

Course Name: Business Fundamentals for Entrepreneurs – Part 1 – Internal Operations

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Week – 03

Lecture – 06

Week 3 Module 6 Part 1

Namaskar. I am Prof. Devdip Purkayastha from the Indian Institute of Technology, Bombay. Welcome to my course, Business Fundamentals for Entrepreneurs, Part 1, Internal Operations. This module is called Manufacturing and Quality. This is the sixth module, but before I get into the module itself, let me again explain the flow of the course.

So, I started with sharing what is a business, what is a company, types of business, and then the big picture of a company, vision, mission, strategy, goals, culture, etc. In the last modules, I talked about how companies innovate and design new products. Once you have designed a new product, the next topic of course is how do you create millions of such products, or millions of liters, or millions of tons of products, and how do you do it with quality, which is today's module. And just so you know, in the future modules I will talk about finance, accounting, leadership, human resource management, and ESG.

Now, today's module, you may think that it is only important for science students or engineering students. But in today's world, students need to have a broad view of business, a broad set of skills, a broad perspective across functions. So to encourage especially the non-engineering, non-science students to participate carefully in this module, the arts students, the commerce students, the humanities students, if you are going to go for a career or start a company, I would encourage you to think about how do you manufacture in large numbers and how do you ensure quality. Today's module, like all modules, will have six topics. And there are two reflection points where you can pause for three minutes and try to write down in a journal everything that you have learnt and a few questions that I will ask you.

Let's start with the first topic. What is mass manufacturing? Mass manufacturing, simply put, is making millions or billions or crores of copies of the product, the new product that a company wants to launch in the market. Basically it uses a few concepts called economies of scales, specialized workers, and a continuous set of assembly stations and machines. So how did it come about? So in the early days, and if you are making a simple product, a pen or, a pencil or a toy, one person could finish the entire manufacturing. One person could make a pot or a pencil.

But if you look at a complicated product like a phone or a car, one person can make it but it is very difficult and it will take them a long time and probably the one person will not have the skills to make the entire product. So break up the manufacturing into small pieces and I am going to show you some examples. Break it up into small steps and small stations where sequentially, the car or the phone or the machine is built step by step by step. And I will talk a little bit of examples later on. So, what are the advantages of mass manufacturing? First, it is high precision rate because what happens is in one mass manufacturing station, one assembly line station, one step of the process with specific workers, the focus is only one step, one component, one assembly step.

And the worker is trained and is super specialized on that one step. He may know nothing about the other steps but he is a specialist in that one step. So you get high precision rates and because the same person is repeating only the one step, he can do it very fast. So, the production cost goes down and the production level goes up. So, it is highly efficient. But what is the disadvantage? The disadvantage is you have to invest a lot of money in creating that assembly line, examples of which I will show you later.

It takes money. Also, it needs frequent upgrades because as you upgrade the product, you have to upgrade your assembly line. And of course it is not good for the worker or the employee because he is doing the same thing a hundred times, a thousand times on the same day. And he may think what is my value contribution because only doing one small piece of manufacturing over and over again on the same day. So the morale of the interest level of the employee can come down.

So, let us look at a few examples. Before we get into the actual pictures, let us also understand what are the different elements of manufacturing because manufacturing is not just one simple process. It has got many pieces to it. Manufacturing starts with first the product specifications and certifications, which is what I covered in the last module. A company will innovate and test out and create a few pieces of a new product and they will write down all the specifications and they will get all the certifications to make sure that the new product works before they create millions and billions of copies of the new product. So there is a first key element. Now, getting into the manufacturing itself, there are several parts. The first part is if a product needs 10 components or 100 components or a car may want 1500 components, those components have to be procured. From many different suppliers and brought to a central assembly point.

So that is procurement. Apart from the components, you may also require, depending on what your final product is, commodities. For example, if you are a chocolate company, the commodities that get into a chocolate manufacturing is a lot of sugar, cocoa, which is cocoa powder, milk, and some flavorings and some fruits and nuts. That is what goes into making a chocolate bar. So then you have to procure the sugar in trucks, truckloads of sugar, containerloads of milk, cartons of cocoa powder, and the flavoring, etc.

So, you need to procure the components for a product like a car or a phone or commodities like sugar, milk, cocoa for a chocolate bar. And then you have to procure packaging material.

Imagine the chocolate once is made, a small bar, it needs to be packaged. Or if it is a liquid food product, like a beverage, it needs a bottle. That is called packaging.

So that needs to be procured. So that is another piece of manufacturing. Then you get into the actual manufacturing once you have got all the components and the commodities and the packaging material together. You have to assemble them if it is a hard product like a car or a phone. If it is a metal like steel or food or chemical, then there are no components.

There are chemicals which have to mix together, or commodities, which have to mix together and process to create the final product. And then once you have made it all, you have to package it. You will probably understand a bit better when I show you some of the actual case studies. But keep it in mind that you have to procure the product, you have to assemble them or process them, and you have to do all of this keeping in mind the quality standards. Because you cannot have a chocolate bar with, let's say, insects in it.

That will destroy the goodwill of the product and the company and people will fall sick. And you cannot have a car which keeps breaking down or a phone which does not work. So the other part of manufacturing is quality standards and quality control. And we will talk about it. And then the last part of the manufacturing, all the things that happen in a manufacturing plant, would be logistics.

Because you have to bring in all the components and commodities and the chemicals and the iron ores or the coal to bring it all into a factory. And once you produce the product, the final product, you have to take it out of the factory and give it to where the customers are. So all of these is what goes into a manufacturing process, let's say, in a manufacturing plant. So, what does it look like in real life? Let's start with what a product specification. What is a specification? This is the first part I said of manufacturing.

A product specification can be very detailed, book, manual, data sheet, etc. And you should cover these elements. First, you should define the use case. What is the use case for the product? If it's a motorcycle, it is a certain use case. If it's a car, it's a certain use case, some other different use case.

If it's a small car, a cheap car, it is a use case. If it's a very expensive, big car, it's a different use case. Motorcycles, cars, and then trucks is a business use case. So whether it's a motorcycle or, a car or a truck, the business cases are very different. But for the company to define the specification of a car, it's not enough to say, oh, we'll build a four-wheeler.

Because it has to make sense ultimately for the customer. And therefore, the company in the product specs will probably have to write down and say, okay, these are the cars that the customer already is using. But here's what our car, our company car, will be unique about and will be better, etc. So to define the use case, I can see what are the options and the specs that you have to include under the use case. You then have to write down the features.

And the features are, what will the product look like? Is it small? Is it big? Is it heavy? Is it waterproof? Is it dustproof? Is it round? Is it square? What will it look like? What will it feel

like? How will it work? Will there be buttons on the side, buttons on the front, or buttons on the top? Will there be a jack here, a power cord there, the voltage? So, what will it work like? What will the quality look like? If I drop it, is it shatterproof glass? If the car, God forbid, crashes, how safe is the car? How good is the quality? How many miles will the car run before you need to replace certain things? And above all, what is the cost? So these are all the features. The use case, the features. And then you get into the benefits. So, if you put all of this together, what are the benefits to the customer? Because you can't just look at it from a company point of view. You have to look at it from the customer point of view.

How will our company product be faster, cheaper, better, more satisfying, and what are the quality certifications? So, some phones may not be waterproof or dustproof. Some phones may be dustproof but not waterproof. And some phones can be dustproof and waterproof. And some phones can be military grade. You can put it in water, you can throw it, you can drop it, the phone will be okay, it's rugged.

So those are all certifications. IP67, IP68, phone, dust and water specifications. And all of this is captured in what are called design documents. So if you go to a plant, the workers need to know exactly what is the product all about. Because in a big plant there may be 1,000 workers, 5,000 workers, or 10,000 workers. And those 10,000 workers must all know what is the product all about.

What are the designs of the product? And of course, what is my step of the product? What do I have to do with the product? So if you go to a plant, a manufacturing plant or a factory, you will find very detailed design documents. Which will be drawings, manuals, spec sheets, blueprints. You will also see that there are samples of a screw, of a wire, of a liquid. There may be 3D printing. So, all of this together is a product specification.

But if you look at it from a customer point of view, let's say if you go out to buy a car, you will see a car. So this is an example of a Toyota Glanza car. So when you go to a Toyota showroom, you will see a car. And you will know what it looks like, what it feels like, what is the quality of the paint or the shine or the tire, how tall is it, how big is it. But you may still want to know what are the specifications of the car.

So, if you go to the showroom, they will give you a brochure which looks like this. It is from the Toyota website, Toyota India website. And it will tell you the features or the specifications of that product, which in this case is a car, will be listed in that brochure or the website. So you can see the engine specifications on the screen. How big is the engine? Is it petrol or is it diesel? What are the kind of variants? What are the dimensions? How long? How wide? How high? How is the suspension? What kind of suspension it is? And then if you look on the screen, you will see what kind of brakes does the car have and how heavy is it.

So, these are all technical specifications. As a customer, you may want to know it. But in a factory, in the Toyota factory, there may be 10,000 workers or 5,000 workers. So they will need the specification in far more details. And they will have the documents for that.

So, these are specifications. And then features. As a user, more than the specification, you may want to know what the features are. And you can see a lot of the features of the car in the data sheet. And I encourage you to start looking at cars and phones or laptop specifications as a business person, not just as a customer.

So, features. You can read it on the screen. The rear seat. How comfortable is it? Is it leather? Is it not leatherette? The steering wheel. How comfortable? The sound.

The music. The air conditioner. These are all the features. So, this is typically about product specifications. So once you have got the product specification, remember the chart I had shown you, then the next part of manufacturing or the next part of activity in that factory is to get all the components. So, a car that I showed you can have 1,500 components, maybe more.

Five tires will be there. There will be lots of screws and rubber parts and large body parts which are made of sheet metal. And electronics and the engine blocks and the piston rod and the batteries and the wipers. Things that you can see and things you cannot see because they are in the engine or they are below. And same with the phone.

There are many parts on the phone. You can only see the screen and the body. But inside the phone there may be 1,000, 2,000 parts. Microprocessor chips, memory chips, PCB boards, wires which you cannot see, temperature controllers, etc. So procurement is the process of a company obtaining all the parts that goes into the company's products. And the company may not make all the products themselves so they look for supplies.

So, if you buy a phone from an Apple or Samsung or any of the big companies, the phone company will not make all the components. So the screen may be made by someone else. An LG or Samsung may make the screen. The chip itself can be made by someone else like Qualcomm or Nvidia or whoever.

The memory chips may be made by someone else. In a car, the manufacturer who is making the car, assembling the car, will not make the tires. They will buy the tires from someone and the battery from someone else. And the steel for the body from someone else. So that's the procurement process. And of course, a car manufacturer or even a beverage manufacturer or a food manufacturer will have many suppliers.

And you have to have relationships with the supplier and look at some examples from food and chemicals as well, apart from cars and phones. And as I said, procurement can be for components, if it's a phone, car, etc. It can be for agriculture commodities, if you're making food, a beverage. It could be for chemicals if you're making a washing powder.

And, of course, packaging material, etc. So, how do you procure? Is it as simple as that? Now if you're buying, let's say you are buying a phone for yourself. And you understand that it's quite a complex process. But remember, the phone manufacturer doesn't have to buy one piece of the chip or the screen or the memory module. He may have to buy 10 million pieces, 1 crore pieces, 100 million pieces, 10 crore pieces.

So, procurement in such large numbers is very complex. If you're making chocolates, you're not buying, as a customer you're buying one small piece of chocolate. But the manufacturer of chocolate has to buy tens of millions of liters of milk ten's of millions of kilos of sugar, and millions of kilos of cocoa. And millions of meters of the wrapper with which you cover the chocolate. If you're making metals, some goods with metals, you may have to buy thousands of tons, truck full of material, ship full of material, aeroplane full of material.

So, it's a complex process. So, what are the steps in procuring? First, the procurement department and most big companies will have a procurement person, which in many ways is the reverse of the salesperson. So in my next module, in my next course, I will talk about salespeople, sales processes. So, sales processes and salespeople are selling to the customer. But the company's procurement processes and procurement people are buying from the suppliers.

They have some similar but also different processes. So first of all is to understand the requirements of the company. How much of which component does the company need? If I'm making a thousand cars a day and a car has 1,500 components, I have to buy 1,500 into 1,000 components. That's 1.5 million components per day.

And then you multiply it by days and weeks and months. So you have to identify the internal requirements, the components, the numbers, the delivery schedule, etc. And then the procurement person has to go and identify suppliers. Where do I buy the tires from? If I make a thousand cars a day, I'll need 5,000 tires a day. And then so many tires per week or per month. So which tire manufacturer do I buy from? So, you have to identify the external supplier.

And then you have to place the order. But before you place the order, there's negotiations on the price. So I'm going to buy 1 million tires. What is the best price? So there's negotiation. And then the order is placed.

And the order may not be for a million tires, which is over a year. It may be I need 10,000 in January and 10,000 in February and I need 500 every day. So the order is placed like that. And then the order is placed. The supplier will start feeding into the plant. Remember, one plant may receive goods from 100, 200, 300, even a thousand suppliers.

And therefore, goods receipt itself is a very complex process because linked to the good receipts is the payment that has to go out. And remember, if a company is selling every day 1,000 cars whose value is let's say \$10,000 each, so that's 10 millions every day. That's about 100 crores of rupees. But the component values that's coming in every day may be half of the sale value, which may be 40, 50 crores of components are coming in every day.

And someone has to keep track of all of that. And then the quality has to be checked. If you're getting 5,000 tires every day or 1,000 batteries every day, you have to make sure that the quality is correct. And finally, of course, someone has to keep track of all of these and make the payments. So therefore, many of you may want to look at manufacturing as a career, but my suggestion to you is manufacturing has got many parts to it.

And you can choose a career. For example, they're professional procuring specialists. Just like they're professional sales specialists, they're professional procurement specialists. And there are highly trained professionals who run factories or assembly lines. So as you understand each of these processes, and you see the examples with each process, you can choose your career option of which career interests you. So now we have talked about the product specifications and then procuring the components or the commodities.

Now that you have looked at how the product specifications are defined and how the components are procured in a factory, let's now go inside the assembly process of the factory. And I'd encourage all of you to actually go and visit a factory. If you can't enter, at least look at the factory from outside. And you can go to any part of India in an industrial area, plan a day's visit there, and look around all the factories. And if you know someone, enter the factory and go and see how all the steps that I'm describing to you are actually happening.

It will give you an appreciation of business, and it will broaden your understanding of how to choose your career. And one of the most interesting aspects of manufacturing is the assembly line itself, where you can see step by step by step how products are being manufactured. So let's look at what does an assembly line look like. So, this is how a typical car assembly line will look like.

It's not a very sophisticated assembly line because it's a manual assembly line. So you can see the empty shell of a car, which is one step in the assembly line. But when it starts, there's nothing. So, it may start with pieces of the body being welded together. That's maybe the first few steps of the assembly line. And then once the body is made, you will find the different components are being screwed on to the body, as you can see in this picture.

And if you look carefully, you will see that there's a lot of parts which are kept on the side. So this is what you'll see if you enter an assembly line which is undergoing manual assembly. But a lot of the modern plants are robotized.

So, there is actually no human being putting in the components. They're all robots. And you can see a picture of those robots. Now, these robots are not the ones that you may have read about or looked at pictures of. Robots who look like human beings. No. These are still robots which are arms, which are coming in and assembling different parts of the car.

They may be welding the body itself. They may be screwing on a component. They can be hard flipping or flitting or fitting two plastic parts to each other. And the yellow ones that you see on the side are the robots. And you can see the assembly line itself, which are the cars.

It's a moving line. The cars keep moving. And at each step, the robots come in, assemble something. And in a manual assembly line, the human workers will assemble something. But the car keeps moving from when there is nothing to when there is a finished car. Let's look at a form.

So again, this is how an assembly line or an assembly factory or a factory can look like. And you should go on field trips and have a look at such factories. And if you go inside one of these factories, and I'm going to show you the inside of a phone factory. Remember, this phone has very small parts. And they have to be either welded or screwed or plastic fitted, tightly fitted to each other.

And on the assembly line, you have to fit in the parts from the sides. So this is what it will look like. It is dust free. It will be pollution free.

And the workers are assembling the phone. Till you get the phone on your hand. Now, I will now encourage you to reflect a bit about what I've talked so far. Think of a car or a phone that you are using. And write down in your journal the components that you can think of. So, if you are riding a bus or a car, look around you and see what the components are. The seat, the battery, the body, the window, the rod, the handle, the steering wheel, the dashboard, the plastic.

Think of the components. Think about where the car manufacturer got the components for. So if you look at the body of the car, it's made of steel. Someone would have supplied the steel, maybe a Tata steel or a JSW steel, to the car manufacturer. Look at the tire and think about who could have supplied the tires to the car manufacturer. Study the car or the phone and think about how it was assembled.

How the body parts are welded together. How the tires are screwed to the axle. How the dashboard, the plastic dashboard, is fitted. How the seat is put into position. Or if it's in a phone, look at the phone and see how the screen is fitted to the side chassis. And if there's a button on the side, how is the button fixed to the body of the phone? And think about how they could have been assembled. Try to visualize and draw in your journal what could be the steps of an assembly line of a car or, a phone or any product that you choose.

And think of some way that if you are an entrepreneur and you want to set up your own assembly line, how you can improve on it. As always, have your journal, do the reflection points together one by one, keep the notes so that by the end of the course you have assimilated the learnings better. So take your time.