Allocation management and Aggregate Planning

Strategic resource organization

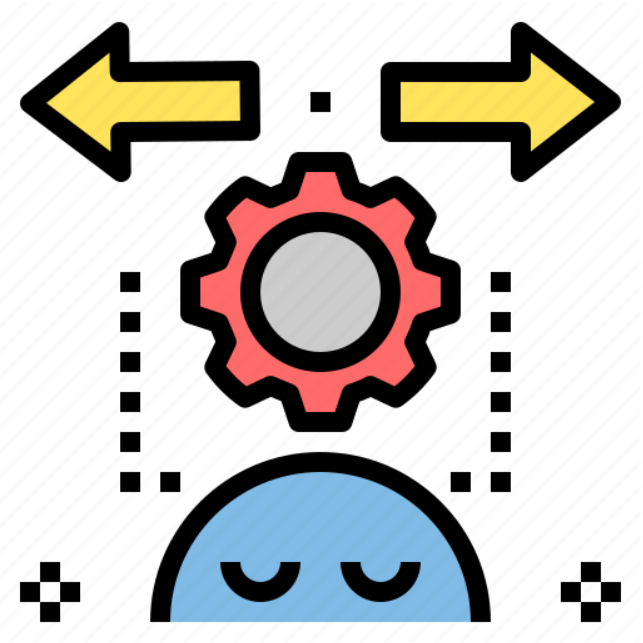
Decision Making in operation management. Three types:

- Strategic Decisions
- Operating Decisions
- Control Decisions

Strategic resource organization

Control Decisions

- These decisions concern the day-to-day activities of workers, quality of products and services, production and overhead costs, and machine maintenance.
- Examples include making decisions:
  - labor cost standards for a new product
  - frequency of preventive maintenance
  - new quality control acceptance criteria



Allocation management

Resource allocation

- Process in which it is decided where to allocate **scarce resources** to produce goods, creating merch or deliver services.
- **A resource**: can be considered a **production factor** used to produce goods or services. Resources can be many things, including labour, machinery, technology, natural, real estate, financial resources, etc.
- A management activity that's closely related to strategic (resource) management. The value of these activities is in meeting organisational objectives.
- The relationship between resources and strategy:

  The strategy determines which resources are required, but the availability of resources can also limit a strategy.

Allocation of resources

- The efficient allocation of resources to the right places
  is complex and often hampered by several factors, including :
  - scarcity,
  - financial criteria,
  - organizational politics,
  - ambiguous objectives,
  - risk aversion, and a
  - lack of knowledge and information.

Process of allocation management

- **Simple case scenario**: an organization may have multiple projects running (those projects may not be sharing the resources at all).
- **Little more complex situation**: resources shared in some proportions. Those numbers are published regularly so that someone can analyze the utilization numbers.
- **More complex case**: n° of projects is huge and size is massive (especially like national projects involving more than 100's of team members):
    - The dynamics of such projects are very difficult to manage manually.
    - The project costs can sharply rise where the resources are underutilized, and it is actually very difficult to calculate who bears the losses.
    - Hence there is a need to manage and forecast the resource allocation.

  Video:
  https://study.com/academy/lesson/resource-allocation-in-management-methods-process-strategy.html

Aspects Negatively Impacting Resource Allocation

Aspect that you must take into consideration when allocating resources, that can complicate the process of allocation itself:

1. **Timeline changes**: Production manager or program manager decides they need the project done sooner (like yesterday), or client is suddenly in a big rush to get things done. ...situation when one of the pieces of the puzzle took longer than expected and now everyone else needs to work faster to get their part done**.**
2. **Scope changes:** if scope of production changes, people working on it are likely to change too.

   Additional tools may be demanded for new tasks and needs. Or even different resources may be needed, which implies waste of resources and time to get the required ones.

Aspects Negatively Impacting Res. All.

3. Resource Availability Changes: if the right resources to get the job done are not available, some problems may arise in getting everything allocated.

Maybe the people you need for this project aren't available when you need them: find new people or you're going to need to rearrange the timeline. This can make it difficult for production managers or program managers to get the job done or to ensure that someone else can get the job done.

4. Task Dependencies: when part of the production needs to get done before another one.

This may imply unplanned delays (e.g. part A takes a week longer than it was planned). And that might not be possible with the original team that you put together. Because what if the team that's responsible for part B has another project that now needs to be done? Now you have to figure out a way to work around their other schedule or to change the team you have planned.

DEPENDENCIES

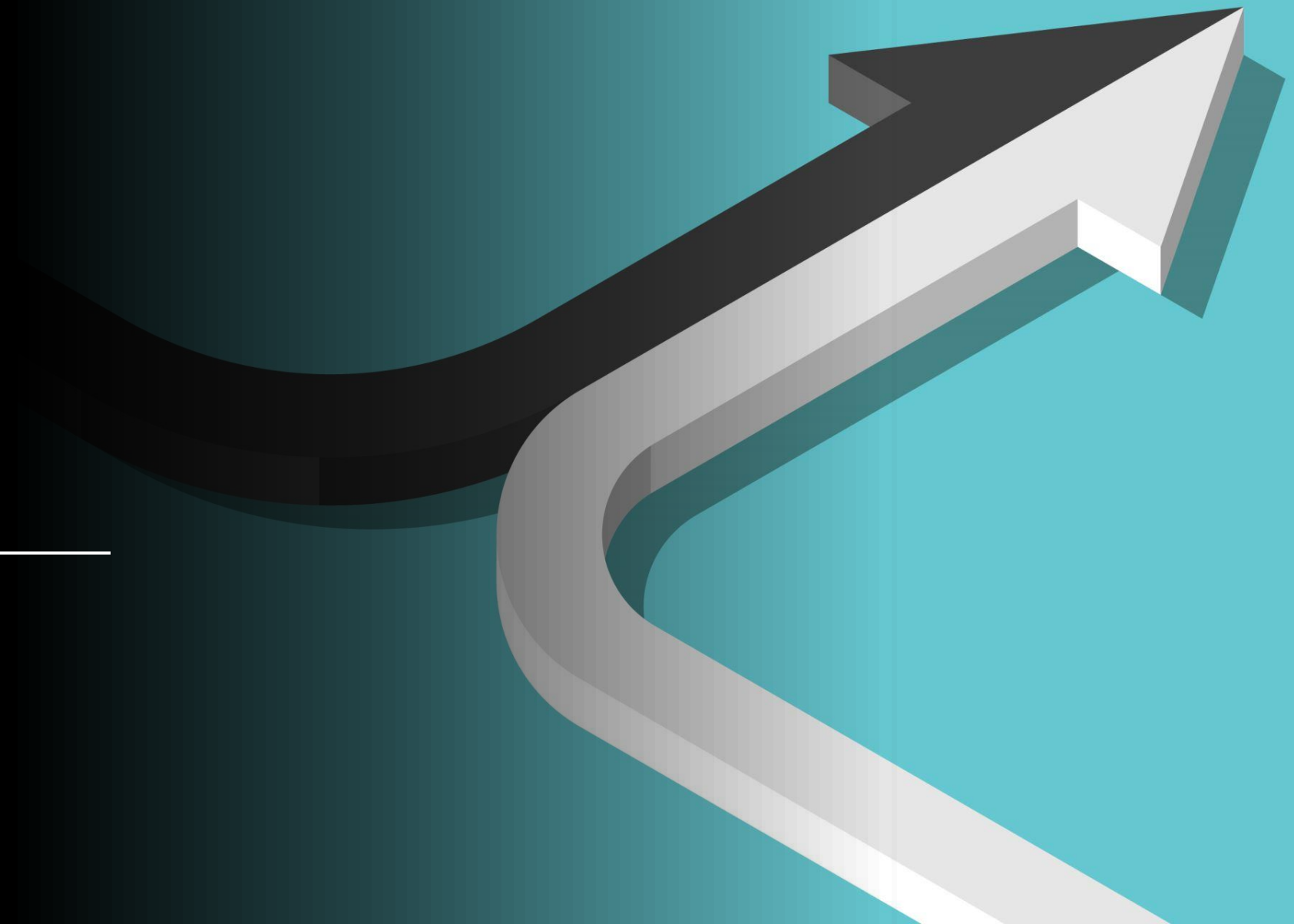
Aspects Negatively Impacting Res. All.

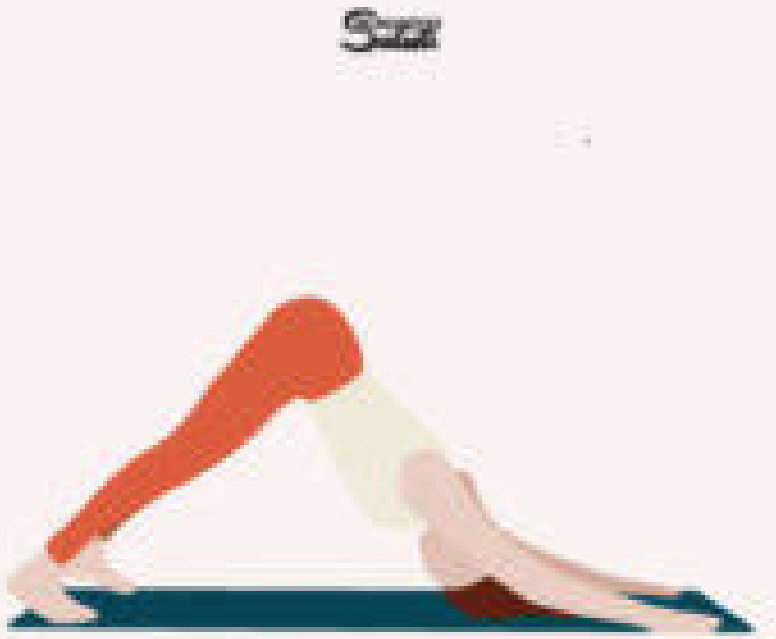
5. Overall Urgency: aspects of project requiring priority and it's often the case that a project that comes first will be pushed aside in favor of an entirely different project that needs to be completed.

You may thus need to reallocate some of your people so they can work on the newer project or your project might lose people because your manager believes the other project is more important and allocates your team to that area instead.

6. Teamwork: Your entire team needs to be able to work together. Teams should be able to work together in small groups as well as needs to be able to get the project done together. This isn't always easy, especially when you're bringing together people who may not work together frequently. In that case you want to make sure that you're doing some team building and that you're figuring out ways to make sure everyone can get along.

Flexibility in resource allocation





Strategic resource organization

- **Flexibility in Manufacturing Systems:**

- *Flexibility in manufacturing*: the ability of a manufacturing system to respond at a reasonable cost and appropriate speed, to planned and unanticipated changes in external and internal environments.
- Relates to the *ability of the system* to create products capable of meeting a customer's need.
- Means to produce reasonably priced *customized products* of *high quality* that can be quickly delivered to customers.
- For example, with make-to-stock market orientation; flexibility is the ability to provide the customer with sufficient finished goods.
- If the right product is available too late or at a cost that one cannot afford, it will be an order loser.

Concepts of flexibility

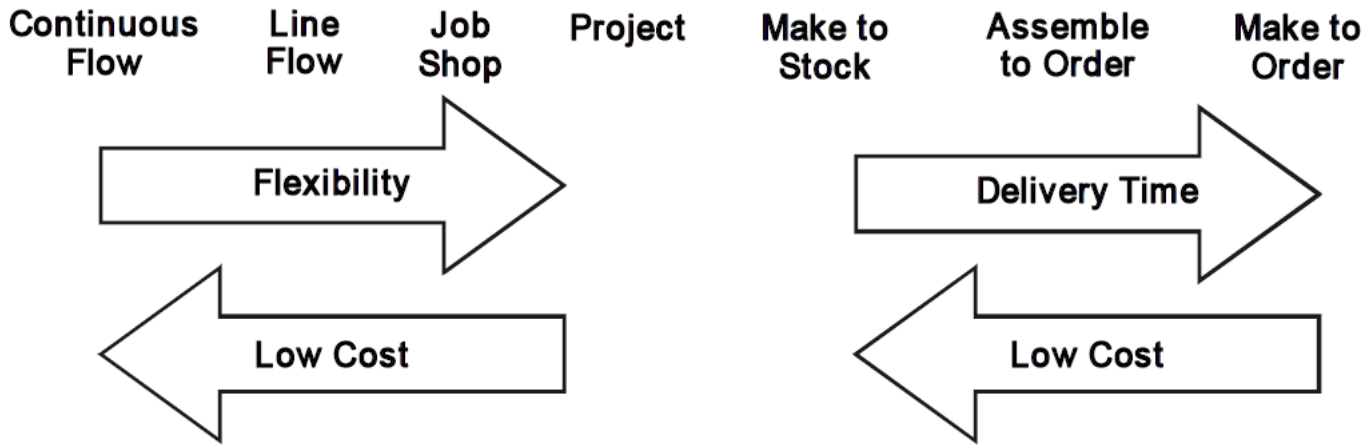
1. ***Mix Flexibility:*** The ability of a system to present a wide range of products or variants with fast setups.
2. ***Changeover Flexibility:*** The ability of an Operations Management system to introduce a large variety of major design change quickly within existing facilities.
3. ***Modification Flexibility:*** The ability of the transformation process to implement minor product design changes, even after the product has been delivered.
4. ***Volume Flexibility:*** The ability of the transformation process to profitably accommodate variations in production quantities. Systems with high fixed costs beget inflexibility since the firm will always be striving to maintain high utilization rates.
5. ***Rerouting Program Flexibility:*** The ability of the Operations Management systems to respond to factors of product shortfall, such as equipment breakdowns, labour absenteeism, or a delayed raw materials shipment.
6. ***Material Flexibility:*** The ability of transformation processes to adjust for unexpected input variations.
7. ***Flexibility Responsiveness:*** The ability of the firm and its managers to change the strategic objectives in response to changes in the marketplace.

Factors influencing Flexibility

Different processing strategies have different impact on the timeliness of providing the product to the customer.

- Flexibility is affected by reductions in lead times;
- If flexibility improved, it impacts the timeliness of providing the product to the customer.
- Flexibility also plays a significant part in determining the cost of the product.

Relationship between Cost and Flexibility:



Factors influencing Flexibility

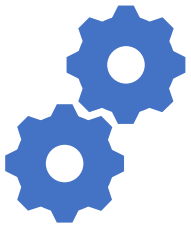
Measures of overall system flexibility show how:

- Parameters *such as"*
  - machine utilization,
  - range of products manufactured,
  - customer order turn around time and
  - new product introduction frequency
  - …..**influence the product.**

Based on these criteria, there are three levels of manufacturing flexibility:

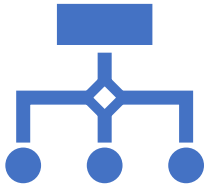
- Basic flexibility
- System flexibility
- Aggregate flexibility

1. Basic flexibility (f.) includes



(a) **Machine** f.: enable the machine to process various operations with ease;

(b) **Material handling** f.: measures the ease with which different part types can be transported and properly positioned at the various machine tools in a system;



(c) **Operation** f.: measures the ease with which alternative operation sequences can be used for processing a part type.

2. System flexibility (f.) includes parameters like

(a) **Volume** f.: measure of the system's capability to be operated profitably at different volumes of the existing part types;

(b) **Expansion** f.: ability to build a system and expand it incrementally;

(c) **Routing** f.: measure of the alternative paths that a part can effectively follow through a system;

(d) **Process** f.: measures the volume of the set of part types that a system can produce without incurring any setup; and

(e) **Product** f.: volume of the set of part types that can be manufactured in a system with minor setup.

3. Aggregate flexibility comprises:

(a) **Program** f.: the ability of a system to run for reasonably long periods without external intervention;

(b) **Production** f.: the volume of the set of part types that a system can produce without major investment in capital equipment; and

(c) **Market** f.: the ability of a system to efficiently adapt to changing market conditions.

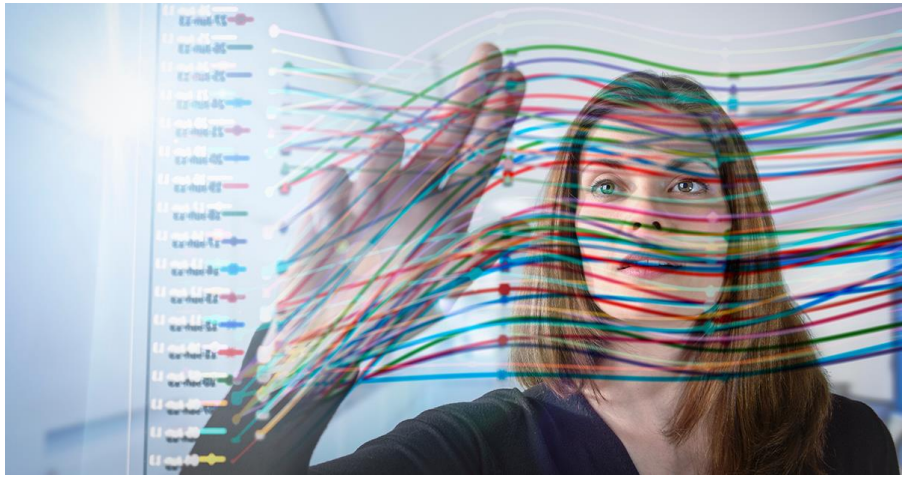
Aggregate planning, capacity

Aggregate planning

Determine the **quantity and timing** of production for the immediate future

Objective is to **minimize cost** over the planning period by adjusting:

- Production rates
- Labor levels
- Inventory levels
- Overtime work
- Subcontracting rates
- Other controllable variables

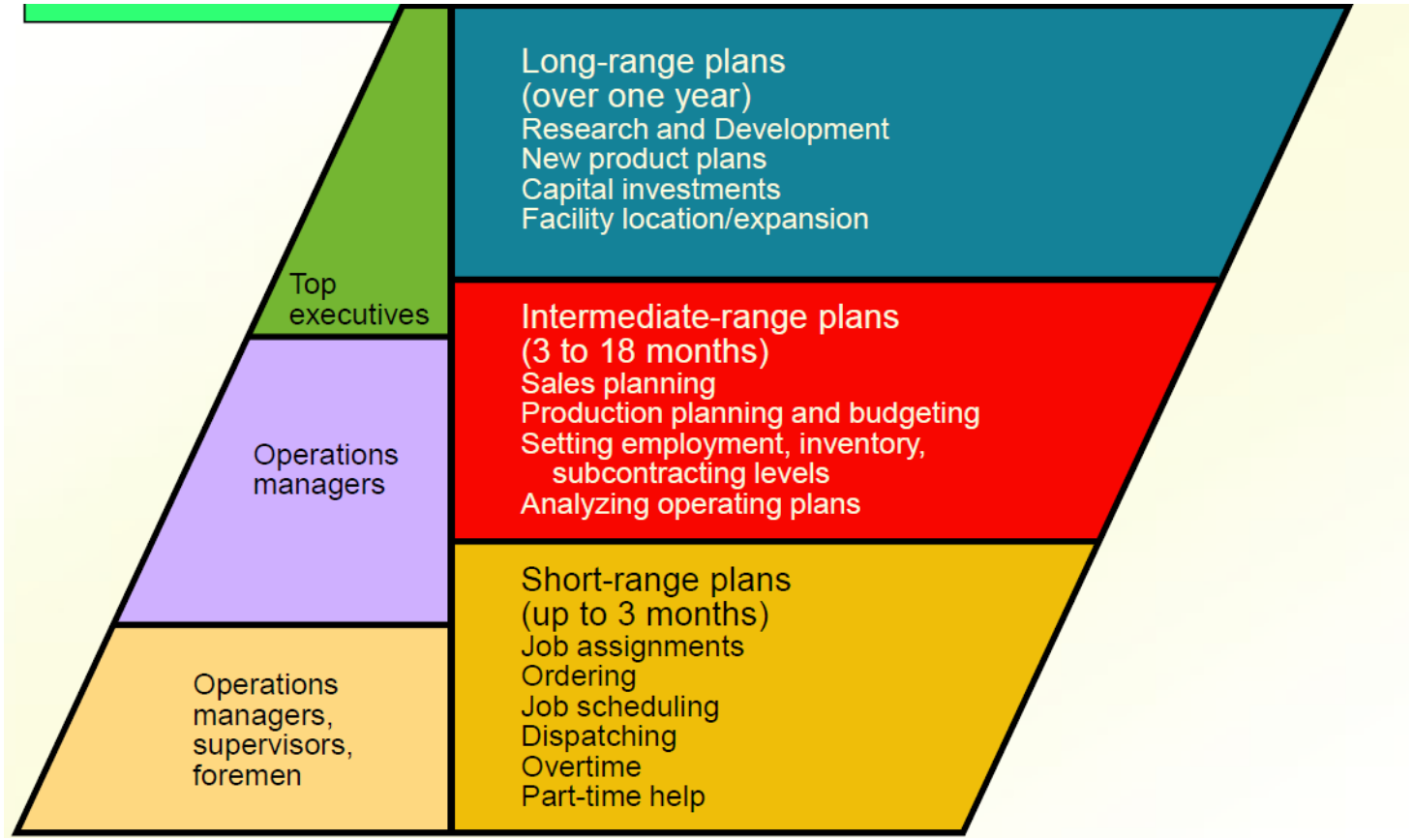


Required for aggregate planning:

- A logical overall unit for measuring sales and output
- A forecast of demand for an intermediate planning period in these aggregate terms
- A method for determining costs
- A model that combines forecasts and costs so that scheduling decisions can be made for the planning period

Aggregate planning

Responsibility and planning horizon



Aggregate planning

Capacity planning

Capacity: theoretical vs normal capacity:

- **Theoretical**: what can be achieved under ideal conditions for a short period of time. No equipment breakdowns, maintenance requirements, set up times, bottlenecks, or worker errors. But this definition is meaningless for managers (things are much different from that). Capacity is thus **capacity of output in normal conditions**.
- **Normal Capacity:** describes the maximum producible output when plants and equipment are operated for an average period of time to produce a normal mix of output.

Due to defining capacity in this manner, it is not unusual for a facility to operate at more than 100% capacity (overcapacity).

Capacity is mathematically expressed as:

$$Capacity = Maximum\ production\ rate\ /\ Hour\ x\ Number\ of\ hours\ worked\ /\ Period$$

Production rate = n° of units produced/Amount of time

Aggregate planning

Firm' s Capacity to produce, whether measured as output or input, depends on the number or type of equipment it has – the intensity with which this equipment is used – the production efficiency, the nature and extent of the supply chain; the product mix to be produced, the demand levels, and distribution capabilities.

Example: Capacity can be changed by changing the number of working hours, production rate, or product mix.

- Though, the normal capacity can be measured in the manner described above, it is often difficult to measure operational capacity.

- There are day-to-day variations, job changes, product mix changes, absenteeism, equipment breakdown, facility downtime, etc.

- Due to these variations, the capacity of a facility can rarely be measured in precise terms, so measurements must be interpreted with care.

Effective capacity (utilization)

product mix: complete set of product/service offered by a firm

- **Effective Capacity**: the capacity, which a firm can expect to achieve, given its product mix, methods of scheduling, maintenance, and standards of quality.
- **Efficiency**: a measure of actual output over Effective Capacity and is expressed as a % of the Effective Capacity.
- The **Rated Capacity** is a measure of the maximum usable capacity of a particular facility.

Rated capacity = Capacity x Utilization x Efficiency

Example:

- One facility has an **efficiency of 90 percent**, and the **utilization is 80 percent**.
- **3 process lines** are used to produce the products. The lines operate 6 days a week and three 8-hour shifts per day.
- Each line was designed to **process 100 standard products** per hour.
- The rated capacity is: Rated Capacity = (Capacity) (Utilization) (Efficiency)

= (100) (3) (144) (0.8) (0.9) = = 31,104 products/week.

Determinants of Effective capacity

- **Most of the capacity plans are based on the following:**
- 1. Set time and resource allocation to meet demand;
- 2. Set strategies for meeting new requirements (new demand, competition, time changes for projects, etc.); and
- 3. Determine the cost of non-conformance to the plan (waste, time slippage, costs, variance
- in quality, etc.).

Factors		Issues
Facilities	Design Location	Layout
Product/Service	Design	Product or service mix
Process	Quantity capabilities	Quality capabilities
Human Factors	Job content Job design Training and experience Motivation	Compensation Learning rates Absenteeism and labour turnover Knowledge
Operational	Scheduling Materials Management	Quality Assurance Equipment breakdowns
External Factors	Product standards Safety regulations Unions	Pollution and environmental standards Stability of society/ government

Capacity and…

Capacity and Product mix:

- The matter of product mix is important, especially while planning for future activities.
- Top management often finds it desirable to express addition to new capacity in terms of money value of sales.
- Details regarding product mix breakdown, type and number of machines needed, etc., which are vital to achieve the desired increase in capacity, are left to the concerned engineers.
- Thus, the definition of unit of output is closely linked with the product mix, and therefore poses a difficult problem as regards capacity measurement.

Time and capacity – example

- Time poses another problem. Capacity is often defined as the quantity of output in a given time.
- However, some manufacturing processes require continuous operation. Thus, a thermal power generation unit must either operate continuously or not at all, as otherwise the boilers cool down. So, the capacity of a thermal power generation unit is the total amount of electricity it can produce by operating 24 × 7.
- Most factory operations are not, however, like this, as they operate on a shift basis, hence for a specified period.
- These capacities are measured by the output per shift.

Individual machine capacity

- No matter how broadly we may define capacity, in the final analysis, in manufacturing, it has to come down to capacity of individual machines.
- The plant usually comprises a set of work centers for performing various operations that are involved in the process of transformation.
- Each work center consists of machines of a given type (like lathes, milling machines etc).
- Once the capacity of an individual machine is determined, it is easy assess the capacity of the work center.
- However, often it is not so simple: the individual machine capacity itself will depend upon several factors such as machine utilization ratio, number and type of operations performed on the machine, the individual operation times as well as machine setup time, etc.
- Nevertheless, estimation of individual machine capacity can often serve as an aid to assess the capacity of the work center.
- Knowledge of the individual work center capacity can then enable us to assess the entire plant capacity.

Managing capacity

Before taking a decision on capacity, the following steps need to be done:

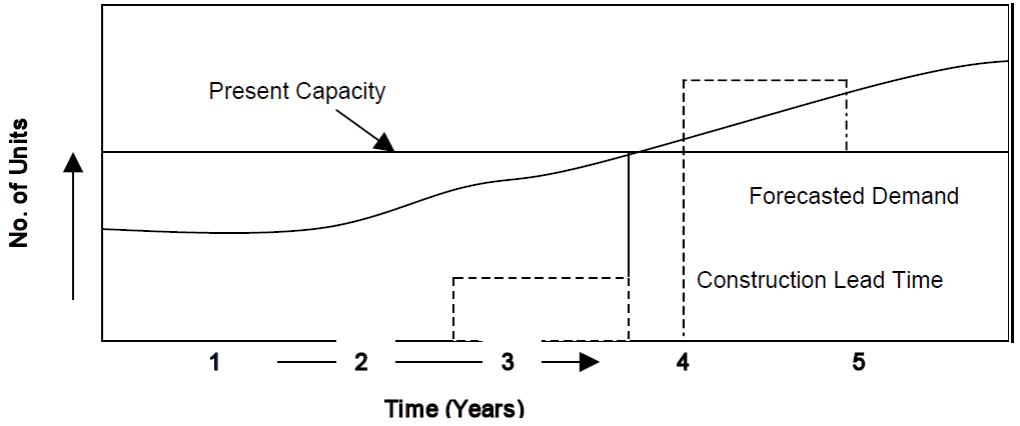
- 1. **Forecast** demand for individual products within each product line.
- 2. **Calculate** the array of **assets required** to meet product line forecasts.
- 3. **Project availabilities** of the existing array of assets over the planning horizon.

- Informed capacity decisions can be made only when management knows the ability of its present resources and the bottlenecks in the existing array of assets (system capacity) and what causes them.
- An assessment of individual plant capabilities and allocation of production throughout the plant network has to be made.

Demand forecast and capacity

- There must be a high level of confidence in the accuracy of the demand forecast.
- Once a **forecast** is available and management determines the point where demand exceeds existing capacity, the time it takes to add on the additional capacity needs to be determined.
- If capacity is expected to exceed two years in the future and it takes eighteen months to add that capacity, then management should begin to plan the construction of the additional capacity six months from date.
- Possibilities are that management can meet the capacity shortfall in the third year, as depicted in the Figure by using the various tactics for matching capacity to demand, described further.
- Finally, investment in assets is also necessary to raise the marginal efficiency of capital employed, till it equals the interest rate.

Relationship between Capacity Gap and Demand (Dutta)



Demand forecast and capacity

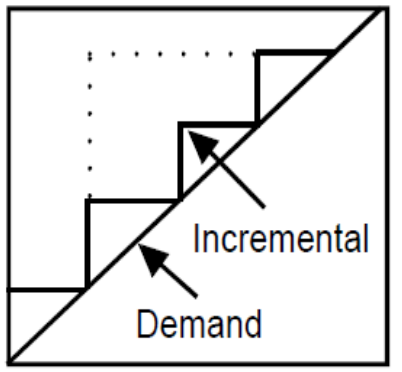
- **1. When**
- The timing and sizing of expansion are related capacity gap analysis is essential in determining when demand will exceed Capacity and by how much. Gap analysis tells you what kind of Capacity you need at given points in time.
- The temporal dimension of Capacity analysis is important in every aspect of business, whether it is in finance, marketing, or production, you can gain competitive advantage through strategies in each area.
- Capacity offerings can also yield a competitive advantage. You have to determine whether you will gain a competitive advantage by introducing that kind of capacity at a particular point in time.

Demand forecast and capacity

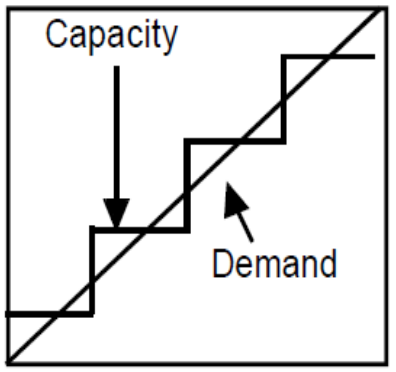
Changing capacity

- Capacity is in some ways a variable and subject to change.
- It is possible to raise the operating capacity incrementally depending upon demand.
- This is because rarely does a plant operate at 100 per cent of its capacity.
- An industry with an 80 per cent average utilization would have a 20 per cent capacity cushion for unexpected surges in demand or temporary work stoppages.
- Large capacity cushions are common in industries where demand is highly variable, resource flexibility is low, and customer service is important.

Capacity Addition Options



Incremental vs. one-step



Average Capacity

Demand forecast and capacity

Tactics for matching Capacity to demand

1. **Adding people** to the production process; if the operation runs two shifts five days a week, then overtime or another shift could be considered.
2. **Increasing motivation** of production employees; by providing incentives, involving people in the operating problems, improving job satisfaction etc.
3. **Adjusting equipment and processes**, which may require purchase of additional machinery or selling or leasing existing equipment.
4. **Redesigning the product** to facilitate more throughput.
5. **Improving the operating rate** of equipment; better scheduling, improved operating procedures, or improved quality of raw materials can increase capacity by increasing product yield.

Questions to be answered by management

2. What Kind

- What kind of capacity are you going to add?
- This brings us back to our assessment of alternatives or the trade-offs.
- Type of capacity can be separated into a technological or engineering question and an economy of scale or business question.
- The economy of scale question is a direct link between demand, capacity, and process selection.
- There is an optimal capacity at which the cost of producing the product is minimized.
- When demand exists for a product, one or more firms will supply the capacity as long as the price customers are willing to pay is sufficient to cover costs and provide a reasonable profit.
- A firm would like to bring down its costs to create an entry barrier and preempt competition.
- What technological alternatives exist? What kind of technological changes do you anticipate?
- Can you increase your capacity by introducing new technology as opposed to increasing labor?
- Technology has become a very important factor in business today.

Questions to be answered by management

3. How much?

- Once the decision to add assets has been taken, the question then arises is, 'How much capacity is needed'?
- The answer will depend upon what triggered the capacity addition decision.
- It ties back to the forecast that drove the capacity decision.
- In addition, most businesses face variability of demand, i.e., peaking by time of day, day of week, month of year.
- Seasonality in demand creates risks of under-utilization of capacity during the off-peaks and strain on capacity during the peaks.
- There are both quantitative and qualitative implications in such decisions.

Capacity Planning through Decision Trees

- **Decision Trees** are most commonly used in capacity planning.
- They are **excellent tools** for helping choose between several courses of action.
- They provide a **highly effective structure** within which you can lay out options and investigate the possible outcomes of choosing those options.
- They also provide a **balanced picture** of the risks and rewards associated with each possible course of action.