

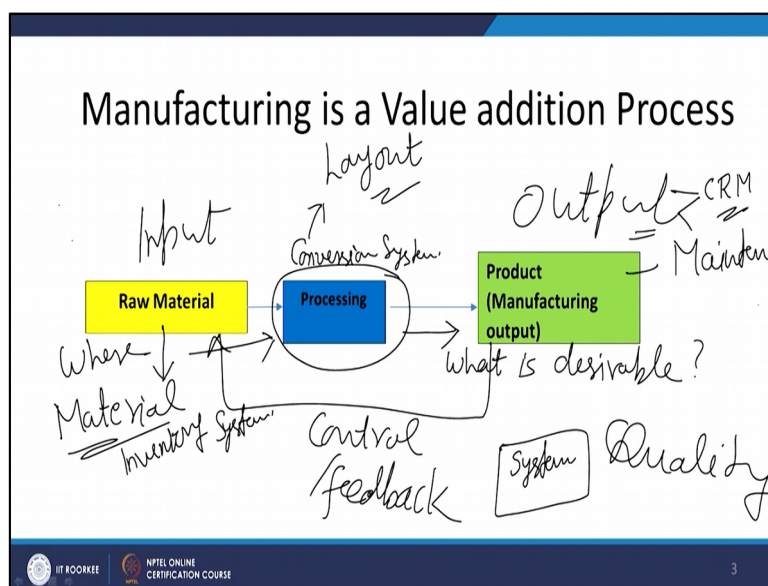
Manufacturing Strategy
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Module No. #01
Lecture No. #02
Operations Systems

Welcome friends. In our last session, we discussed the importance of subject like, Manufacturing Strategy. how manufacturing can provide, advantages to the country, as well as to an organisation. And, manufacturing is one sector, if it is properly handled, can give long-term sustainable advantage. in last session, I coined the term, competitive advantage through manufacturing. Now, in this session, I am giving you the term, long-term sustainable competitive advantage, if it is properly handled.

Now, to understand, that how manufacturing gives you, long-term sustainable advantage, we need to understand, the concept of operation systems. Now, in this session, we will be focusing on, manufacturing, or operational activities, or production activities, from the concept of system, or theory of system. Now, as we discussed in the previous session, the first session, that manufacturing or production activities, are value addition activities. So, that concept will give us an idea, that what is the system concept, or what is the theory of system, in this production or manufacturing activity.

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Now, in the system concept, how do we study a system, that is important. That, you have a system, where something is within the system, and everything else is external to system. So, the focus, where we are discussing our problem, that boundary, decides our system. And, everything, outside that boundary, is out of the system, or the external component to the system. Now, if I see the manufacturing from this point of view, this processing, or the conversion system, is something, which we want to govern, which we want to manage.

And, this conversion system, gets input, from various external entities. the output of this conversion system, also goes to the external environment. So, there are different types of pressure, on our conversion system. One, what is desirable? what type of products, we want to manufacture? So, what is desirable? And, from where, the inputs will come, so that you can produce, the desirable output? So, three things are there.

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- ① • An operation or production system receives inputs in the form of materials, personnel, capital, utilities and information.
- ② • These inputs are changed in a conversion subsystem into the desired products and services, which are called outputs.
- ④ • A portion of the output is monitored in the control subsystem to determine if it is acceptable in terms of quantity, cost and quality.

one is our input, that is one thing. the second is, the conversion. And, third is output. So, these are three important subsystems, which are making our production system. one is input subsystem. second is conversion subsystem. And, third is output subsystem. And, in some of the recent cases, you will also find, one control subsystem. So, that is the fourth. So, you have one, two, three, and four. One, two, three, will always be present.

one, two, three, will always be present. Fourth, may be optional. in some cases, fourth may be there. some means, in most of the cases, fourth will be there. But, there may be few cases, where this control subsystem, may be absent. But, one, two, three, these are important components, important subsystems, of our manufacturing system. Now, in the input

subsystem, you have inputs in the form of materials, which I am saying as, raw material, components, the subassemblies, all these are the form of material.

Then, personal. personal means, your engineers, labour, supervisors. all the staff, all the manpower, is the personal. So, manpower is the personal. Capital, the money, how much monetary resources, you have. And, monetary resources, define your ability, to have good manpower. Whether, you can afford manpower, who is demanding very high packages. Or, if you do not have, that much capital, so you will compromise, on the technical skills, on their managerial skills, of your manpower.

So, capital is another very important input, for your manufacturing, or for any kind of managerial systems. Then, utilities. Utilities, the most important utility for any manufacturing system is, energy and water. without energy and water, manufacturing system cannot work. So, some of you can think that, utilities can be the part of material. But, since the share of utility is so high, that it is always advisable, to study, or to point utilities, as a separate. Because, these are the support systems.

these are not the actual part, or actual component, of your finished product. But, to have your finished product, utilities are important. without energy, your machines are not going to work. So, but energy is not the part of your final product. so therefore, we are discussing utilities as a separate input. and then, information. what type of product, you want to make? So, that is also, a very, very important input, to your manufacturing subsystem.

And, nowadays, since many of you know that, how our manufacturing is becoming, more and more data driven. And, when we are talking of data driven manufacturing, so information also becomes, a very important critical resource, critical input resource. And, lot of organisations are putting, lot of emphasis, you can say efforts, on getting real-time information, real-time data, so that, what type of products, how to have more flexibility, in your manufacturing, all those things are coming.

And, during our course, we will see that, how information has become, a very critical input resource, in our manufacturing activities. So, these are some of the input subsystems. you have material, personal, capital, utilities and information. And, you believe me, that for each of these inputs, you can have a separate subsystem. So, we will discuss, in the next figure.

Then, the second important subsystem, is your conversion subsystem, where these input resources are processed, and so that, you can get the desired products and services.

And, these desired products and services, are actually called as output. So, how do you convert them? And, we require lot of efficiency, we require lot of managerial skills, to convert these inputs, into desirable products and services. So, actually, this conversion subsystem will take, lot of our time for discussion. and then, the output is the third important, you can say, subsystem. That, what type of products, what type of services, you are requiring?

And, depending upon, the customer's choice, the target customer, and here, we require some of the inputs of, marketing information system also, that your market research department, who is closely monitoring the behaviour, the changing pattern of the customer, so they give you information, they give you input, that what is desirable, what are the expectations of the customer, so that, you can build, those expectations, right from the design stage in your product.

So, that is the output part. But, you also have a control subsystem, where you try to see, whether the output, which you are producing, is acceptable, in terms of quantity, cost, quality, etcetera. Because, for an example, if you are running, a low-cost airline. And, in low-cost airline, your focus is primarily on, providing the lowest possible fares, to your passengers. But, the way you are managing your operation, the way you are doing this conversion process, all resources are costlier resources.

your conversion process, is not efficient one. And, as a result of that, you will see that, your prices are much higher than other airlines. So, you need to see that, your control subsystem, is not effectively working. and therefore, your cost is escalating, than your competitors. And, the control subsystem, therefore helps you to keep check on, whatever parameters which you are setting for yourself, whatever level of quality you expect, whatever level of production output you are setting, for your organisation.

Whether, you want per day, for a product. let us say, a plant is running, steel plant. you want, 100 Metric Tonne output per day. But, you see that, your plant is producing, only 60 Metric Tonne, 70 Metric Tonne. So, it is operating at, 60, 70% of efficiency. So, this control

subsystem will help us, in diagnosing our conversion process. And, we can fix the problem, once we identify, our entire process. So, this control subsystem, is also very important.

And, this is the job of a manufacturing engineer, that how to design that control subsystem, so that you can identify, the areas of problem. So, these are four important subsystems. And, as I say that, this is input subsystem, this is conversion subsystem, this is output subsystem. and then, you have this type of control, or feedback mechanism, through which, you get this information, through this control mechanism, through this feedback mechanism, you get, whether your output is desirable or not, whether it is as per the acceptable limits or not.

And, it becomes a very vital information. if you see, our previous discussion, we say that, information is a very important input to the system. And, that information, many a times, come from our feedback mechanism, from the output. And, this will set that, how to change the configuration of our conversion subsystem, so that, output is as per the acceptable limits. So, this is how, our operation subsystem actually operates.

you have inputs, then conversion, and then output, and this control feedback. Now, as I was saying that, at each level, these are four primary subsystems. But, within these four primary subsystems, you can have various subsystems, within them also. for example, we have one input system, which is related to material. Now, material is one very important input, to our entire process. Now, in our operation management classes, though that is not the subject matter of this particular course.

but, in our operation management classes, we have good amount of discussion, on our material management. And, that material management starts, with our inventory systems. Now, the entire inventory system, how do you develop the EOQ formula, what type of P or Q type of inventory system you are going to follow, what type of bill of material you have. And, the entire material purchase planning, is the part of this material management subsystem.

So, this material management subsystem, is a very important component, of your input subsystem. So, this is just one example, that each of these subsystem, so you can understand in this broadways, that first we have, a production subsystem, within the organisation. if you consider the organisation, within organisation, we have a production subsystem. and then,

within production subsystem, you have three major subsystems, input subsystem, conversion subsystem, output subsystem.

in some of the organisations, we do not have this control subsystem. But, in most of the organisations, we have this control feedback subsystem also. Now, within each of them, you have further subsystems. So, for example, we discussed, with an input subsystem, we have material management subsystem. So, how do you plan, your material requirements. So, depending upon the characteristic of your organisation, depending upon the characteristics of your customers, you decide, what type of material management system, you are going to have.

Now, if your customer has, different type of requirement. for example, if your customer has, a very steady kind of requirement. for example, you are in the business of retail of grocery items. you are in the business of retail of grocery items, where the demand is almost very much horizontal type. so now, when the demand is almost horizontal type, your material management system should be designed, so that, you can have minimum cost of that material.

you have minimum cost of that material, if your output, if your customer requires, or if your demand is almost horizontal in nature. So, that is a kind of a rule, which cannot be changed. on the other hand, if you are in a product, which is of some emergency nature. you are in a business of MRO, Maintenance Repair Organisations. And, if you are serving MRO type of industry, in that case, responsiveness is more important.

so accordingly, your material management concept will change, depending upon what type of output you desire. But, if you do not understand this, if there is a mismatch, in your input strategy, input subsystem, and the output subsystem, you will not be able to take advantage of your manufacturing subsystem, for the advantage of your organisation. so therefore, I am emphasising, that at each subsystem, there are different types of subsystem.

Now, if you come to this control system, now in this control system, one of the most popular control system, is about quality. you have, some acceptable level of quality, for your product. we will discuss quality, in this course, in detail also. But, just to have a beginning idea, quality is simply defined, fitness for use. And, when I say fitness for use, it means that, we need to have that level of quality, which is good enough for our customers.

So, if my customer is requiring a very high level of precision, I must give that high level of precision, to my customer. But, if my customer is not requiring, the high level of precision, so there is no point of giving high level of precision, to that customer. Because, high level of precision, will increase the cost, to that customer. And, the customer is not requiring, that high level of precision. Gear, is one such common example.

gear can be used, in Aeroplane. And, Gear can be used, in your normal sugar cane juice machine also. Now, when you are making Gear for Aeroplane, you require, exceptionally high level of precision. But, when you are making Gears, for a sugar cane juice machine, that level of precision, probably may not be required. so now, what level of precision is requiring, that I want to say is the, acceptable quality level.

Now, when we have this feedback system, we continuously monitor, that what level of quality, we are producing. if I am making Gears for Aeroplane, so I continuously see that, I am maintaining that high level of precision. then only, those products will be acceptable, to Boeing, to Airbus, or to any other company. Otherwise, not. So, it is requiring, a feedback system. And, if the deviation is more than acceptable limit, I need to give this information, to my processing system.

And, we will immediately stop, our production system, and see, what are the reasons by which, we are not able to do the things, within the acceptable limits. And, after correcting, after removing the problems, after fixing those problems, we again start. So, this feedback system quality, is one simple example, in this case. coming to this conversion system. for example, layout, is one simple example, of this conversion system.

That, what is the layout of your plant? how the machines are placed? And, this simple thing, this simple subsystem, of conversion subsystem, layout subsystem, or the placement of machines within the plant, that is deciding, one very important thing, that is the efficiency of your organisation. as in my previous session, I was mentioning that, movement of goods, from one machine to another machine, is a non-value adding activity.

Now, if your machines are not properly placed, this movement increases. when this movement increases, your energy, and by energy I mean to say, the cost of conversion

increases. And, as a result, we lose efficiency, in our conversion process. So, designing the appropriate layout itself, is a very important subsystem of the conversion subsystem. there are many more. But, just I am giving one simple example, of each type of subsystems.

So, in case of input, we discussed material subsystem. in case of feedback, we discussed quality subsystem. in case of conversion subsystem, we are discussing this layout subsystem. So, these are the subsystems, which we need to monitor carefully, so that, our overall system, gives value to the organisation. Then, output subsystem. Now, output, is as per the requirement of the customer. output should be, as per the requirement of the customer.

what type of products, what type of services, the customer is looking for? And, that is a very important thing. that is a very important subsystem. the customer relationship, CRM, that is a very important type of subsystem, of this output subsystem. Traditionally, we feel, that CRM is part of marketing activity. most of the time, we study CRM, under the marketing discipline. but actually, the product is being developed by the manufacturing setup, production department.

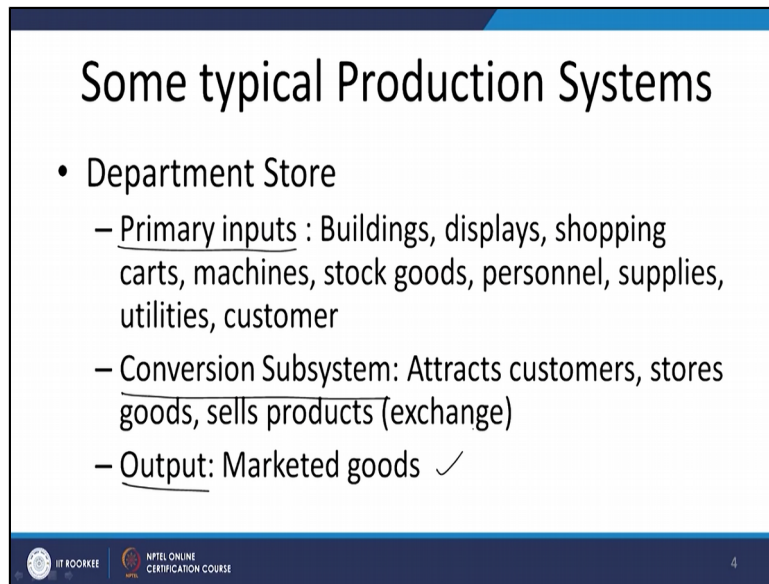
So, production department should always be, an integral part of the CRM team. Because, they only can tell, what is the best way, to use this product? And, what is the best way, to dispose this product? what is the best way, to maintain this product? So, all these things, are the part of CRM. So, if I very specifically say, with respect to output, the maintenance of the product, that is precisely, one component of CRM, which is being taken care by, the production department, or manufacturing activities.

So, what type of maintenance, maintainability, your product has? what is the reliability, your product? has what is the availability, your product has? all these things, are the important component of your, maintenance subsystem. So, at each level of this conversion process, we have different types of subsystems. just for the sake of example, we have discussed, that for the input, we have material management.

for conversion subsystem, we have layout subsystem. for output, we have maintenance subsystem. for feedback, we have quality subsystems. And, all these subsystems, are not only one, one, one. there are many subsystems, in the input. there are many subsystems, in the conversion. there are many subsystems, in the output. And, there are many subsystems, in the

feedback system also. So, this is just an overview, that how an operation subsystem looks like?

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The slide is titled "Some typical Production Systems". It contains a bulleted list with the following items:

- Department Store
 - Primary inputs : Buildings, displays, shopping carts, machines, stock goods, personnel, supplies, utilities, customer
 - Conversion Subsystem: Attracts customers, stores goods, sells products (exchange)
 - Output: Marketed goods ✓

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now, some example, to have better clarity, about these production systems. So, I am taking an example of service organisation, and one example of the manufacturing organisation, so that, we can understand this thing, in every wider perspective. So, example I am taking of the, department store. And, you see, I have three important subsystems. And, I request my participants, that identify the feedback subsystem, for this departments store system.

Now, the input is, in the form of buildings, displays, shopping carts, machines, stock goods, the employees, supplies, utilities, and customers. in a department store, all these things are the input material, inputs to the system. Now, the conversion subsystem. that means, how are you attracting customers, to your department store? how are you storing goods, how are you displaying goods, in your department store? merchandising activities.

and then, how are you selling those products? what type of exchange system means, whether you have a centralised exchange system, or you have a distributed exchange system, or other type of E-Systems, etcetera, you are following, in your department store. all that is the part of, conversion subsystem. So, how a customer is purchasing, and moving away, from the departmental store.

And, output is the marketed goods. the products, which you want to sell, through your departmental store. So, the marketed goods, goods which are moved out of your department

store, that is the output. And, as I say, that I expect that, you should write, on the forum that, what is the feedback, in case of a department store. Next, we take an example of, manufacturing setup. this is the Automobile Factory.

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- Automobile factory
 - Primary inputs: Purchased parts, raw material, supplies, paints, tools, equipment, building, personnel, utilities
 - Conversion subsystem: Transforms raw materials into finished goods (automobiles) through fabrication and assembly operations
 - Output: Automobiles

Handwritten notes:

- Services: Hospitals, Colleges, Airlines
- M. HEP, F.P., Fertilizers

and, in the Automobile Factory, when you compare the inputs, with the departmental store example, you will find that, some of the input resources are common, but some of the resources are different. Like, here we have, raw material, purchased parts. these are, tools, equipment. these are something, which are different than the, departmental store example. But, utilities, personal, building, etcetera, these are same, as in the case of earlier example.

Now, the conversion subsystem, we very easily understand, that transforming this raw material, into the finished products. the automobile, which you want to make, two wheelers, four wheelers, commercial vehicles, heavy commercial vehicles. And, we use the fabrication, welding, machining, drilling, etcetera, and some assembly operation, where we do, various components put together, to give the final shape of the vehicle.

and obviously, the output of this Automobile Factory is, the finished automobiles. that is the, output of this factory. So, you can make, such type of understanding, that what are the input, what are the conversion, what are the output, for any kind of example. take for example, you can do on your own, for hospitals, colleges, airlines. you take, so many examples. all these three examples, are coming from, the service sector.

But, you can take, many examples of the manufacturing setup also. Like, you can take, some heavy engineering plant, you can take, some foundry plants. these are examples of, engineering. Or, you can say, other type of products, heavy engineering, foundry, then fertiliser plants. So, these are, some of the manufacturing activities. And, these are, services activities. And, I request that, you can make, this type of input conversion, and output classification, for these examples.

And, this will give you, the idea, that once we go for the analysis stage, that where the problem lies. And, once we can pinpoint the place of problem, it will help us to easily correct it. Otherwise, if you do not know, where the problem is, how will you correct it. So, this classification of system, into various subsystems, help us in exactly locating the problem area.

And, that is the purpose, we discussed, these two examples, in the form of primary inputs, conversion subsystems, and outputs. So, with this, we come to almost end of this session. And, now I request, all the systems, not only this manufacturing system, but as a student of Manufacturing Strategy, or the management course, we should be able to apply this concept of systems theory, to break our bigger systems into smaller systems.

So, this will help us, in proper diagnosis of our problems. And, it will give us, much simpler way to act upon those problems. Otherwise, where will action be there. And, you will not be able to locate, those point of actions, which will result in, poor implementation of solution also. So, with this, I thank you, for participating in the second session of this course of Manufacturing Strategy