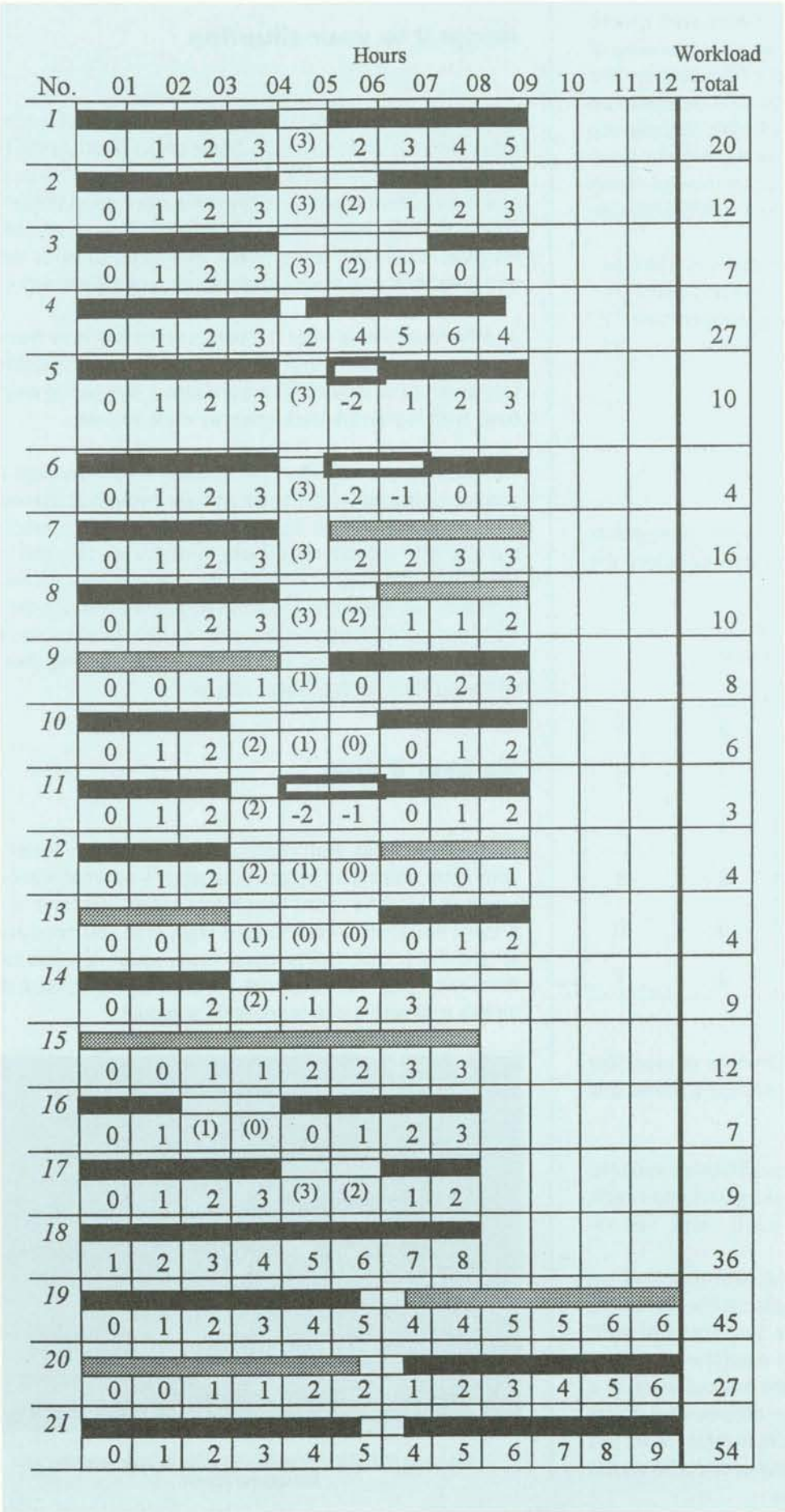
Go over the ideas with continuous job-rotation roster with your crew and try to create your crew's optimal work-shift schedule. Start to count how many points you have in your present situation. To assess your work load you need at least an eight-week period to cover most usual conditions (see formula on page 12). After that, the crew can complete a three-month trial with a new work-shift schedule.



Waratah HTH 230 harvester on Hitachi base working in Kaingaroa Forest

21 examples of the calculation of the work load

This table shows 21 examples of how to calculate the work load points for one operator during different work-shifts. Do not count the numbers within brackets, they illustrate the load sustained during the break.



Harvester/processor

Extraction machine

Break | light work

Hard manual work

Tension in neck and shoulders can be released by undertaking a few hours of hard physical work.

Working in a harvester usually gives more neck and shoulder pain compared to work in an extraction machine.

During a long shift, the operator probably reduces the work rate and will not accumulate all these work load points in examples number 18-21.

Five examples of shift schedules

On the following pages are five examples of different work-shift schedules (see the over-view in Table 2). They illustrate a cut-to-length system in a production thinning operation with one harvester and one forwarder.

The figures in the examples are imaginary and your situation will be different. The examples can give you some ideas on how to develop your work-shift schedule. The key is to work smart, not to work too many hours. This will achieve a consistently high income and maintain good health.

The first example looks at rotation between work in the harvester and manual work. During manual work the operator can recover from the work-load built up while operating the machine. The idea is to have a fresh operator in the harvester and utilise the most expensive machine as much as possible.

In example two, the harvester is utilised 17.5 hours per day, the forwarder 16 hours and manual work is undertaken for 6.5 hours per day. Full rotation between all shifts and the harvester and the forwarder gave the operator 7.5 work load points on average per day.

Work, according to the roster in example three, gave as much as 17 work load points during harvesting. A way of reducing this high work load is to rotate between the harvester and the forwarder on a weekly basis.

Another example of job rotation is given in example four. There, the operators change between machines after half the day.

In example five the operators work nine hours per day Monday to Thursday and have a day off every second Friday.

Process and not an answer

These examples are to give you some more ideas for your work-shift schedules. Do not just formulate one schedule; create half a dozen together with the crew. When formulating your roster, it is crucial that all members in the crew give their opinions on preferred working hours. Experience has shown that it is best to continue the discussions until all in the crew agree with and accept the new work-shift schedule.

This report will not answer all your questions on how to design work-shift rosters in mechanised logging operations. Only you and the crew have the answer. However, hopefully this report will help you to formulate continuous job-rotation rosters giving a high and sustainable performance.

References:

[1] Ponten. B., Belastningsindex - ett hjälpmedel för målstyrt arbetsmiljöarbete.(Work-load index for forestry machine operators, in Swedish). Arbetsdokument nr 3/97. SLU

[2] Gellerstedt. S., 1993. Work and health in forestry work - a multivariate study of cutters and machine operators (in Swedish). PhD thesis. Chalmers University of Technology, Sweden.

Table 2 - Overview of the five examples of work-shift schedules. All examples are from a cut to length system in thinning with one harvester and one forwarder.

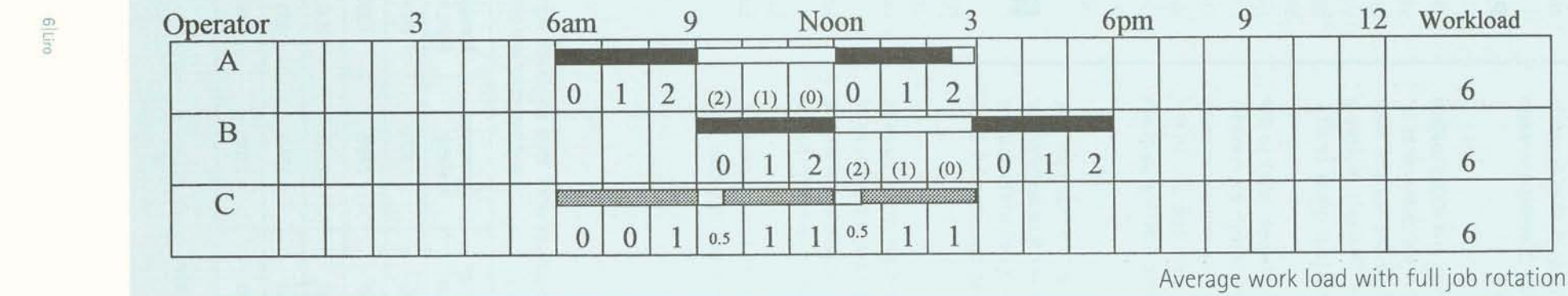
Ex.	Wages hrs/week	Harvester hrs/year	Forwarder hrs/year	Manual work, hrs/year	Production tonne/year	Work-load points[1]	Finish work
1	120	1900	1400	800	38000	6	Early night
2	200	2700	2700	1300	54000	7.5	Late night
3	160	2700	2500	800	50000	10.6	Late night
4	160	2340	2550	800	47000	10.6	Late night
5	160	2000	2200	1280	40000	10.5	Free friday

[1] *Average work load when full job rotation*

Example 1:

Cut to length system in thinning with one harvester, one forwarder and a total of three personnel, 3 x 8 hours wages per day (120hrs/week).

	Days[1] / year	hrs/ day	Calculated hrs/year	Utilisation[2]	Used hrs/year	Productivity ton/hr	Predicted production ton/year
Harvester	200	12	2400	78%	1900	20	38000
Extraction machine	200	8	1600	85%	1400	27	37000
Break, light manual work	200	3 4	- 800				



Average work load with full job rotation: 6

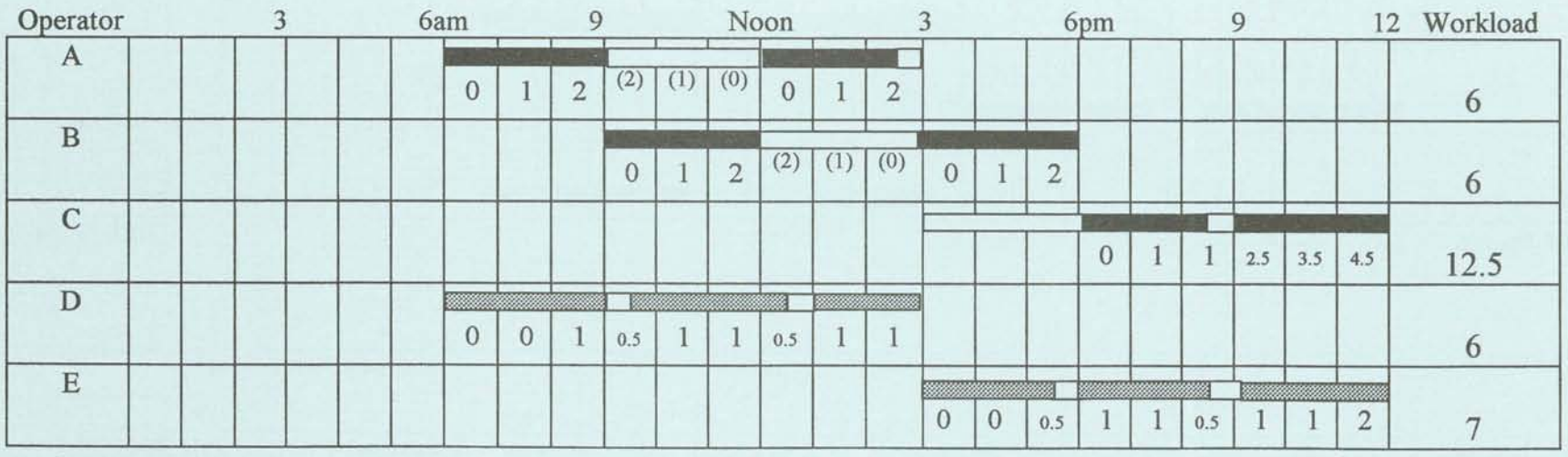
The first harvester operator works one week on morning shift and the next week on afternoon shift. The morning shift begins at 5 am with three hours in the harvester. The second operator arrives at 8 am and operates the harvester for the next three hours. During these hours the morning shift operator takes a break and then does manual work such as log-quality control, trimming, inventory and planning. At 11 am the first operator enters the machine again and drives for an additional 2 1/2 hours. Maintenance is done by both of the operators at 1.30 pm. The second operator operates the machine from 2 pm until 5 pm. The forwarder operator completes an ordinary day-shift. Each of the operators gets 6 work load points when using this schedule.

[1] 200 days/year = 365 days/year - 104 weekend days - 13 public holiday - 15 annual holiday - 33 days including transport, regular service, crew meetings, skilling, bad weather, leave, etc.
[2] Productive machine utilisation % is the part of the hour when the machine is working (all planned stops such as transport, service, etc., have not been considered here).

Example 2:

Cut to length system in thinning with one harvester, one forwarder and a total of five personnel 5 x 8 hours wages per day(200hrs/week).

	Days[1] / year	hrs/ day	Calculated hrs/year	Utilisation[2]	Used hrs/year	Productivity ton/hr	Predicted production ton/year
Harvester	200	17.5	3500	78%	2700	20	54000
Extraction machine	200	16	3200	85%	2700	20	54000
Break, light manual work	200	5 6.5	1300				



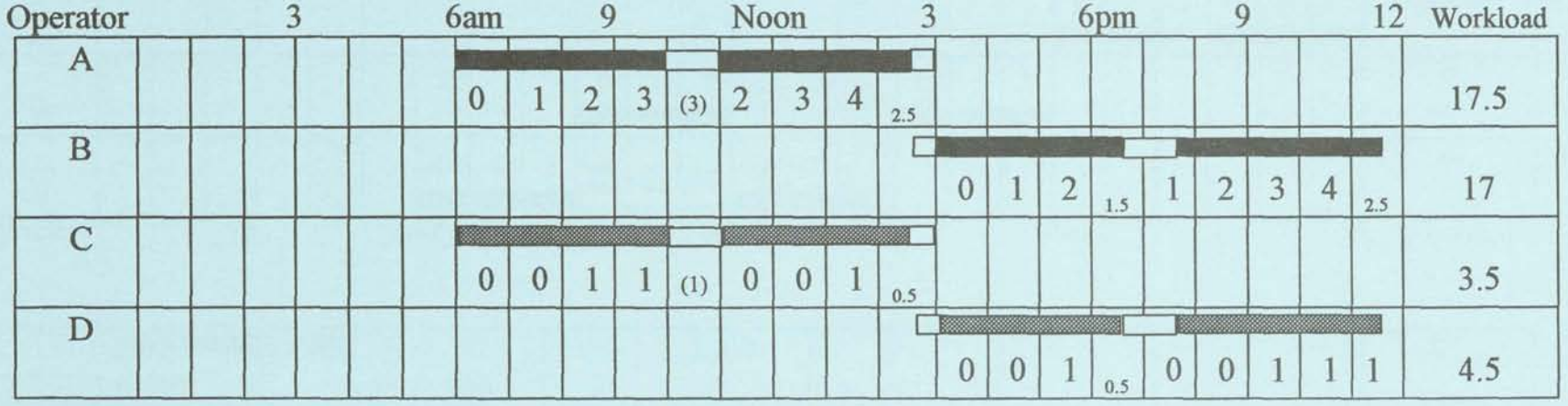
Average work load with full job rotation: 7.5

The three harvester operators work the 3+3+3 overlapping shift schedule from 5 a.m. until 11 p.m. They exchange shifts every week. During the hours on the ground the operator takes a break and then does manual work such as log-quality control, trimming , inventory and planning. Maintenance is done at 1.30 p.m. The forwarder operators complete a 2 x 8 hour shift. Note that the late shift in the harvester gives 12.5 work load points.

[1] 200 days/year = 365 days/year - 104 weekend days - 13 public holiday - 15 annual holiday - 33 days including transport, regular service, crew meetings, skilling, bad weather, leave, etc.
[2] Productive machine utilisation % is the part of the hour when the machine is working (all planned stops such as transport, service, etc., have not been considered here).

Example 3: Cut to length system in thinning with one harvester, one forwarder and a total of four personnel, 4 x 8 hours wages per day (160 hrs/week).

	Days[1]/ year	hrs/ day	Calculated hrs/year	Utilisation[2]	Used hrs/year	Productivity ton/hr	Predicted production ton/year
Harvester	200	16	3200	78%	2500	20	50000
Extraction machine	200	16	3200	85%	2700	20	54000
Break, light manual work	200	4 2	800				



Average work load with full job rotation: 10. 6

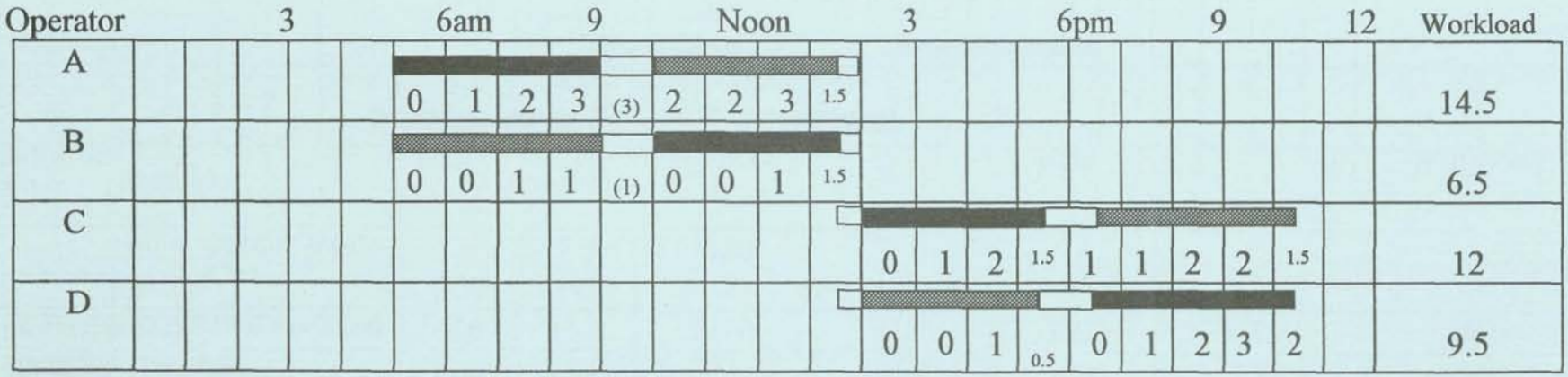
This 2x8 hour shift-work schedule gives you 17 work load points when harvesting and 4.5 points when forwarding. Rotation between the harvester and the forwarder will reduce the average work load points per operator. If you and your crew find that work at early morning and late evening more exhausting than at other hours of the day, you can multiply the more exhausting hours by a factor (for example 1.2). That may give more accurate work load points.

[1] 200 days/year = 365 days/year - 104 weekend days - 13 public holiday - 15 annual holiday - 33 days including transport, regular service, crew meetings, skilling, bad weather, leave, etc.
[2] Productive machine utilisation % is the part of the hour when the machine is working (all planned stops such as transport, service, etc., have not been considered here).

Example 4:

Cut to length system in thinning with one harvester, one forwarder and a total of four personnel, 4x8 hours wages per day (160 hrs/week).

	Days[1]/ year	hrs/day	Calculated hrs/year	Utilisation[2]	Used hrs/year	Productivity ton/hr	Predicted production ton/year
Harvester	200	15	3000	78%	2340	20	47000
Extraction machine	200	15	3000	85%	2550	20	51000
Break,	200	4					
light manual work		2	800				



Average work load with full job rotation: 10.6

In this work-shift schedule, the operator alternates between the harvester and the forwarder during the day. This schedule gives a lower work load and allows a higher utilisation of the hours in the harvester. Note that, if you start in the harvester and shift over to the forwarder on the other half of the day, you will get more points than if you start in the forwarder. This is because you built up a work load when operating the harvester and the break is not long enough to allow full recovery.

[1] 200 days/year = 365 days/year - 104 weekend days - 13 public holiday - 15 annual holiday - 33 days including transport, regular service, crew meetings, skilling, bad weather, leave, etc.
[2] Productive machine utilisation % is the part of the hour when the machine is working (all planned stops such as transport, service, etc., have not been considered here).

Example 5:

Cut to length system in thinning with one harvester, one forwarder and four personnel, 4x8 hours wages per day (160 hrs/week). This example shows a 10 hour day Monday to Thursday with two operators having free day every second Friday.

	Days[1]/ year	hrs/ day	Calculated hrs/year	Utilisation[2]	Used hrs/year	Productivity ton/hr	Predicted Production ton/year
Harvester	200	12.8	2560	78%	2000	20	40000
Extraction machine	200	12.8	2560	85%	2200	20	44000
Break, light manual work	200	4 6.4	1280				

Monday - Thursday

Operator	3	6am	9	Noon	3	6pm	9	12	Workload
A		0 1 2 3		(3) (2) (1)		2 3 4			15
B				0 1 2	(2) (1) (0)		0 1 2 3		9
C		0 0 1 1		(1) (0) (0)		0 0 1			3
D				0 0 1	(1) (0) (0)		0 0 1 1		3

Friday

	3	6am	9	Noon	3	6pm	9	12	
A		0 1 2 3		(3)		2 3 4 5			20
B		0 0 1 1		(1)		0 0 1 1			4
C & D		Free every second Friday							

Average work load with full job rotation: 10.5

[1] 200 days/year = 365 days/year - 104 weekend days - 13 public holiday - 15 annual holiday - 33 days including transport, regular service, crew meetings, skilling, bad weather, leave, etc.
[2] Productive machine utilisation % is the part of the hour when the machine is working (all planned stops such as transport, service, etc., have not been considered here).

Formula for work-shift schedule

	Days/ year	hrs/ day	Calculated hrs/year	Utilisation	Used hrs/year	Productivity ton/hr	Production ton/year
Harvester 1							
Harvester 2							
Extraction machine 1							
Extraction machine 2							
Loader 1							
Loader 2							
Break, light manual work							

Personnel	3	6am	9	Noon	3	6pm	9	12	Workload points

Formula for assessing work-shift schedule

Note the points you have got per day and summarise them at the end of the trial period. Bring this formula with you when you are discussing your shift schedule.

Day \ Week	1	2	3	4	5	6	7	8	Day Total
Monday									
Tuesday									
Wednesday									
Thursday									
Friday									
Saturday									
Sunday									
Week Total									

Total

Compare your work load points with the others in the crew									
Name \ Week	1	2	3	4	5	6	7	8	Total