

**Toyota Production System**  
**Prof. Rajat Agrawal**  
**Department of Management Studies**  
**Indian Institute of Technology – Roorkee**

**Module No # 02**  
**Lecture No # 10**  
**Create Continuous Process Flow**

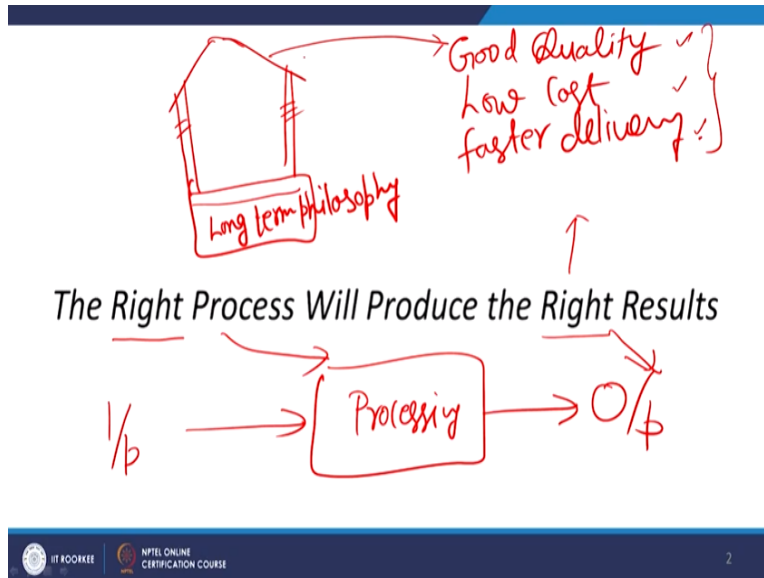
Welcome friends, this is the last session of the second week, we are already into the discussion of various principles of Toyota production system. In our previous session, we discussed the first principle that is the actually foundation of all the remaining principles, we discussed about the long term philosophy for an organization we discussed with the help of example of Toyota and Ford company that how the focus of Toyota's mission all long term created a purpose which is much more than just earning the salary checks for its employees.

Now we are starting with the second P of the Toyota production system that is the process and somewhere around 7 principles of Toyota production system are only related with this process part. Because, Toyota says that, if you have the right process, then you will be able to produce right output and the very first principle in this process aspect is creating a continuous flow system. Now this continuous process flow is very important thing in Toyota production system some of you may know it with the name of JIT also.

Now, the role of this continuous process flow system is to help organizations to identify the problems immediately as soon as it comes, when you do not have the continuous process flow system, many a times you are not able to identify the problems will not come to the surface and these problems may remain hidden and it may create some kind of disaster because you are not able to solve you are not able to fix those problems in time.

So, therefore, the second principle that is creating continuous process flow for identification of the problem for bringing problems to the surface is very important, when we discuss this particular thing, this particular statement always need to be in our mind.

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That right process will produce the right results if you have the right process, you will have the right output. Without following the right kind of processing system, we have discussed that in an organization you have input, then you have the processing part and then you have the output. Now, since this diagram makes it very clear, when you have the right process, then only the right results will come without right process right results are not possible.

And that is where this continuous process flow system will help us that it is a kind of right process as per the Toyota production systems definition and when you have this right process, you will be able to achieve the right result the right result is in terms of good quality. We have already discussed it in the form of if you remember the house of Toyota, where we have two pillars, and this is the roof of the house.

And in that roof of the house, we mentioned the good quality, low cost, faster delivery, these are some of the results, which we are expecting from our process. And for that purpose, we need to have these two pillars, this is the long term philosophy that is the foundation and these two pillars, where you see that how you are eliminating waste, how you are following the principles of Kaizen, how you are able to achieve JIT because that is not the end.

Sometime it is also very important to understand this misconception comes that if we are able to implement JIT, we feel that we have achieved the success we have achieved the excellence if I am able to eliminate waste that we feel that we have achieved the excellence. No, these are just

the means these are the part of process the final objective is the final result is to achieve good quality, lower cost and faster deliveries, these are ultimate objective, therefore, these are the part of my roof.

So, the right process will produce the right result that is what it is and that is anywhere not only related to manufacturing or service organization in our life also, if we follow the right process, we get the right output we get the right you can say fruits of those processes.

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JEE - 20%  
80% Crowd

20% → Growth of org.  
80% →

**Most Business Processes Are 90% Waste and 10% Value-Added Work**

— Liker | 4 Semester.  
↓ ~ 2 years.  
42 Hrs. → 14 weeks.  
+14  
52 - 28 weeks  
= 24 weeks.

80-20 → 90-10  
↓  
50-50

Now, another important thing on which I will like to draw your attention that most business processes are 90% waste and 10% value added work. This is as per Liker, who is the author of this popular book that Toyota way. Now in life, we know the principle of at 80 - 20. And Liker has slightly gone into the extreme side that he changed this 80 - 20 into 90-10. So, 80 - 20 we all know that most of the time they are only 20% things which are contributing to the final output and rest 80% things are not willing to contribute into the final output.

If in India, for an example, JEE joint entrance examination is one of the most competitive examination and every year lakhs of students are appearing for this JE examination. So, all those lakhs of students are not having competition with each other out of that large number of students who are appearing for JE examination, the competition is between only 20% the students and rest 80% are crowd there is no they are not part of competition, they are just increasing the number.

In our organizations also, we see that 20% people are actually contributing for the growth of the organization and remaining 80% people are simply you can say liability or they have no specific role in the growth of the organization. Same thing Liker mentioned with respect to processing part, that 90% of the activities or 90% of the resources, which we consume are for the wasteful activities, only 10% resources are for the value added activities.

This is a very significant aspect as you can change this ratio from 90-10 to even 50-50 you can be a highly competitive organization that only 50% of the resources are wasted and remaining 50% of the resources are used for value added activities. But this is not so easy identification of those wasteful activities. And converting those things or reducing the share of those wasteful activities will automatically increase the share of value added work.

That is a very important thing and many organization almost all organizations are suffering from it. You take an example of MBA course. So the courses in MBA normally in India are for 4 semesters. And these 4 semesters are spread over 2 years. Now in that 4 semester, each semester has somewhere around two and a half months of teaching. Or you can say that a semester has somewhere around 42 hours of teaching of a particular subject.

And these for 42 hours of teaching is spread over 14 weeks. Now 14 weeks teaching is taking place. So in a year, there are 2 semesters. So  $14 + 14$ , you have 28 weeks, that much teaching is taking place in 1 year, how many weeks we have 52. Now, out of 52 weeks, we are using only 28 weeks for the teaching purpose, where we are adding value to the student when a student is coming to class, only then value is being added.

And though there are a lot of things to do outside the class also. But if I simply say that a student is there during the academic mode, so whether he is in class in those 14 weeks, or he is in the hospital, during those 14 weeks value is being added. So, I am not differentiating in between classroom teaching and non-classroom activity value adding but that is happening only for 28 weeks in a year.

For remaining 24 weeks, which is almost 50-50% of the time he is not into the academic environment, some of them may go for some kind of practical activities may go for some kind of projects, but if that is not the part of your curriculum, so, no proper value is being added during

those 24 weeks. And that is a very significant live example, that how much waste we are creating in a 2 years MBA program because of this limited use of time.

So, same thing is happening in organizations also, that large number of activities are wasteful activities, where no value is being added and only very limited activities are there or limited processes are there which are helping in some kind of value addition.

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- A good place for any company to begin the journey to lean is to create continuous flow wherever applicable in its core manufacturing and service processes.
- Flow is at the heart of the lean message that shortening the elapsed time from raw materials to finished goods (or services) will lead to the best quality, lowest cost, and shortest delivery time.

Now going further into this discussion, we can see that a good place for any company to begin the journey to lean is to create continuous flow. As we have discussed many a times that this Toyota production system is basically a journey towards lean manufacturing. So, the starting point of your being into lean process is to start with creation of this continuous flow system, continuous process flow that is the starting point of journey towards leanness.

Now how it happens wherever applicable in its core manufacturing and services process not limited to manufacturing only whether you are a manufacturing organization or a service organization is start working on continuous flow that something will be produced from your system regularly, something will be happening regularly.

And it is you I will like to give this part in this time edit itself that this is actually against the idea of that mass manufacturing or the idea of batch manufacturing, where we are making things in batches or at some particular time and then for rest of the time we remain idle. So, this system of

continuous flow says that we need to continuously produce maybe very lower quantity, but we need to produce that lower quantity continuously.

Now flow is at the heart of the lean message that shortening the elapsed time from raw materials to finish goods, if we are able to do this system of continuous manufacturing continuous process flow, it will help us in reducing the overall process time. Because what happens when we are producing in batches in that time, lot of time is wasted in waiting unless until a batch gets completed, you will not move to the next stage because everywhere in the idea of batch manufacturing, we are obsessed with efficiency.

So, if I am moving from point A to point B, I will like to have efficiency, I will not like to run my transporter every time for single unit. So unless until there is sufficient quantity, then only this batch will move from place A to place B and therefore, these items will be waiting till there is a sufficient batch then again at this stage also when it has to move from B to C these products will move only when you have sufficient quantities and then only transporter will have efficiency.

So everywhere because we are very much concerned with efficiency this takes a lot of time in waiting. So, the idea is how to shorten because on time delivery with limited time is very important aspect. So that is possible only when you have a continuous process flow. So, that is where we say that the it is the heart of the lean message and it helps you in shortening your time the process time from raw material to finished goods.

And it also gives you the best quality, lowest cost and shortest delivery time all 3 objectives, which we just discussed in the form of TPS house, the roof of TPS house, all those 3 things are possible, when you are able to design a proper continuous process flow and the extreme case of continuous process flow is that when we are able to create a single piece flow. The single piece flow is the ultimate objective of this continuous process flow system that we are able to design a system a process system, where single piece is able to move from input to output stage.

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Flow also tends to force the implementation of a lot of the other lean tools and philosophies such as preventative maintenance and built-in quality (jidoka).



Flow also tends to force the implementation of a lot of the other lean tools because of flow, you are able to implement various other lean tools also. And one of them which is one of the pillar of your Toyota Production System house that is the preventive maintenance and built in quality which we also know as Jidoka. Jidoka, if you remember if you these two pillars, if you recall, which we discussed in one of our session, that one pillar was focusing on JIT and another pillar was focusing on Jidoka.

And that Jidoka is basically built in quality that our process should be capable enough to take the responsibility of its quality. If I am producing something, I do not require any external check for checking my output, I have that built in mechanism to check the quality of my output. So, that is the Jidoka and for lean system, it is very important because if at any time some failure comes at a particular stage, so, it is going to disturb my entire process, because I do not have inventory.

So, I cannot absorb those faults, if some fault occurs, if some defect occurs at any stage, maybe in the machines may be in the product, this is going to affect my entire process. And therefore, whenever there is a maintenance issue, wherever there is a defect, it creates a lot of urgency in the Toyota Production System in a lean manufacturing environment, while in case of a mass manufacturing or batch manufacturing organization that type of urgency may not be there.

Because in that, we see things in totality here we see things on a regular basis. So, a lot of urgency is there in a Toyota kind of environment. So, all these tools becomes possible because of

the approach of continuous process flow systems preventive maintenance and built in quality that is very important thing for this TPS house.

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Creating flow, whether of materials or of information, lowers the water level and exposes inefficiencies that demand immediate solutions.



Now, going further, creating flow, whether of material or of information, lowers the water level and exposes inefficiencies that demand immediate solutions. Now, what does it mean lowers the water level and exposes inefficiencies that demand immediate solutions. Now, if you have a container and in that container, there are certain sediments now, if you have water level up to this particular point number 1.

So, those settlements are not visible, and you will not be able to understand that the capacity of this vessel is reducing because of formation of these settlements. And because you see that from the top you are able to see water, everything is focused enough water is there and you keep working with that, when you reduce the water level, when water level comes to this point number 2 this sediment which is there, this becomes visible only when the water level is reduced to point number 2

And now, when you see the settlement, you will immediately take some corrective action to remove this. So that it should not reduce the capacity of your vessel, you want full capacity of the vessel, you want this vessel for storing water, but if many such sediments are there inside this water, it actually reduces the capacity of your container. So, therefore, you need to see that there is a provision that if excess inventory is there, many such problems, this is a example.



But in reality, if you have the water up to point number 1, many such inefficiencies this you can say is inefficiency these type of inefficiencies are not coming to surface and therefore, you will not be able to see them you will not be able to take corrective actions and finally, you will work with less efficiency. But when you reduce the inventory when you are able to see those problems, obviously, you need to fix those problems.

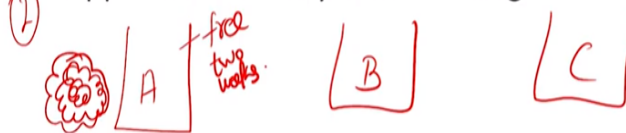
And therefore, creating flow will help you in achieving in identifying those inefficiencies in your system and take some kind of solution that demand immediate solutions. So, if this type of sediments are there, if this type of inefficiencies are there, problems are there, some kind of issues are there, then you will solve those issues on an urgent basis. Now, many a times because assembly line and the mass production were very important milestones in the history of manufacturing.

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## Traditional Mass Production Thinking

- ① Economies of Scale → lower cost.

- ② Apparent flexibility in scheduling



Now, when I am talking the history of manufacturing. So, since most of the organizations are very much concerned with this philosophy of mass production. Now in mass production organizations, two things are very important, why mass production are so successful and in that traditional thinking of mass production, one important thing is about economies of scale.

So, your efficiencies, that is one very important thing that we feel that it gives us lower cost. And the second thing is we believe that it helps in some kind of flexibility in scheduling activities I

say that it is apparent flexibility in scheduling actually, it is not so, but since you have produced a batch a good number of quantity of a particular intermediate component at A then at B you have another machine that C you have another machine.

Now, you have a batch of products available here and then this machine is free once this batch is completed, this machine becomes free for let us say 2 weeks because the next batch will come after two weeks. So, you can use this looks like that, you can use this machine for 2 weeks for some other product also that is the idea of apparent flexibility in scheduling. That the same machine can be used for different types of products, because at day 1, you have a batch of different products.

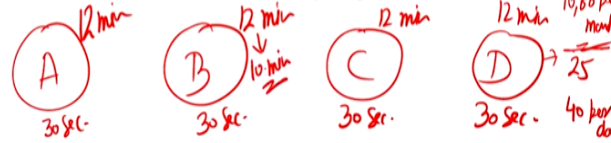
At day 2, you have a batch of different product on day 3, you have a batch of different product. So, because of that, you enjoy this apparent flexibility in should you lean. So, these are the 2 primary way of appreciating the traditional way of mass production. So, these are the 2 important things with respect to idea of mass production, one is related to efficiency. And then the flexibility though actually speaking, this flexibility is just our way of thinking apparent flexibility.

The actual flexibility is not that much possible, which we will see is possible in case of a continuous production system. Now, we move to a very important terminology, because when we are trying to design a continuous process flow system.

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## Takt Time: The Heart Beat of One-Piece Flow

- Takt is a German word for rhythm or meter.
- Takt is the rate of customer demand—the rate at which the customer is buying product.



This term Takt time is very important. It is a German word, which is used to define rhythm. Now, we need to develop a system when we are developing this continuous process flow system where every process take almost similar amount of time if it is ABCD 4 processes, which are happening in my making of this product. So, if this process takes 30 seconds, I need to design that each of them take 30 seconds and how this figure of 30 second comes this figure of 30 second comes because of Takt time.

Now what is it in terms of our operation systems, that Takt is the rate of customer demand. Let us see if I am selling 1000 products per month, and I am working for 25 days in a month so how much products I am selling? I am selling 40 products per day for these 25 days and now in each day, I am working for 8 hours. So, per day working time is 8 hours and in 8 hours, I have to produce 40 products.

So, one product 40 products per day and 8 hours are the working time. So, you can say that in each hour, I have to produce 5 products in each hours is 60 minutes, 5 products. So, after every 12 minute 1 product should come out of this system. So now after every 12 minute, when I am saying that 1 product should come out of the system. So that 12 minutes become is my Takt type that the there is a demand of a product after every 12 minutes.

So, in that case, I will design my system that each process takes 12 minutes. So that after every 12 minutes, there is a new product ready and as soon as that new product is ready, there is a

customer also to purchase that product. So, in that way, there is a good synchronization of my output and the demand from the market and there will not be any overproduction there will not be any inventory there will not be any storage of finished goods.

So, this is the key of designing a continuous process flow system. So, we need to see that what is the Takt time and how much is the total operating time available with us and based on that, we will design a system. So that each process each intermediate step takes almost this similar type if one stage for an example, if B becomes very efficient. So, what we can do that when I am saying the efficient, so, in place of 12 minute, it takes only 10 minutes because B is a very efficient stage.

So B is taking only 10 minutes, now what we will be doing, we will dis balance my entire process, because it will create faster output and that faster output will go to C, but C is already working. So, those output will be in the waiting stage. So, I am starting producing a waste, where that efficiency is creating waste. So, I need to see that there should not be extra emphasis on efficiency of a particular station, I need to work for the efficiency of entire work process simultaneously.

If there is one Superman in my system, so that Superman is more dangerous than many normal persons working at the same pace in the organization. So, that is one important thing that Takt time becomes the important element for designing the system. Now, let us see quickly that what are some other benefits that is required, that is forcing us to go for 1 piece flow system from mass manufacturing, that is one way of manufacturing that is one philosophy of manufacturing.

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## Benefits of One-Piece Flow

- *Builds in Quality* ✓
- *Creates Real Flexibility* ✓
- *Creates Higher Productivity* ✓
- *Frees up Floor Space*
- *Improves Safety*
- *Improves Morale*
- *Reduced cost of Inventory*



Now, from that philosophy of mass manufacturing to one piece flow system why we want to move because it is helping us in achieving Jidoka, it is giving you the option of build in quality it creates real flexibility, the mass manufacturing is creating apparent flexibility, but 1 piece flow system is helping us in creating the real flexibility. The meaning is that as soon as you want to change the design, you can immediately change the design without having any backlog without having any WIP.

So, the changing processes that is the ultimate objective of flexibility, that new type of products can be introduced without much difficulty that is very much possible with your one piece flow system. So, that is the real flexibility creates higher productivity because every time you have a sense of urgency and you cannot hide inefficiencies, because of fluctuations in the production.

So, therefore, you are able to achieve a constant and higher rate of productivity it frees up floor space that is very simple to understand, because there are no waiting inventories. So lot of space is available otherwise, in our mass manufacturing organizations to stock intermediate processed items a lot of floor space is involved. But here in 1 piece flow system, you are available, you are having a lot of free space on the shop floors.

And since you are system is working in a very smooth manner, it improves the safety and morale of your employees, you do not have that kind of production system where things are hidden. Therefore, the safety is better and your employees feel that we are very critical resource for

maintaining this entire system. So when that sense of pride, that sense of your achievement is there. So it helps in improving the morale of your employee.

And since we do not have much raw material inventory, we do not have much work in process inventory and we do not have much finished goods inventory. So the cost of inventory also reduces. So these are the benefits because of which this idea of 1 piece flow system is being recommended over mass manufacturing and in our coming classes. We will see that with the help of examples of Toyota and other companies who have implemented this idea that what type of benefits in terms of some key indicators they got by implementing this 1 piece flow system over the traditional approach of mass manufacturing. Thank you very much