The Future of Manufacturing Business: Role of Additive Manufacturing
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Lecture – 10
Agile Manufacturing - I

Welcome back. This session, we are going to be covering about agile manufacturing. My name is Murali. I am a technology consultant for NPEDIA Technologies. We will have two parts of this agile manufacturing. First part, we will discuss about what is agile manufacturing? Why and how? and then in the second session, we will talk about some of the actual implementation, the advantages and the disadvantages.

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Let us look into the agile manufacturing. Before that, you know it is a little bit of a comedy strip that everyone is familiar with. This is Dilbert, making fun of the agile. Agile means that you do it yourself, no more training, no more documentation. This is pretty much taking a dig at agile practices itself. So, I thought I will use that as a way to lighten the mood up.

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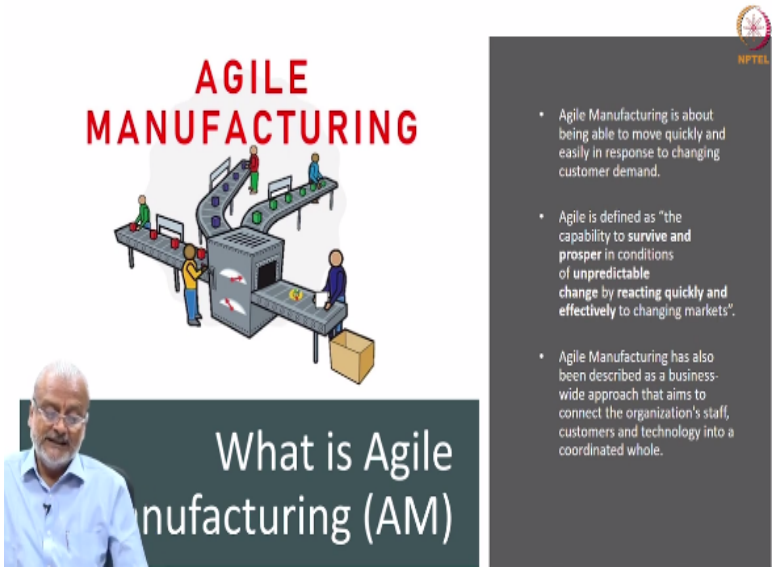

Agile manufacturing is gaining lot more popularity these days. Why? We will understand some of it in a short while. When the market is fluctuating or when there is a disaster happening in the environment, then the manufacturing facility need to quickly adapt itself for a new condition. So, the agile manufacturing defines it as ability to quickly and easily respond to the changing customer demand.

The customer demand is a little bit ethereal here. You know the customer demand may not exist in a particular fashion that then when can you change your manufacturing outcome? Now that becomes the challenge here. Let us look at the agile itself. Sometimes you need to look; what is agile? It is a capability to survive and prosper in condition of unpredictable change by reacting quickly and effectively to changing markets.

Whenever you say agile manufacturing, you also have to bear in mind, you need to take a business wide approach that aims to connect the organization staff, customer, technology and coordinate as a whole. All of this is becoming a part of. But when you say agile, what comes to your mind is something like Cheetah in the animal kingdom. So that means that it can go at a very high speed at the same speed it may be able to change directions.

I guess you know if you derive a similar paradigm, it means that you know you are moving at certain speed, will you be able to change the direction and will you be able to get the outcome? Let us look into that.

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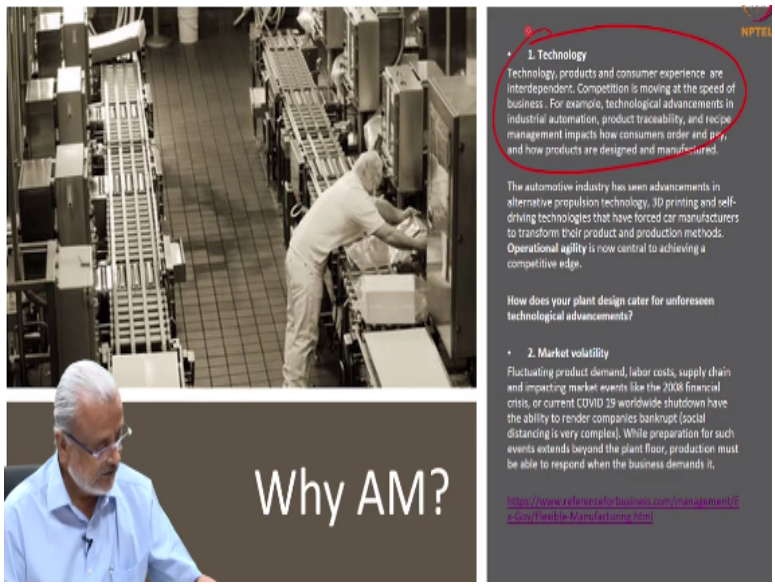

Why do we do the agile manufacturing or why agile manufacturing becoming important. So, we have kind of indicated here. Let us look at this technology products and consumer experience are interdependent.

Competition is moving at the speed of business. So, technological advancement in industrial automation, product traceability, recipe management impacts how consumer order, pay, and how product is designed or manufacturing. Automotive industry is going through major changes now. You know whether it is alternative propulsion technology, 3D printing, self-driving technology is completely changed the market.

So, use your industry ready for giving next generation product. When the technology changes, an entire workflow will change as well. That becomes a very important one. Your operational agility is key to technology changes that are happening in the market. You know everything is going to become electric in the automobile industry.

So, can you shop floor handle that, is an important question that you may want to address. One thing to keep in mind in all the agile is you know how does our plan, design cater to unforeseen technological changes, whether it is operational or whether it is design or whether it is technological. That you need to keep in mind. That is the reason behind why agility becomes very important.

The second reason is the market volatility. Right now, we are facing it, COVID-19. We faced a similar one in 2008-09 framework I think, market collapsed. Suddenly demand will disappear. Your production capacity may not be fully utilized. That means, money may be draining by the hour. Can you reconfigure your plant to do something different?

I got kind of a link here. You look at it at leisure, but I kind of have a ready reckoning here.

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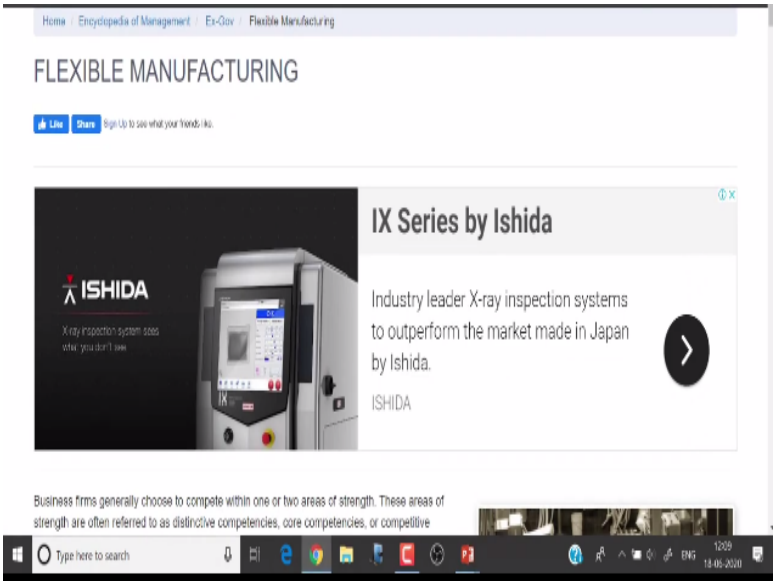

It is something known as the flexible manufacturing. How it can be configured to do a completely different approach to manufacturing.

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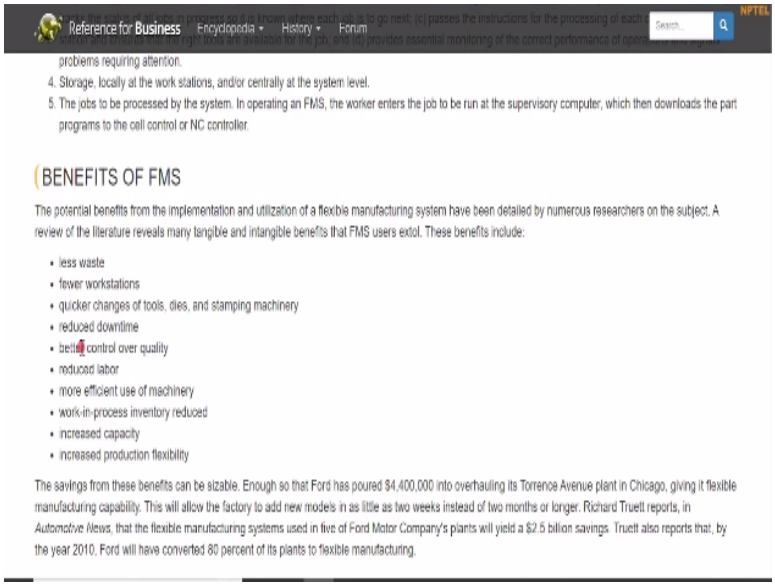

Look at this you know, less waste, fewer workstation, quicker change of tools and dyes, reduced downtime. This kind of a approach to your shop floor becomes important. So, these are the key reasons. Anything that we do we need to know why are we doing that. Technology change and market volatility are the key drivers behind agile manufacturing for you.

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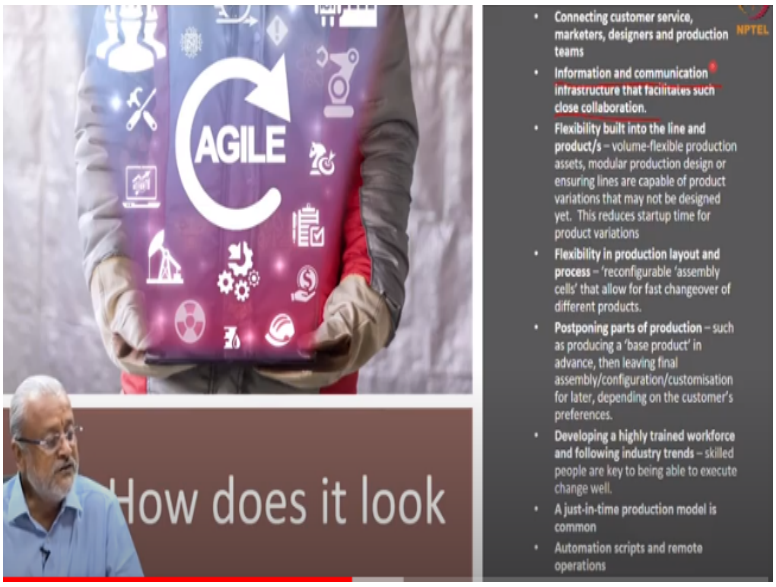

Let us look at you know let us think of a Best Picture. If we implement agile manufacturing completely, how will it look, either in the shop floor or in your organization. What are the best possible scenario that you could have? Connecting customer service, marketers, designers and production team. Know there is a good coordination between them.

Because you know whenever there is a change in the customer needs, if you are able to implement it, then you always have full capacity utilization and customer need matching. No wastage in your product and in the new technology, what is important is the information and communication infrastructure facilities are in such close collaboration.

That means that you know when whether, even when you talk about customer to production line or some defects to production line, some changes that are needed to production line. So, there has to be a constant communication between them to make

it happen. Flexibility built into line and products. That means that you know you are building a particular product.

It needs to be modular, just like the cell phone or the laptop that we talk about. The components can be separately manufactured and they can be assembled together and put together very effectively and these components, if you want to do it differently, you may be able to do. For example, if you do the modular very well most of the components can be reused for a tablet or for a mobile phone or other e-reader.

All of them though it is different product, you may be able to use the same components in one product to give different solutions as well. So, the underlying principle here is volume flexible production assets, modular production design ensuring lines are capable of productive product variation that may not be designed yet.

No as you know that is why I told you the example of mobile phone or mobile phone to tablet, tablet to e-reader, and in future it may be some other product that we have not envisaged yet. These if you are able to build that into that it becomes much more effective. For example, if we take the automobile from the traditional fuel injection to electric can you make can you use the same production line to get it happen?

Because it is just a fuel injection alone that need not be assembled. But is it the overall structure capable of manufacturing and giving you the output? That is the question or thinking hat you need to wear on that. Flexibility in production layout and process. You know your production flow will have to be quickly reconfigurable to new products, if you will. That needs to happen.

Then postponing parts of the production. You know this is a very interesting approach. You may have a base product in advance and you may have to leave a delay, so that when another product another component of it arrives for you, you may be able to do a late assembly into that. You know the base product in advance leaving the final assembly configuration customization for later depending on customer preference.

It could be something like a radio that you fix in your car, maybe a seat accessory that you are fixing in a car or right and left steering wheel that you need to put in a car. One is the ATA assembly and you can think of variation that you may have. It maybe the customization may happen due to geographical location or country wide practices. There may be some variations that may be happening.

Or even know let us take you know you take a T-shirt or regular shirt that you are wearing, there is a variation between men and women where the buttons and the hole need to go. Rest of the things can be fixed first and then finally, the holes and the buttons can be added later on. So, this kind of delayed assembly will help you in bringing certain agility into your workflow if you will.

Then traditionally, the people that you are using in your production line, they do not need to know much. If they know just one job, it may be screwing a nut and a bolt. If they just know that, that is good enough for you to complete the production. What is interesting in that agile one is that is not enough in the agile. He should be able to operate more than one machinery.

They should be knowledgeable about more than one machinery. Quality control on that and they will be able to fix the problem and that all of them becomes very important here. So, developing a highly trained workforce and following the industry trends is very important in terms of incorporating the agile manufacturing into your workflow and just-in-time production model is very common.

What is more important in the agile manufacturing is more digital machineries will be there, assets will be there, and automation scripts and remote operations becomes very essential for them. There are many lights out operation that are there in the workshop. It is very closely related to agility of a business operations.

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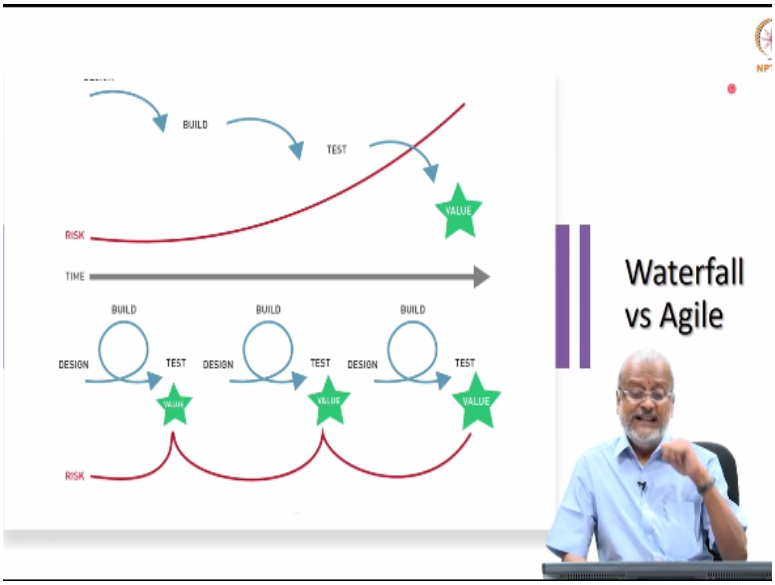

We need to understand what is agile. The term agile comes from the software industry and we are kind of deriving it to suit it for the manufacturing environment as well. In software, from the requirement, you try to develop the document, you try to build it, you try to test it and then finally you get the end product.

If you want to change the specification in between, you cannot do it in the waterfall. We have to wait till the next release that comes. It has its own risk in the sense that you know that if there are some middle level changes and if there are some design fault, if you want to fix it, you may not be able to fix it. Whereas, in the agile there are short span of a lifecycle development which is design build and test, design build and test, design build and test.

Because of that, what happens is your resilience to mistakes that you have. You could try few things. The industry uses a term called pivoting. You might innovate, you may be able to fail fast and fail CP is another term that they use. You may be able to keep pivoting and keep on improving upon the product every now and then.

Finally, it may look like you have gone through multiple iteration, but the value that you derive out of agile environment becomes much more resilient, much more staying in touch with the customer needs compared to the waterfall. For example, in waterfall if a product takes 18 months for you to develop, lets if you assume automobile manufacturing or any machinery that you are doing in 18 months is going to come out.

If there are some mistakes in that you have to live with that whereas in the agile if there are some correction that needs to be done, some design modification, some aesthetic need to be changed, some innovation need to happen, all of them can be incorporated into the agile. Now how does it impact in the manufacturing itself, we will see it in a short while.

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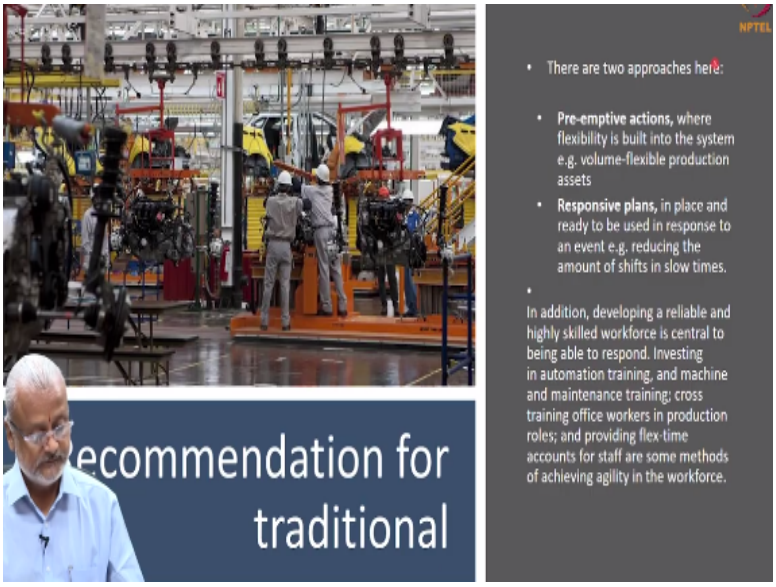

Now what will typically people ask is now I already have a shop, I want to turn it to agile, can I do it? That will be the question. You know if you really look at it, we started with the why question. Then we know what is you know why and what is the best-case scenario. What are the ways in which it is likely to operate? We understood the components or the fundamental behind the agile manufacturing.

Now we are looking at we already have a shop, how do I do it? How do we change it? Can I make my shop floor agile? There are two approaches to this that is indicated here. One is the preemptive action, where flexibility is built into the system, volume flexible production assets. Another is responsive plan in place and you know in place and ready to be used in response to the event.

That means, let us say that you know that shift you need to put in place. You have a manufacturing target, in order to achieve that one shift would not be enough, that you will have multiple shifts to manage that. So, these are the two ways in which you can

you know you can build certain agility into that. Now let me provoke you with an additional question. Post COVID-19 you need to have social distancing.

You need to make sure that the machine panels are not being operated by multiple people on that. This will obviously be going to hold you in terms of production capability on that and because of that, you need to manage your overall production in a much more creative manner. You may have to go to shifts for doing that from the productivity perspective.

From the panel, multiple people operating perspective you could do remote, but the problem with the remote is that you know there could be some security threatens that you may have. So, people are exploring can they use voice. You do not have to necessarily touch the phone in order to operate the machine. Can you use voice?

You can imagine something like an Alexa integrated with the machine. Can you use voice commands, so that machine can be operated? That way the people who may be at risk because of using the same panel can be effectively managed. So, these are the new way in which you are adapting to the risk that are getting presented or influenced from the market.

In addition to the one that we already talked about, developing a reliable and highly skilled workforce is essential to respond, to be able to respond, investing in automation training, machine and maintenance training, cross training office workers or production role providing flex time accounts for staff and or some methods by which you can slowly start building agility.

So, these are more a recommendation from the perspective of for the existing manufacturing unit, what are the things that you will be able to do in order to build the agility on that.

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Now either to reconfigure, or if you are building new one, there are some key elements that are there for agile manufacturing. If you want to be agile, you know let us say that you are trying to plan a manufacturing plant today. Then you need to think about it and manage it very effectively. One is the product design will have to be modular. That will help you to reconfigure your end product.

Or even change the model by which you are delivering. Are you going to deliver a product or are you going to deliver a service? Even in one of the earlier lectures, we talked about it. Is it the product or as a service that we are going to be delivering? The modular product design will help you in that. The next one to pay attention to is information technology.

Whether it is communication or even your product design, you may be using a CAD application for that or a wireframe for that or a simulation for that or even a digital twin to make it happen. So, each of them if you look at it, the information technology is very tightly knitted as a fabric into the manufacturing that will help you to do the agile manufacturing. So, we will cover a little bit more of that as we move forward into that.

And then we have to look at it as a partnership. So manufacturing is not a isolated job anymore. There are parts, if people are good in doing that, you know maybe a annealing, may be shaping, maybe lathe, maybe you know the different activities that you are doing. If somebody else or your partner is very good at doing that, it is better

for you to let them partner with you to make it happen and that also gives you agility. You can focus on your core capability and others can focus on the subcomponent facility and you will be able to assemble together in a very effective manner. So, if you look at yourself as a corporate partner, you have short term partners and cooperative projects together. These kinds of things will help you to improve upon the agility.

The fourth one you have to pay very close attention is the knowledge culture. It is not that you know you are good at manufacturing one component. You have the knowledge of making it happen and when the knowledge shifts to higher and higher knowledge, you will be able to adapt and you will be able to reposition yourself and that gives you the necessary agility.

Remember the one that we talked about you know a cheetah running at 60 kilometers per hour suddenly changes direction you will be able to do it and that is because of the knowledge culture that we are talking about.

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Now let us look at the planning that we need to do. In order for you to do a AM Planning, agile manufacturing planning, you know it could be for a new plant or it could be for a existing plant. You need to start with researching about what is agile manufacturing. What does research mean? It has three components. What is the cost of agile manufacturing?

The process required for agile manufacturing for your plant, because this will vary between the vertical and the industry you are in. For example, chemical plant will be completely different from the automobile plant, completely different from something like a steel roll, rolling mill plant.

Everything will be different. So, when you say cost of agile manufacturing, the machinery, the plant layout and everything like that, and the process that you need to implement into that and the concrete task involved in the process. That is the research component that will help you to figure out about how to do agile manufacturing, planning and then you need to have a task force.

Because remember, it is very closely related to people's capability. So, if the people are not knowledgeable, then it is going to drag you down a bit. You need to have a task force that is driven to make it happen and then the third component is you have to examine the current supplier chain supply chain, and you have to figure out where your strength lies, what works for you.

If it works for you, then it is going to enhance your agile capability and sometimes the partnership do not work. You have to probably cut them off. You have to figure out what partnership works, what does not work. So, you need to nudge them appropriately into that and remember, when you say agile manufacturing, the agility happens within a short time, but your sustainability of the plant is over the long time.

So, your plan is for the long term. When it is long term, you need to have certain parameters around it. What is your benchmark? Benchmark means not the machine level metrics, is more from the success of your business and how do you measure your objective, from that perspective. You have to figure out what are your milestone and what if it goes wrong? That is where you will talk about your agility.

Supposing the demand goes drastically down, market crashes, what will you do? Those are the things that you need to plan ahead and when you plan and do and release product into the market, sometimes you know there may be a mistake and how do you encounter that, how do you manage that, and how do you change the

direction? So, these are some of the steps that you need to pay attention in terms of the planning.

So, this you know we looked at the why AM, what is the definition? What is the best-case scenario? Difference between agile and the waterfall and what are the key components in agile manufacturing? What are the steps in making it happen? We looked at that. We are coming to the half hour break here.

In the next one, we will continue with some of the sensibilities around how to go about implementing it and what are the used cases, benefits and some disadvantages in dealing with the agile manufacturing. Thank you.