Business Data Management
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ACE Gears case intro

Professor G Venkatesh: Do you want to lead into the case a little bit?

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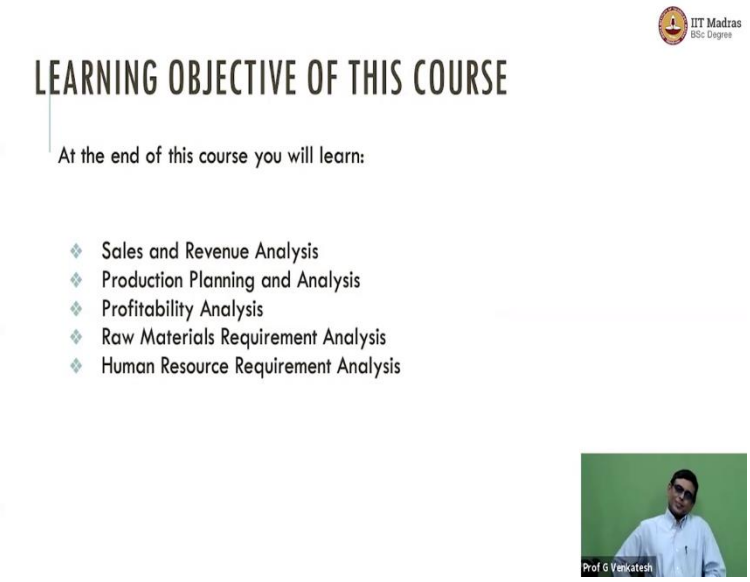

Professor G Venkatesh: We are going to look at several issues that come up in manufacturing industry. Specifically, I think Siva will speak with his experience about. First, I mean, this is a data science course, so question about where the data come from in the manufacturing industry? Is it digital or do we convert all the existing physical records that are there in manufacturing industry to digital? Those kinds of issues, we must look at it, so that will come.

Certainly, we will try to introduce some of that, but we want to see the digital data that is available in manufacturing industries and use it to do some analysis of sales and revenue like what we did in the FabMart, the e-commerce case that we did already. But the difference from that case leading into this case is that where these products are not stopped and sold like e-commerce, but they are manufactured.

When you look at the manufacturing aspects how do we do production planning and analysis of the and scheduling of the production and the analysis of that. And the materials that go into production basically they have costs, and we look at the bill of materials, and then profitability analysis of different parts and work back from there to understand the materials how you plan procurement of materials. What kind of materials are required first to do this production? What kind of human resources are required to do this production? So, requirement analysis that we will be doing for these raw materials and human resources.

And we saw a little bit of some of this in the first four weeks, how material and people, how important they are in the costing, and in planning and all that so we are going to get into it in more detail in this case. And, of course, as we go along doing all of this, we will be doing this through spreadsheet, so we will learn a little bit more about spreadsheets and how to use spreadsheets to do this kind of analysis.

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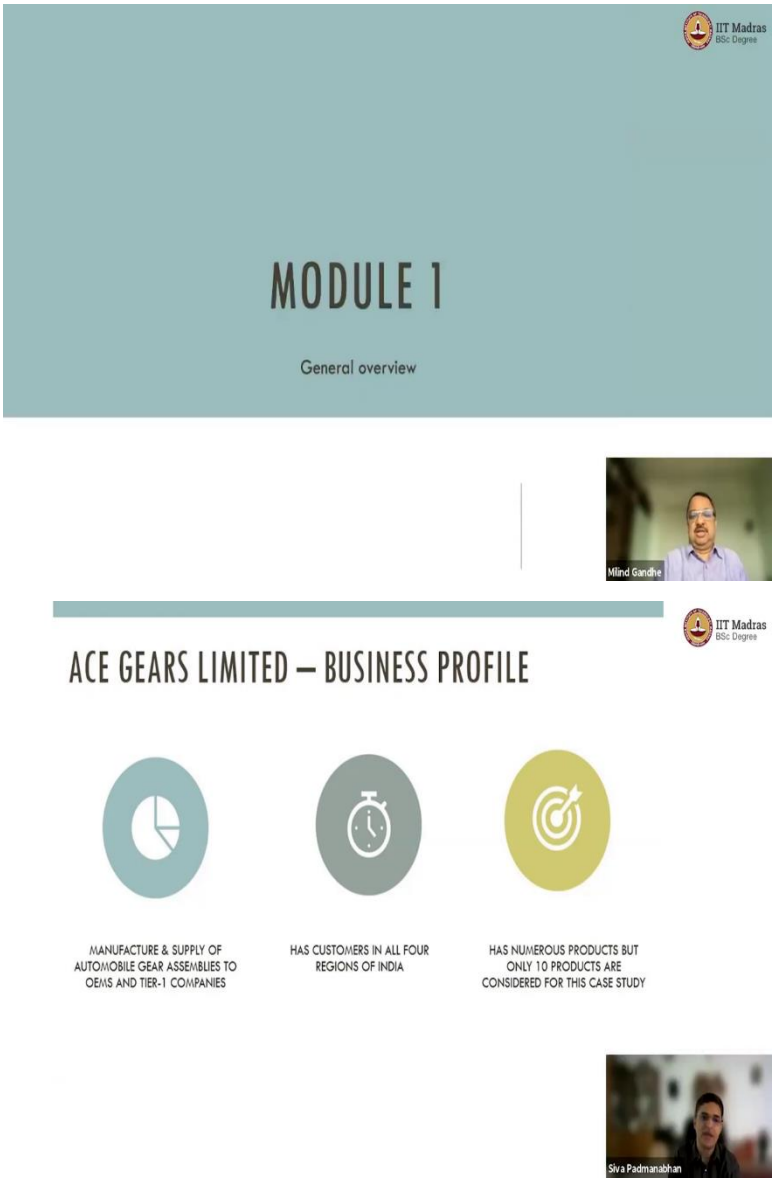

Dr. Milind Gandhe: With that context, maybe, we can start talking about the case that we have today. The case that we have today is about a company called Ace Gears, and Ace Gears is what is called in the automotive industry as a Tier 1 supplier. The people that make the cars that make and sell the cars in the automotive industry are called OEMs and these would then be people like.

Professor G Venkatesh: OEM is original equipment manufacturer? OEM is.

Dr. Milind Gandhe: That is correct, original equipment manufacturer. And there are companies like Hyundai or General Motors or Ford companies like that, but there are a bunch of companies, as Siva was mentioning that make the sub-assemblies. And Ace Gears is one such company, and so in that context it is called a tier 1. Siva, why do not you tell us a little

bit about this company? What does this company do? What are some of the challenges that a company like these faces, that we can use data to analyze?

Mr. Siva Kumar Padmanabhan: Absolutely. So, as Milind just mentioned the Ace Gears is manufacturing gear assemblies. Basically, when you think of the concept of the gear, it is the way to transmit the energy that is created from one source into another place. In specific context of the automobiles, you have the engine that is creating the internal combustion engine that is creating the rotating energy, and the gear is used to actually transmit this energy to the different wheels. That is why it is called a transmission because it is transmitting the energy from the motor to the to the different wheels.

This company is involved in creating gear assemblies that go into this transmission. That is the main business of this of this company. And it must supply mostly to OEMs but also to some tier one companies which then create finished transmissions. It does both things. And it has customers in all the parts of the country. Basically, it is supplying to OEMs located in the different regions, and you will see that in a bit later on in this case study.

It has several products. It has several different types of gears, gear assemblies and so on. And for the purpose of this case study, we are actually going to consider 10 products just to keep it easier to follow that we will look in this case study. And Milind when we talked about some of the challenges that an industry like these faces, is that automobile demand is highly variable, as we all know. So, it depends on several things. It depends on government policies around and changes in those policies.

It depends on the festive season, for example, where a lot of people tend to buy new cars, and so on. It depends also on availability of parts. Right now, we have for example, passing through a phase when electronic components are not available in the way that they used to be. So, now there is a supply challenge that comes into the industry.

Then, of course, there is labor. Labor or people are very important to run these nines and create these products. And sometimes what happened in 2020, was that the cost of COVID, for instance, all this labor that worked in factories in this industry went back to their native towns and villages. And that meant there was a big shortage of labor and of course, the safety of operating the factory in the pandemic.

These are all kinds of challenges that affect this industry, right from the demand to the supply to all the resources that are required for this industry keeps changing over time.

Dr. Milind Gandhe: These challenges seem large. And I am very curious to see how using data, perhaps, we can break them down into smaller challenges.

Mr. Siva Kumar Padmanabhan: Absolutely. I think data has made a huge difference in the productivity and the cost of running operations for this industry. They were one of the pioneers to adopt technology to run their planning and manufacturing and procurement operations. So, if you go way back in early 90s, Mahindra and Mahindra were one of the first companies in India to implement a full-fledged ERP system SAP system. The industry has been.

Professor G Venkatesh: You may have to explain what is ERP system? I guess in the slide later, maybe which it explains it?

Mr. Siva Kumar Padmanabhan: Yes, I think there is a slide in a couple of slides. We have one that talks about ERP.

Professor G Venkatesh: ERP is Enterprise Resource Planning,

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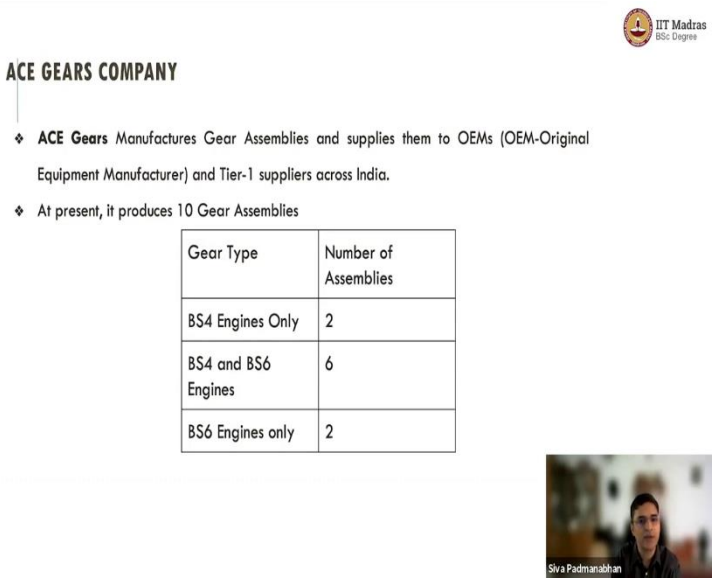


Mr. Siva Kumar Padmanabhan: Yes. ERP is Enterprise Resource Planning. And we will talk a bit more in detail when we get to that point. But it is basically the way to integrate all the different planning functions of a company into one single base of data. Earlier, you used to have different types of data to manage different parts of the company or different functions of the company.

If we go down one or two slides that is the slide about ERP. So that shows you, as you see here, earlier, all the circles used to operate independently. So, you have the finance department, which has its own accounting system and then you had the production department, which had its own production tracking system. You had the human resource department, which had its own HR system, and so on. And all these systems are not connected. The data was not common, commonly held right, in one single database.

And what that meant was the data that production shows would be different from the data that sales shows, or finance shows and this used to cause a lot of confusion and a lot of error in the way we plan and execute the business. But with the coming of the ERP systems back in the 80s, and really accelerated in the 90s and the last decade is companies are now operating

out of a single system which got integrated database so that once you record a product as produced out in the production module, it immediately updates the costs in that costing module, it updates inventory in the finance module, it updates the availability in the sales module and so on, everyone is now working with the same set of data. So, that is a bit about ERP. But as I said before, automotive industry has been a very forerunner in adopting the ERP systems.

Dr. Milind Gandhe: This is this picture is quite interesting because in the Fab Mart case, we saw and perhaps a simplified view that we were only talking about inventory management, planning and finance. But clearly, what this picture tells us is that there are many, many departments in the company and each one of them is doing their own bit and all of it must sort of gel together like a gear, almost.

Mr. Siva Kumar Padmanabhan: Yes, that is an interesting analogy, that is very true. And if you look at the manufacturing industry and compare it to a service industry or other industries it has got a much broader set of activities. If you look at a training industry or even e-commerce it is about procuring a product and then making it available to the customer in a very far way.

But if you look at this industry, it has got to think about how I not only procure all the components that are required to create my product but also it must schedule all the machines that are required to convert the components into a finished product. It must make sure that the labor is available at the right place at the right times, it must make sure that the finished product at different stages of production is tracked appropriately, and then it must think about making sure it is distributed to the right places, so that the logistics industry can then take it over and deliver it to the final point. That is why you will see a lot more richness in the business functions in manufacturing.

Professor G Venkatesh: Also, in e-commerce example that Milind pointed out the data is already digital in the digital form because you have sold it electronically, I presume. You have a digital data right from the beginning at the origin itself. Whereas, here, presumably some item is shipped their shipment, shipping voucher and all there are many physical records.

When things are physical goods or physical and lot of records are also physical, I presume, and somewhere this physical data must get converted to somebody has to make entry, digital directory to make this thing into a digital data. So, can you speak about when data gets entered a system into the ERP system?

Mr. Siva Kumar Padmanabhan: Yes, absolutely. That is a great point. And there are many points which are still pay per based in the industry. Although, the companies leading companies are trying to minimize how much physical entries are there. A typical example is when product or when your raw materials arrive at your inventory or store, storeroom right if it is a steel bars or whatever that is buy is being bought.

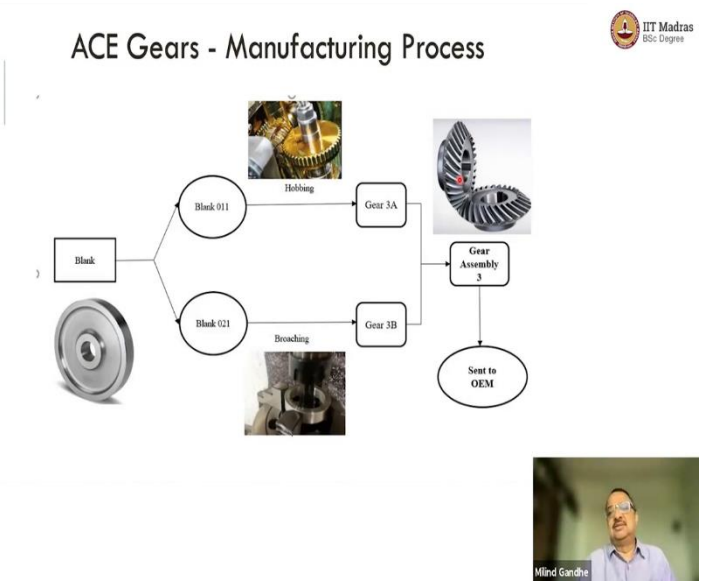
And so, somebody must then record that this has been received, how much has been received, is it in good quality. And a lot of times you find that this is maintained in manual records, and then later somebody enters that data into the system. Although, companies are now providing point of interfaces that people can key this and right at the time that they receive.

Similarly, when you are manufacturing, the actual quantity produced is recorded by manufacturing execution systems that are attached to the line but from here it needs to then travel into the ERP system. So, you will see some data that is coming from machine into the

ERP system as well. There is number of points where there is manual information or external information that needs to be captured in the ERP system.

Dr. Milind Gandhe: Fantastic. While you were mentioning that this company makes 10 products and that it is a very large number of products. Perhaps, you can tell us what are the kind of products that this company meets?

Mr. Siva Kumar Padmanabhan: Yes. As we were saying they do make several products and they are considered 10 of them in this case study. What you see there is, something called a gear assembly. All the products that we are talking about here are gear assemblies. So, gear assembly, you can think of it as a more than one gear joined together, and there are different types of gears. There are helical gears and the power gears, all these types of things that are used in the transmission and we are considering a gear assembly, which is made from two gears. (Refer Slide Time: 14:30)



The way this works. If you go down one slide, I think might be easier explained with some pictures. As you can see here, on the right side, you see the gear assembly, so it has got two helical gears that are put together. And what that then does, as you can imagine, is transmitting the energy that is created in one axis into another axis, right from vertical to horizontal or horizontal or vertical.

And this gear assembly involves two gears. So, as you can see here, this is gear assembly number 3, that has been sent to the OEM, but it involves gears 3A and 3B which are the two gears that are part of that assembly. Now, the company must then make these two gears and gears are made using a two-step process. One is called hobbing and the other is called broaching.

Hobbing is thought of it as the way that the external teeth of the gear are actually cut, and then the broaching in a very simple way is the internal things like whether it be that a shaft kind of thing that allowing it to be fit, etcetera, to be to be made as the broaching process. And the whole thing starts the plan that you see on the left.

The company procures these blanks which look like that, and then they do the hobbing process which cuts those teeth that is in the outer side and then the broaching that finishes insides. And similarly, it must make two such gears 3A and 3B in a very similar way and then

they are put together into this assembly and quality inspection is done, packaging is done and then it is sent to the OE.

That is the whole process that we are going to see. And we are going to see this from the sales end and working backward through the chain. Because we have begun to see how much the actual sales of these assemblies is, and then we will see, to make those sales know what the number of gears is we need to make. And then from there, we will see how many brands we need to buy, and so on. We are going to go from the right to the left as you proceed to the case study.

Dr. Milind Gandhe: When I hear the word gear. Siva, I think of when I change my gear in my scooter or in my car and that this assembly is what enables it, is it?

Mr. Siva Kumar Padmanabhan: Absolutely. There are different, transmissions are a very complex mechanism, but you can think of it as there is a certain amount of power and torque that the engine can create. When you are in a standstill and you want to move forward, you need a very high level of torque, that means, you need a very short gear. Think of it to move your car forward with a lot of push, that is a torque that it gives.

But as you get most vehicle moving now you want to increase the speed of a vehicle and then you are switching to longer and longer gears from the shorter gear so that you get more revolutions on the wheels, as the car or two-wheeler moves forward. That is the whole purpose of this transmission is switch, helping you to switch from a state of rest to a state of increasing speeds, and that is when the horsepower kicks in.

When you are on a high speed then you want more horsepower. When you are on a very low speed, you want more torque. And that is what this gear assemblies enable.

Dr. Milind Gandhe: Why would I have 10 different kinds of gear assemblies? Because there are different car models? Are there different motorcycle models? Is it?

Mr. Siva Kumar Padmanabhan: Yes, absolutely. So, if you think about the industry itself that is both passenger vehicles and commercial vehicles and the company supplies to both. If you think of trucks and pickup trucks and so on that is a commercial vehicle segment. And then even within the passenger vehicles there are so many manufacturers and most of them have proprietary transmissions.

They make their own or they source from a certain company that has made for that model. When you look at all these different models of transmissions, then you need several different gear assemblies that go into it.

Dr. Milind Gandhe: In this slide, you were mentioning that there are 3 different kinds of gear assemblies.

Mr. Siva Kumar Padmanabhan: Yes. What we will cover in the slide is, we want to illustrate an important aspect which was a transition from bar at stage 4 to bar at stage 6 six that happened on April 1st, 2020. The Supreme Court ruled that because of the increase in pollution in the country and the government, of course, regulations are already in place to move from BS4 to BS6, but there was a clear ruling that March 31st, 2020, was the last day that the BS4 equipped vehicles would be sold based on the court ruling.

What you see here is, that there are certain assemblies that are used in the car in the transmissions of the BS4 types of vehicles. The cars that were sold before March 31st, 2020, used gear assemblies that were fit for BS4 are upgraded for BS4. And then once the new norms kicked in on April 1st, 2020, the industry switch to BS6. And then what happened is,

some of the parts that were in the transmission had to be redesigned and made more stronger and more resilient to support BS6.

What happened is of the 10 gear assemblies that we are going to discuss this case study, there are 6 of them that can be used or that were used in both the BS4 and BS6 transmissions. The reason being that those gear assemblies did not get affected because of this transition, they continue to be used. But there are two parts or two assemblies that were stopped, you know, when the BS4 ended, because those gear assemblies could only be used in the older BS4 transmissions.

And there are two parts that were new parts that started selling just before the transition for BS6 happened. And these parts are specifically made from BS6 requirements or changes because of the BS6 requirements in the transmission. These two parts are new parts that only start selling very close to the date of the launch of the BS6 vehicles. You see all these examples in the data because you will see the assemblies one and two which have BS4 which you will see that they stopped their sales, or the sales stopped. They drop off and then they start than before there are six norms with them. And then you will see six parts which continue their sales because they are not affected by the transition. And you will see two assemblies that start the sales just before we are seeing.

Professor G Venkatesh: This pattern, where you see one type going down and other type going up and so on is very typical in manufacturing. Because there is a technology change or when a model is discontinued another model is introduced, you will see these transitions. You will see transition from one type to another type.

Mr. Siva Kumar Padmanabhan: Yes, absolutely. I mean, some of this is regulatory, like from the government of this law to other changes that come because a new model is introduced, or a new generation of a car is introduced. So, if you look at a very popular car like Honda City, it has had 4, 5 generations. Every 6, 7 years, a new generation comes. And then you have a new generation of a car, almost everything gets changed. It is a new engine, typically, there is a new transmission.

When those things happen as well, the components suppliers and all the tier one suppliers all must quickly adapt to that change and start making new assemblies or new parts to cater to the new model, the new model generation of manufacturing. A lot of changes like this keep happening, we are just showing in here, just one change from BS4 to BS6.

Dr. Milind Gandhe: Siva, the thing that strikes me, is that, if I make too many BS4 assemblies, and BS4 cars are no longer being sold, then I have a problem because I will not be able to sell those assemblies going forward. I need to plan and figure out exactly how much I want to make.

Mr. Siva Kumar Padmanabhan: Absolutely, I think you hit on a very important point there Milind. Therefore, planning is so important in this industry. Because there is there is a lead time involved in everything. So, if a manufacturer must start, for example, making new BS6 cars or stopped making BS4 cars, then usually. Let us take the example of the BS6.

The manufacturer starts selling new BS6 cars on April first, that means they must start making the cars at least one or two months ahead, because then they must reach the cars to the showrooms in time. And then if the manufacturer must start a month ahead, then the assembly, supplier of the assembly is that go into the transmission, they must start probably two months ahead to start providing these parts so that then that can get built. It goes.

If you must provide those parts to one side, then the actual raw material, the gear blank maker will probably have to do three months ahead before that. And so, the planning is so important in this industry and time phase, we call it the time-phased planning. So, you must actually look at buckets of time, whether in months, weeks, etc and you have to say how much am I going to make and sell in those markets.

And therefore, what does it mean for the previous buckets for another part of my own factory or my supplier, and then, and go backward like that. So, as we get into the data, you'll see the time buckets that we use, in this case, mostly the monthly buckets for the two years and you will see how those transitions affect many months ahead of the actual change happening at the end at the end of the chain.

Dr. Milind Gandhe: G.V, I think in the Fab Mart case also we looked at a little bit of this timing variability, but there we had a nice 15-day data so we could not see much.

Professor G Venkatesh: We could not see any trends in fact there. Hopefully, we will see more trends in this one, because it is monthly. And over a period, I think 2-year data we have. Let us see how it looks.

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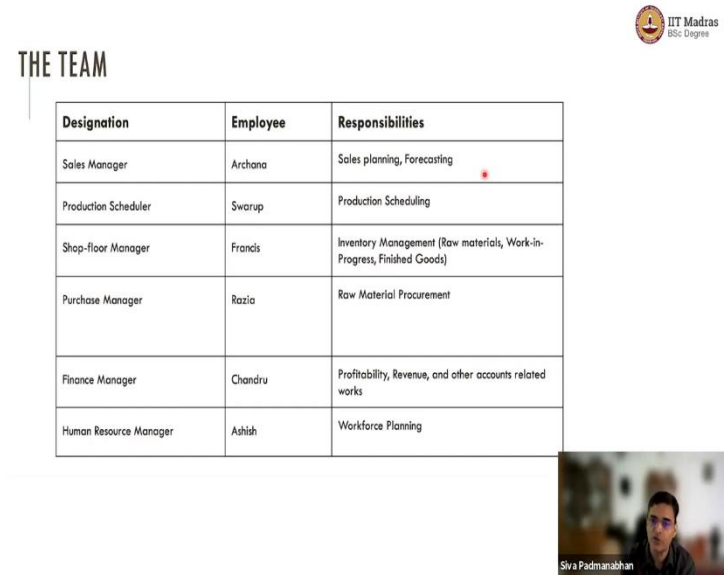

Dr. Milind Gandhe: Siva, why don't you introduce us to some of the people in this term?

Mr. Siva Kumar Padmanabhan: Yes, absolutely. There are new additional different roles as we go through the case study. Just to show you, all the different departments that are involved and planning, scheduling, procuring, and manufacturing. The first role we will see is the sales manager who is responsible for planning the sales of this gear assemblies and forecasting how many we need in the future. That is Archana. And then you hear from Swarup, who is the production scheduler, who must then make sure that the machines, the hobbing, broaching and other machines are appropriately loaded with the right kind of blanks to make the right kind of gears and assemblies.

You will also see the shop floor manager who is responsible for the day-to-day inventory, work in progress, which means, a product that are still being made on the floor of the factory, and the finished goods who is Francis. And then you will also see Razia, who is a purchasing manager who must make sure that the raw materials are procured in time the blanks are

procured, so that, there is no stoppage to any of the machines for want of raw materials. Yet, trying to make sure we have the right number of raw materials, and we do not overly stock more than what we need. Because every item your stock costs there is the cost to buying and stocking back.

You will also hear from Chandru, who is a finance manager who is concerned with profitability, revenue, and other accounting related items. Because at the end of the day, the company must make money, you must make sure your products are profitable, cash is collected at the right time from the customers and so on. So, you will hear from Chandru.

And we will talk about Ashish who is the human resources manager. Because to run all these machines and think of the factory where there are so many hobbing machines, so many broaching machines, so many assembly lines, you need a lot of workforces, both, owned workforce employees and contract workforce, that is a better approach to run these machines to inspect the products of quality and all of that.

Workforce planning is another key element of manufacturing. And we will also meet all these people as we go through the case study.

Dr. Milind Gandhe: G.V it looks like the finance people do roughly the same activity in all companies. Because in Fab Mart also the finance person, the CFO had a roughly similar concerns, but the inventory here that looks a little different, I think because there it was more about sales. It was more about pushing things to customers while here it is more about sourcing from suppliers.

Professor G Venkatesh: It is a combination. It is both technical. There is also this interesting work in progress, which will never be there in a commerce company.

Dr. Milind Gandhe: Correct. So, a little bit of difference, but I think the finance guys are largely the same in all companies.