

Topic 6 Section 2

Planning for Productivity

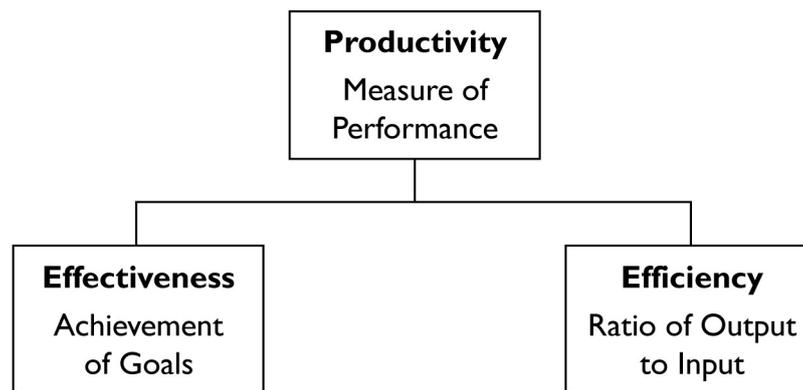
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Productivity

An organisation is productive if it achieves its goals, and translates its inputs (such as workers, machinery and materials) into outputs (a safe, functional road) at the lowest cost. Because of this, the supervisor who wants to set up a productive organisation at the planning stage must be concerned with two factors:

- effectiveness— the achievement of goals (e.g. work completed on time and to specification), and
- efficiency— the ratio between inputs and outputs.



These considerations apply to both machinery and personnel, but operate in different ways for each.

Productivity of Machinery

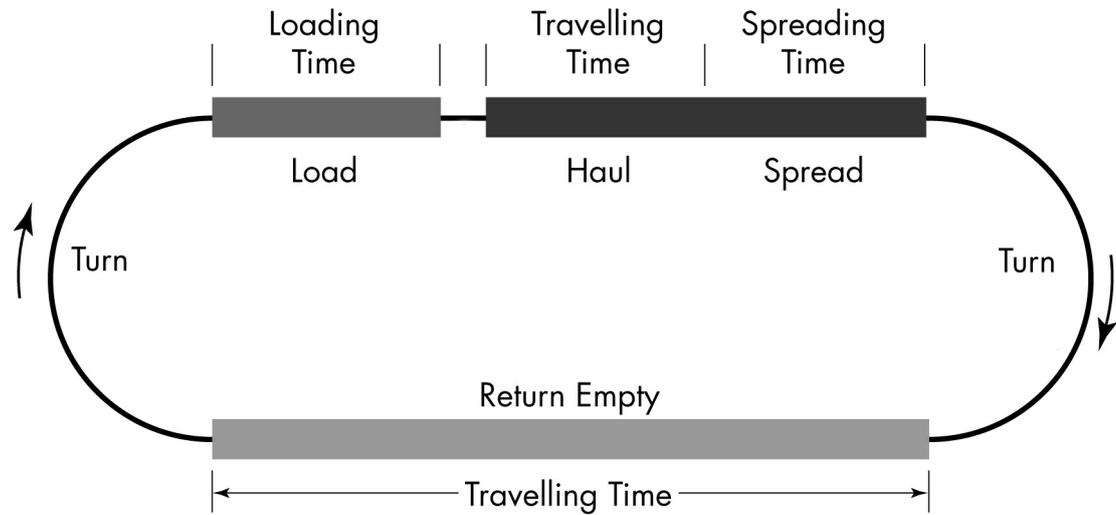
The following discussion uses examples involving three equipment items— a scraper, a loader and a truck— to illustrate the difference between effectiveness and efficiency.

Scrapers

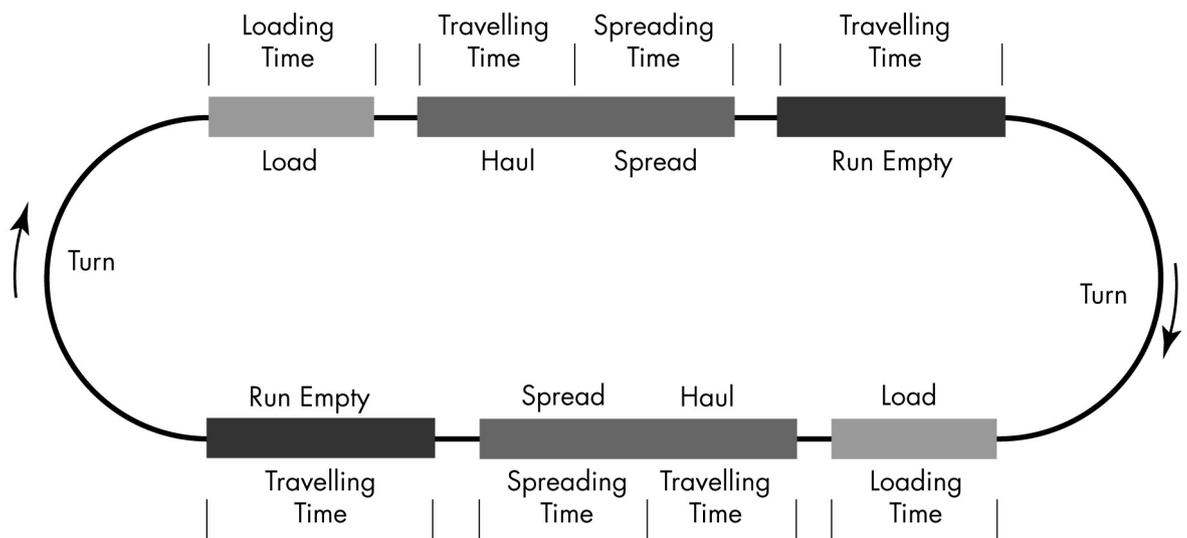
A scraper is effective if it excavates a load, hauls it to the fill, spreads it at the fill, returns empty to the cut to reload, and repeats the cycle. However, time spent on turns and gear changes is not productive, i.e. it does not directly contribute to either winning or spreading material. Of these two factors, turning is the most time-consuming part of the scraper cycle.

Therefore, the fewer turns there are in the cycle compared with the number of loads hauled and spread, the more efficient the cycle.

The drawings below show two possible scraper cycles.



Typical Scraper Cycle



Efficient Scraper Cycle

For the same number of turns, the efficient cycle achieves two loads and spreads, as compared to only one of each in the 'typical' cycle.

The first cycle is as effective as the second, as it achieves the goal of scraper operations (i.e. excavate a load, haul to fill, spreads at fill, return empty to reload). However, the second cycle is more efficient, as it achieves greater output for a similar amount of input.

Therefore, the second cycle would be adopted, as it is more productive (i.e. the sum total of effectiveness and efficiency is greater).

The efficiency of scraper operations depends on numerous factors that the supervisor can influence, such as:

- obtaining heaped loads every time
- working downhill wherever possible
- obtaining loads in the shortest possible time
- using a pusher tractor where appropriate
- spreading loads in the highest possible gear and in as short a distance as it takes to unload the material
- adopting a particular cycle of operations.



Loader

A loader is effective if it loads material from a stockpile, hauls it to the waiting truck, dumps it in the truck body and returns to the stockpile.

The main factors affecting the efficiency of a loader are:

- The time taken for each cycle of load, haul, dump, return
- The number of cubic metres carried per cycle

The cycle time depends on:

- Type of loader— is it a crawler or wheeled machine?
- The type of material being loaded
- Size of the dump target (this varies with the size of the truck body)
- Travel times specified by the manufacturer for various conditions (e.g. level ground)

The number of cubic metres carried per cycle depends on:

- The rated capacity of the bucket
- The conversion factor (from loose to bank cubic metres) of the material being loaded (i.e. the load factor)
- The ratio of material retained in the bucket on each cycle to the rated capacity (i.e. the carry factor)?

The methods used to calculate the time taken for each cycle and the number of cubic metres carried per cycle are shown in Topic 2 in this training series.

Truck

A truck is effective if it completes the cycle of load, haul to dump site, dump, return to load point, spot truck to loader and wait for loader to dump material into the truck body.

The main factors affecting the efficiency of a highway truck are:

- The time taken for each cycle of load, haul, dump, return, spot, wait
- The number of cubic metres carried per cycle.

The cycle time depends on:

- Load time— how many full passes does the loader need to make to load the truck to its rated capacity?
- Haul and return times— what are the average speeds over the haul and return legs and what is the length of the haul route?
- Dump time— this depends on the type of truck (e.g. rear tipper or bottom dumper?) and the cubic capacity of the truck body (e.g. 7 or 10 m³?)
- Spotting time— usually a fixed time that depends on the conditions of the job (e.g. how clearly is the truck body visible to the loader operator?)
- Waiting time— fixed time.

The methods used to calculate the time taken for truck cycles are shown in Topic 2 in this training series.

The number of cubic metres carried per cycle depends on:

- The rated capacity of the truck body
- The balance between the loader's bucket capacity and the truck body
- Whether the truck is loaded to struck or heaped capacity.



Comparisons of Larger and Smaller Trucks

There are no clear-cut answers when deciding between trucks with larger or smaller rated capacities. Either type may be more efficient, depending on the conditions of the job.

The advantages of small trucks over larger ones include:

- Greater flexible in manoeuvring, which may be advantageous on short hauls.
- Higher haul and return speeds.
- Loss of production is reduced when one truck in a fleet breaks down.
- It is easier to balance the number of trucks with the output of the loader.

The disadvantages of small trucks compared with larger ones are:

- It is more difficult for the loader to load the truck body, because of the smaller target area.
- More total time is lost in spotting the trucks because more trucks are involved.
- More drivers are required.
- Since the number of trucks is greater, there is an increased the dangers of ‘bunching up’ at the pit, along the haul road, or at the dump.

The advantages of large trucks compared with smaller ones are:

- Fewer trucks are required.
- Fewer drivers are required.
- The smaller number of trucks makes it easier to synchronise the equipment and reduces the danger of bunching up.
- They give a larger target for the loader during loading.
- They reduce the frequency of spotting trucks under the loader.

The disadvantages of large trucks compared with smaller ones are:

- The cost of truck time at loading is greater, especially with small loaders.
- The heavier loads may cause more damage to the haul roads.
- It is more difficult to balance the number of trucks with the output of the loader.
- Haulage of larger loads may not be permitted on highways.
- If one large truck breaks down, there will be a larger reduction in output than if a small truck stops.



Balancing Truck and Loader Capacities

A ‘rule of thumb’ for selecting trucks is to use trucks with a capacity of at least four to five times the capacity of the loader bucket.

A trucking operation, or any operation involving the balancing of plant, can become complex. The supervisor must carefully select the number and size of units and supervise their operations closely, to ensure that trucks operations are co-ordinated and involve a minimum of lost time.

Loading Trucks to Struck or Heaped Capacity

Another consideration in the operation of trucks is whether to load them to their struck or heaped capacity. Factors influencing this decision are:

- The weight of the material.
- The safe load limit that cannot be exceeded.
- Whether the haul unit is to run on public roads, where legal load limit restrictions apply.
- The maximum safe loads on the tyres. (Overloading could result in considerable lost time due to tyre failure).
- The condition of the haul road. (Overloading could cause a rapid break-up of the surface).
- The power of the engine and the rimpull available to haul the load.

Other Factors Affecting Efficient Truck Management

The following are further considerations in efficient truck management:

- It is desirable to have all trucks of the same capacity and operating at the same speed. (This helps to avoid bunching).
- Starting and finishing times of drivers' meal breaks should be staggered, as far as possible, to reduce wasted time.
- Separate entrance and exit roads should be provided at the pit.
- The position at which the trucks are to be spotted for loading should be clearly marked.
- Some delay and bunching is inevitable. When selecting the number of trucks on large jobs, 'add in' an additional truck to compensate.

Critical Factors

One of the main purposes of spending time and effort in planning a job is to ensure that the organisation set up to perform the work is as productive as possible. The supervisor who insists on using work practices that are known to produce more result for less input (such as those listed above) is promoting efficiency, and will obtain greater overall productivity from machinery.

Productivity of Personnel

The productivity of personnel involves a different set of principles to those illustrated above for machinery, as the behaviour of people cannot be directly controlled.

For example, a grader operator working in wet, muddy conditions can achieve only the best possible operating practices for those conditions, but cannot be expected to do more. The supervisor can give directions and hints, but the behaviour of the driver at the point where work is actually performed is entirely up to him or her.

The supervisor who wants to get the best from personnel on the job must consider both 'hygiene' and 'motivational' factors.

Hygiene Factors or Dissatisfiers

Hygiene factors are those over which the supervisor may be able to exercise some degree of control, such as:

- Working conditions
- Policies and administrative procedures
- Wages and benefits
- Supervision
- Status
- Job security
- Fellow workers.

Motivational Factors or Satisfiers

Motivational factors include:

- Recognition
- Achievement
- Advancement
- Growth
- Responsibility
- Challenge.

Motivation comes from within the person, and cannot be directly controlled (nor is it appropriate to attempt to do so). The factors that lead to a feeling of motivation in employees are harder to analyse, determine or manage.

Relationship between Hygiene and Motivators

Hygiene factors do not, of themselves, produce motivated employees. Instead, there will be dissatisfaction if the hygiene factors are not present or are seen as deficient. (For this reason, they are also known as ‘dissatisfiers’).

For example, a person who does not like some aspect of the type of supervision he or she is receiving, or feels that the salary on offer is too low compared to the effort required to do the job, will be dissatisfied.

Therefore hygiene factors must be both present and seen as adequate before the motivational factors have any effect.

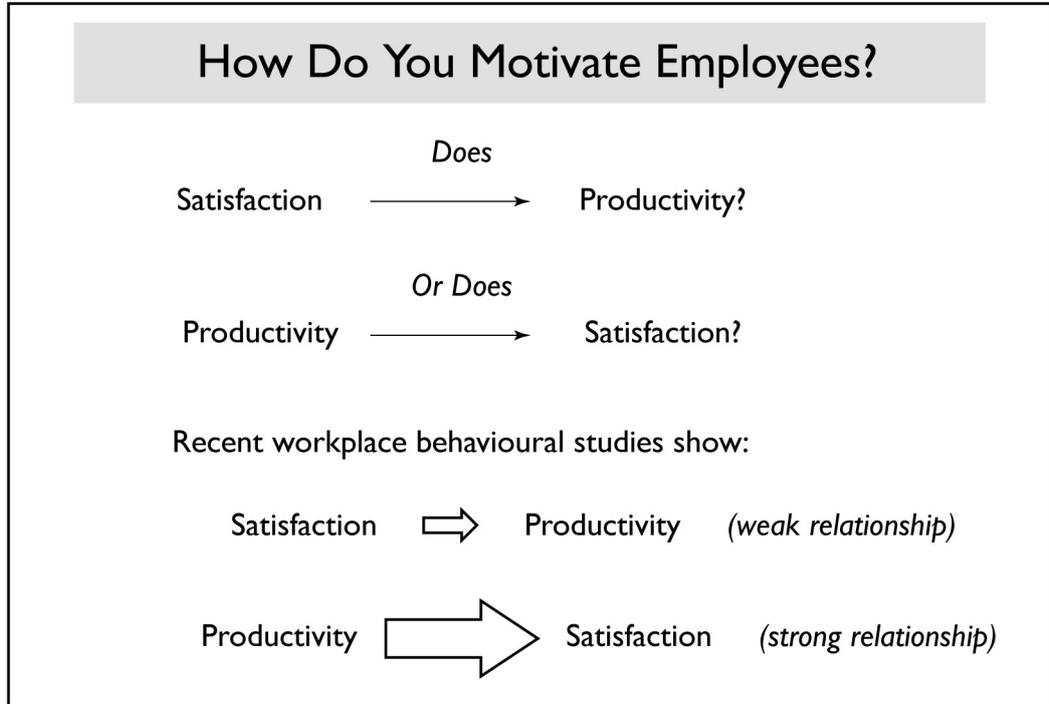
This is especially important for the supervisor planning the job. Factors such as camp accommodation, ability to take leave, hours of work, and relationships with fellow workers are strongly linked to job ‘hygiene’. The supervisor must have strategies for ensuring controllable factors are as good as can be, given the limitations of the job, available funds, company policies, etc.

The motivational factors start to have an effect once a person feels that he or she is able to achieve results on the job. The person who will be most likely to feel motivated to do more on the job is usually the one who feels that he or she:

- is achieving something
- has responsibilities to others on the job
- receives recognition for a job well done
- is working towards advancement
- is growing either in status or in personal development
- gains a sense of challenge from the work itself.

Until the 1960s, it was widely believed that ‘satisfied employees are more motivated’. This led to paternalistic initiatives such as company cricket teams or credit unions, company picnics, and other ways of trying to make employees ‘feel good’ about their employment. While such practices may still have a place in particular organisational environments, it is now recognised that they were more about hygiene than motivation.

In more recent times, numerous studies of human behaviour at work have shown that productivity is more likely to lead to satisfaction, rather than the other way around. In other words, if people feel that they are doing a good job, or are making a contribution to the team, they feel intrinsically good about it.



Best results are obtained from employees who feel they are achieving the required objectives (i.e. being effective).

Including Productivity Considerations in Planning

While the supervisor is carrying out the four steps of planning the job— study of job documents, site inspection, job appreciation, and preparation of a works program— he or she must consider methods of improving the overall productivity of the job. Productivity includes elements of effectiveness and efficiency.

These elements can be factored into calculations affecting both machinery and personnel.

- For machinery, the supervisor should focus on work practices that are known to produce more result for less input— i.e. the most efficient— to obtain greater overall productivity.
- Planning for greatest productivity from personnel involves considering both hygiene and motivational factors:
 - personnel who feel that a hygiene factor (such as accommodation or supervision) is lacking or deficient are more likely to feel dissatisfied
 - once the barriers of dissatisfaction are removed, people are more likely to respond to motivational factors, with the level of response depending on the character of the individual
 - greater overall productivity is likely when people have a personal sense of motivation, feel they are being effective, and therefore feel satisfied with the work.

Thinking through the work methods that are consistent with effectiveness and efficiency is therefore an important part of planning— for both machinery and the personnel on the job. The relationship of effectiveness and efficiency to productivity is different for each.