The Future of Manufacturing Business: Role of Additive Manufacturing
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Lecture – 11
Agile Manufacturing - II

(Refer Slide Time: 00:15)

Welcome back. We are on to the second part of the agile manufacturing. In the earlier one we talked about why agile manufacturing? The difference between agile manufacturing and the waterfall approach for manufacturing. If you need to implement agile manufacturing, what are the key components? and what are the best practices that you could do around agile manufacturing is what we covered.

We also covered about if you have an existing manufacturing entity, how do we go about implementing the agility around that. So, we in the second part, we will continue with some of the other components around agile manufacturing. We look at the benefits of agile manufacturing. If a manufacturing has ability to reconfigure itself and come up with some new solution, there is an instant gratification from the customer.

Consumer appreciate speed and are clearly ready to pay extra for the service. There are many examples of that online retailers if they are able to have something like you know, resources that are giving one day service or immediately they are able to

change the variation that could handle in the online delivery services. They appreciate this kind of additional variation they can instantly support.

The second benefit that it has is you know, it allows consumers to choose. Agile manufacturing guarantees consumers can obtain personalized product without compromising on the quality or speed. Consumer appreciate the ability to make choice and the ability to tweak the product can make it seem more valuable to a customer.

Your organization is not only able to provide more choice in terms of current customization, but you will also be able to be more flexible in changing the product around to suit the future trends. Many fashion products, many retail products that are there in the market is coming into this particular arena, if you will.

So, this instant gratification that you could have and the consumer, putting consumer in the driving seat are the key driving force in the agile manufacturing. It is also that when the market conditions are dire in order for you to sustain the agile manufacturing approach will help the manufacturing entity to be more flexible to the changing needs of the market, to readjust itself for new products if you will.

A traditional manufacturing approach is not able to adjust these trends because by the time they do the customization, the requirement would have changed completely. That is why it becomes very difficult. Even in manufacturing, let us say. Let me give an example in the automobile. The Tesla car had a car access problem because of some excess snow,

and because of the over the air update, they call it OTA, Tesla was able to unlock one or more cars using this feature. Whereas if it were to be in the traditional car there are couple of complication you have. One is the manufacturer may not even know. You may be tied up with some other service organization and they may use something like a AAA where you know, they will bring in another truck and the person may or may not be knowledgeable about the feature.

Whereas, you know in terms of the effectiveness and efficiency, their agility to product or service is much more effective. That is where you have the benefit of the agile manufacturing if ever.

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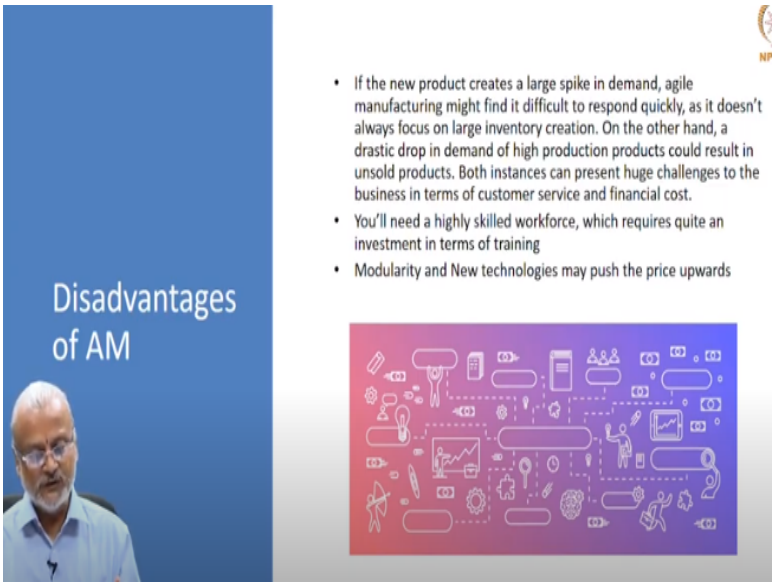

So, is it all good or all bit of roses for agile manufacturing? That we have to look at it. There is a specific time and situation for which again manufacturing can be applied. There are some disadvantages that are there, it is captured here. If the new product creates a large spike in demand, agile manufacturing might find it difficult to respond quickly.

So, because of the customization factor that you have, you will be able to customize it, but suddenly if you want one million pieces, you may not be able to make it happen. At the same time, if you have a very large drop suddenly you are manufacturing about 100,000 product and suddenly tomorrow there is no drop then there is zero drop, even the traditional manufacturing will be in problem.

But agile manufacturing also will be deeply impacted because of the sudden drop in the demand. So, the overall cost if you look at it, the challenges are in terms of the customer service and the financial cost. That you have to bear in mind. In the traditional one there is a delay in time to respond. But in the agile manufacturing, if there is a sudden drop, you will still have problem in terms of the investment that you make.

We will come to that in the next one. Because of the skill force that you have, they may leave you and it may be difficult for you to get the skill force. So, in order for you to retain the force will become very difficult for. That is a disadvantage that you have in skill force. That you can see in many leading-edge manufacturing operations whether it is mobile manufacturing or electric car manufacturing.

If you lose the resource, then it becomes very difficult for you to replace them and because it is modular, and because it is new technology, there is a bit of a cost involved in that. Because you absorb new technology, it may be a little bit more costly than the traditional manufacturing. For example, electric car may be more expensive than the traditionally manufactured fuel injection car.

These are the disadvantages that are there. So, you have to figure out as to if your situation warrants for adapting the agile manufacturing. That you have to pay attention to.

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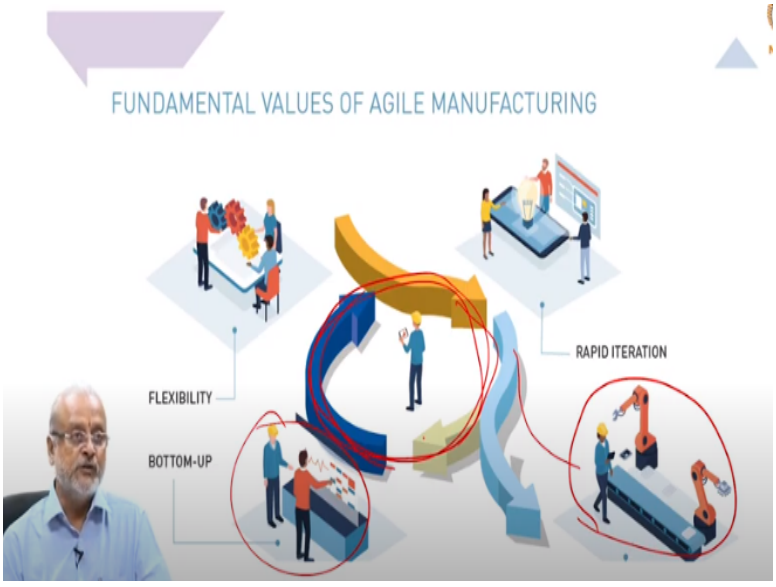

So now, we understood the landscape of agile manufacturing, the why, the how and the methodologies for it, advantages and disadvantages. Let us look at the landscape and some of the impact of agile manufacturing. It has the flexibility on the left-hand side that we see. So, this is with respect to the remember the technology that we talked about earlier.

You know, we have CAD/CAM, we have design solutions, we have even automating design that are helping you. So, you will be able to come up with new solutions very rapidly, very quickly. There is another section in which I talked about manufacturing related radar in which we talked about lot of technology.

You may be able to use all the AIML technology and figure out as to for your operations and design what are the flexibility that you will be able to bring into that. Remember, let us go to that earlier one, we talked about.

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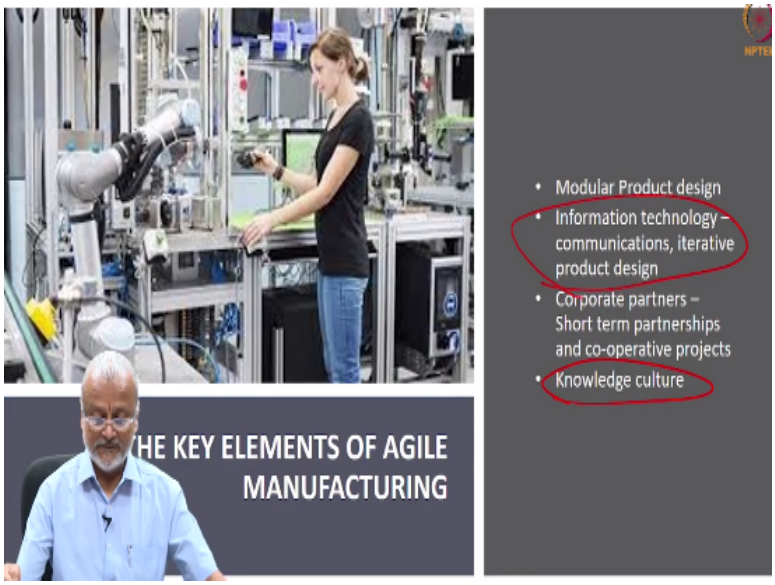

We talked about the Information Technology here. The iterative product design is where it gives you a complete flexibility in terms of doing that. Remember you know if you have to do it from the traditional manufacturing, a car manufacturing may take something like one year for you to get the next product. It need not be the case. At the same time, you may be able to give more than one or two products or three, even four or five.

Other example that you could think of in publishing, you could have many books, and for the same books, you can have multiple covers, attractive covers. You may be able to customize it for end user, maybe author, and the reader can come together. So, this kind of flexibility in consumer needs and wants you may be able to bring it in. Then the next one that we need to be looking at is the iteration.

Let us say that you bring in a new design. Remember, we talked about digital twin? Because it is manufacturing, I am talking about all these things. So, before it goes into the market, how does it perform? Is the material right for you? Does it have the required strength? Is it going according to the circular economy parameters that we talked about? Is it environmentally sustainable?

What is your corporate social responsibility policy? Is it going according to it? Is it secured? Can somebody crack into your autonomous solutions that you have? All these things can be effectively tested, validated, changed, and then retested. So, this kind of rapid iteration, remember the agile small comparison that we talked about. Remember, the waterfall.

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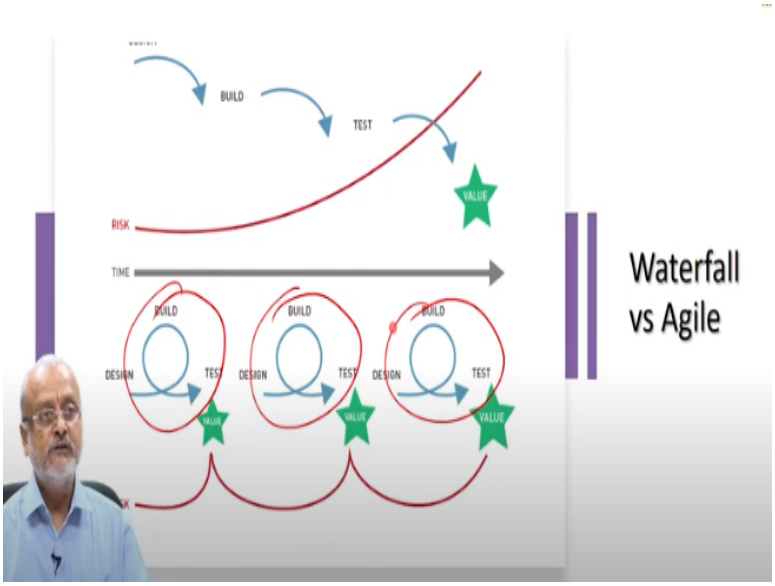

So here is the iteration that we talked about. See these iteration helps you to figure out what potential failures you could have in the field, you may be able to test it in advance using technology. You may be using AR, VR to make it happen, maybe digital twin to make it happen. All these things will happen over here. So rapid iteration is this thing.

Then this one is bottom-up that they call about. You know we will cover it a little bit in terms of the organizational structure next one. Bottom up means that the design solution, everything does not come from top. Executives do not drive the innovations. It is the field level workers; it is the engineers that drive the innovations.

So, the other operations that you have is in terms of bottom-up is to make sure that there is a contribution from people at large in the manufacturing industry. Experts will be able to give you the necessary correction that needs to happen through this iteration that we talked about and then the cycle helps you to make it much more effective before it can come out into the product.

So, this agility helps in terms of the larger lifecycle capability and, then what happens is once it reaches the standard, it is going through these augmented workforces. Here it is quite opposite to the fear that we are familiar or often faced with. When you say robot, when you say automation, when you say artificial intelligence, people always talk about, is it going to take away the jobs?

Is it going to replace human beings? Are we going to hit with more unemployment? That is one dystopian view about technology. The other way to look at is it is actually the robots are actually augmenting the human worker. The human worker is capable of working with the cobots. They call it cobots because it works with human beings, robots work independently.

Cobots work with human beings and it augments the human being's capability to do more by an order or two. If a human being produces x productivity, cobots and human being together can do 10x. That is why you have this component called the workforce that is extremely knowledgeable. Remember, one of the key elements in the research that we talked in this thing talked about manufacturing we talked about is the knowledge culture.

Every worker will be knowledgeable about manufacturing process, machines, how it works, what are the quality, all these activities are very familiar with and because of that, this augmented human along with the cobots will help you to do higher productivity, efficacies for your agile manufacturing. That becomes a very key element in making it happen.

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So, what happens now is this shift the manufacturing industry, factories to a new arena. It is almost like a paradigm shift that we talk about. Something like classical physics verses quantum physics. It is the fundamentals are different, approaches are different, capabilities are multifold. So, let us look at some of the features. Rapidly evolving environment, customer demands and regulations are becoming more and more challenging.

That means that it will be able to accommodate any variations that are there in the customer. You know, example could be social, you may derive the information from this analyzing social web to say that the younger generation wants only electric car, only with two people and you want to have develop a capability on that and you will be able to do that.

It may be limited only with certain group, maybe only with the startup vendors or startup folks who had registered with a particular University. So, those kinds of a targeted manufacturing requirement will be you will be able to handle or let us say that, in Japan it is only right-hand drive, or maybe future car is all autonomous, there is no steering wheel needed.

You need a completely different type of car for that. All these variations, you will be able to handle including the fashion sensibilities as well. So, it becomes a different kind of environment, including government regulations for fuel efficiency,

environmental parameters that they need to pay attention to, carbon footprint, several aspects together, they will be able to do it effectively.

The next one is, let us say the human augmentation that we talked about. The future technology, the future factories is in a constant technological development. They will actively use cobots. They will actively train all their people. So, new technology will always be used whether it is augmented reality, whether it is digital twin, whether it is GAN or whether it is a virtual reality that I talk about, digital twin everything they will be actively consuming it.

The third one is workforce transformation. Workforce means that you know, people will be trained, and people, will know more things. It is not as i, in the traditional manufacturing, if they know one thing, it is good for you to be participating in the manufacturing. But in the future, they will be able to support in multiple lines.

They will be able to help in design. They will be able to help in root cause analysis, quality control, all of them they will be able to effectively work on that. So, all of them put together the future of the workforce is constantly transforming as well. That is the third aspect of the agile influencing the manufacturing and the final one of course is the IT, I should not say IT.

It is more an information fabric that is handling. Whether it is machinery that we are using or the connectivity between the machinery or the instrument that are that we are using or is all integrated together. The whole factory environment will be much more deeply knowledge based and information based is the one that we are likely to see as an agile influence in the manufacturing area.

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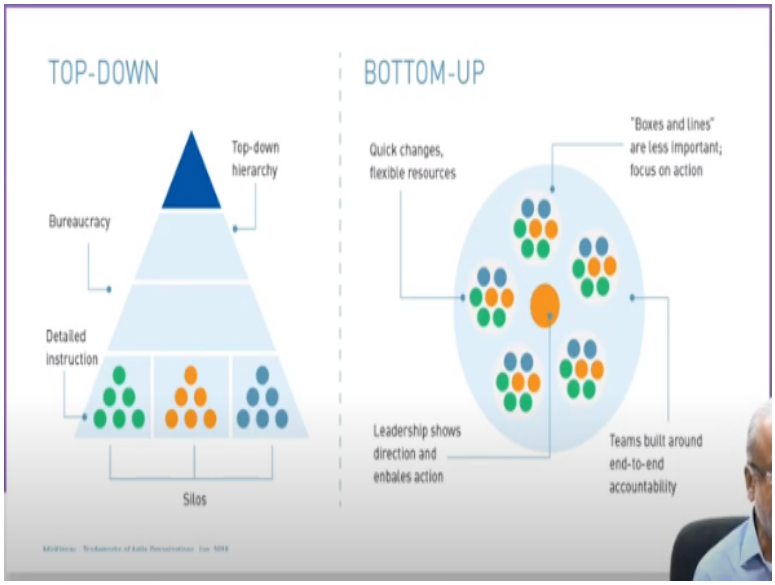

This one is a McKinsey looking at the agility of an organization. We looked at the manufacturing ground level reality in terms of technologically at the ground level. What do we do? what how do we adapt it? and things like that. But organizationally things are different. How does it works? What you see on the left-hand side is the traditional organization.

You have CEO, CFO at the top. You have the middle management and you have the operations. They do the design, they do the specification, they hand you over the worksheet, and you do that. That is the traditional one.

And because of that, if you change anything there at the bottom level, because they are not aware of the variation that could happen in technology, the variation that could happen in production, the variation that could happen in the technology trends, because of all these changes, they will be very confused. They will not be able to deliver as fast as they can.

The second thing to realize is because it is the detailed destruction or instruction, detail instruction that is given, all the activities are siloed because, the guy who is operating on lathe will not know about the assembly, will not know about the quality control, all of them are siloed and because of that, there is a little bit of delay that is there in everything.

If you come to the right-hand side, it is a cellular organization. They will be able to, if there are you have a small team, you have agile team and you have everybody is capable of doing almost all the work. You may be able to handle quick changes, flexible resources are there and leadership shows only directions. They are not saying very specific instruction for you.

Here, boxes and lines are not important. You focus only on the outcome and the team is built for accountability. This is the fundamentally organizationally different. So, the next gen factory if you look at it, we both in our we looked at it from the technology perspective, we look at it from the process perspective. The final piece is the people perspective.

Even from the people perspective, it is different. If you pay attention and structure it in this manner, your agility index, if you will, will be dramatically different for that.

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Now I want to bring one specific factor after COVID-19; safety and security. We have not been paying attention I mean of course the manufacturing people have paid attention to safety for a very long time. Security because of the because of the IT connectivity and always on vector into that. But post COVID-19 social distancing will have to be an important one.

In manufacturing industry, we might not have paid attention to that element before. We have to pay attention now and in security, remote operations, more and more

remote operations are allowed nowadays and because of that we have automation. And because of that we have always on and because of that we have vulnerability, security coming into picture.

One thing that is very important to pay attention to is the ransomware. You know people can come into your network, encrypt your data and go away and then claim a ransom and then only they will decrypt the data. This is very different from earlier sabotage. They will only destroy it, and we need to recover from it. But here, it is more pointed, and there is money to be made and that is the motivation for the attackers.

So, we need to develop our security positioning strategy for dealing with the future situation included in our agile manufacturing sensibility as well. It is a very new area. We need to think about it and develop models to tackle with this kind of new set of problems if we will.

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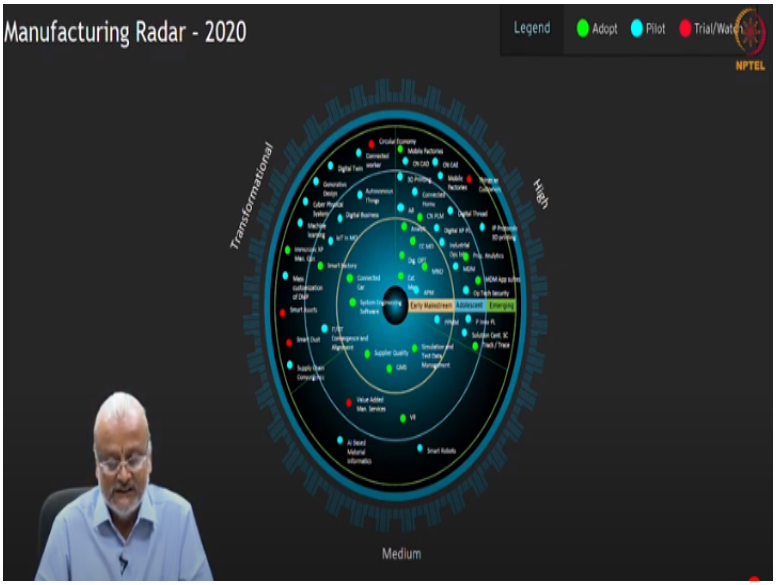

Finally, I want to bring it back to the radar, which I covered in the earlier session. These many technologies are the one that will give you the agility in the manufacturing area. It will give you agility in terms of communication, it can give you agility in terms of manufacturing, it can give you agility in terms of your factory layout, in terms of improved technology.

There are several factors that it will give agility. So, I want to go back to this section here. Information technology, communication and product design and knowledge culture are the key vectors in bringing the agility and I would recommend that you pay attention to the transformational first and high and medium little later on to look at each of the technology.

Also look at the lecture that is covering about the manufacturing data and have a journey map figured out for agile manufacturing. That will help you to tackle and position yourself for manufacturing demand that is going to come in the future. That will be the wrap up for this session on agile manufacturing. Thank you.