Six Sigma
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Module No. # 01
Lecture No. # 02
Concepts in Quality Management – II

Good afternoon, we start again, we resume our lecture. What we have done so far is, we tried to generate some motivation, for why we should be looking for quality? What is the benefit to a company, why does the organization really have any kind of thirst to go toward better quality? That is like something there is a marketing is there, there is a comparative advantage is there and obviously impact your product line, you impact your processes and so on as forth. And, the ultimate impact is on your bottom line that is where you really begin to see the benefits.

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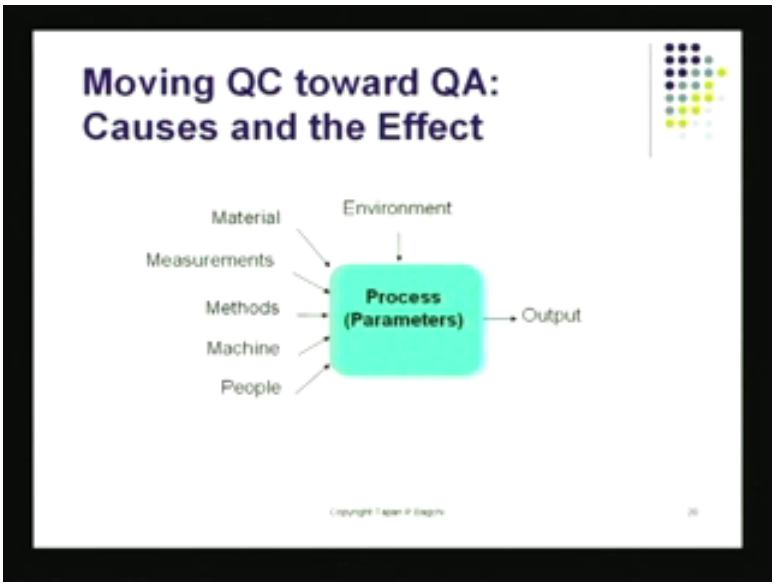

If you look at a system and the kind of system that I have on the screen here, any system that you are operating it is impacted by many different materials. And, in the traditional way of things you got materials, measurements, methods, machines people and so on. They all impact the output and if you just look at the output, you remember the diagram I showed you earlier in the first session.

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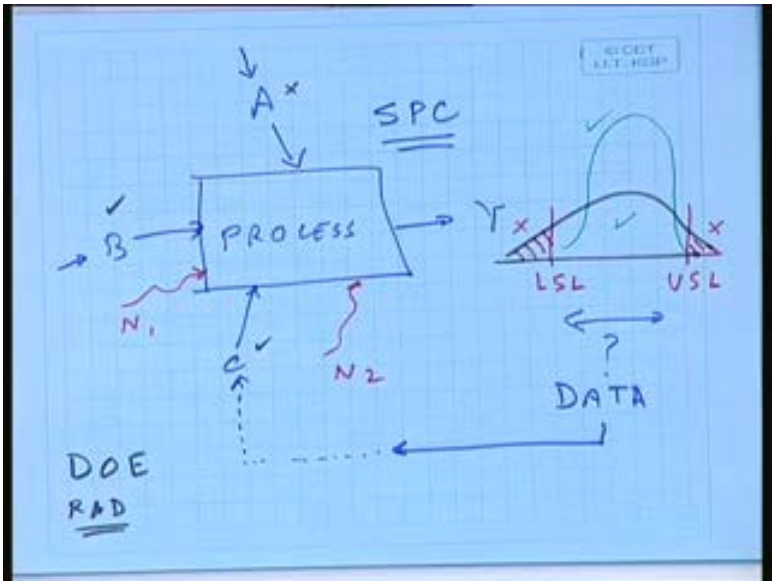

The diagram has an output that has got wide variation. This wide variation is there because many of these factors which are in the on the input side, they are not in good control or they have not been set at their optimum points and this is very important. So, the movement towards six sigma is to make sure that this variance saturates well within your controllable, within your acceptable conditions. It is very very important and also it is important for us then to understand which of these parameters should be manipulated and how? And, that is done by this technique called D O E. So, we will take a look at that gradually as we go into this.

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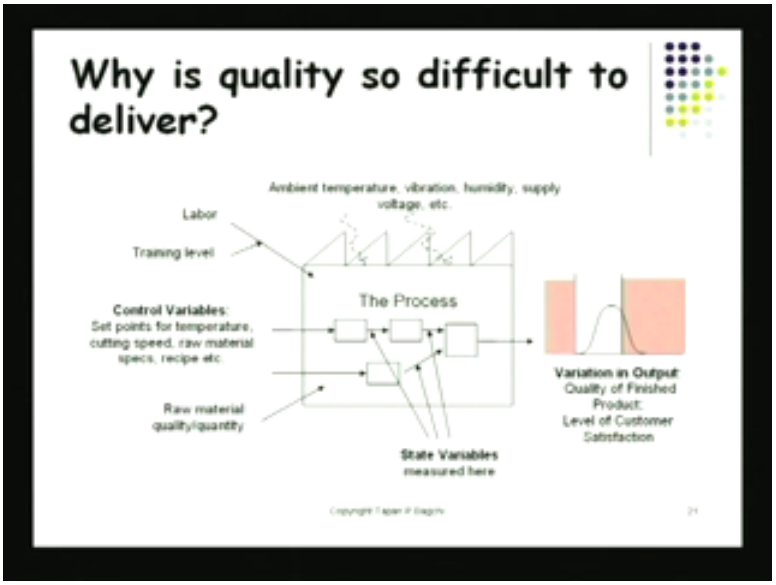

So, we start with the what I have on the slide here. I have basically your diagram and that is showing us the system. If you look at a real factory, a real factory really does pose a lot of challenging controlling quality because there are so many variables there, so many factors there, so many conditions there. And, they are not always in your control and things may change without any notice, you know things may change, conditions may change, you know rain may be there, you know other disturbances may be there. Voltage may fluctuate, raw material arrival may be different, you might have a trainee on the job and so on and so forth. All those things they would impact quality in some way.

The machine will start malfunctioning as an example, tools may ware out, tools may break and so on, all these things they will eventually have an impact on your quality. The result is this what you see on the right hand side, there is production that is in the (( )) area the red area, red area to the right and red area to the left. It is very difficult to sell anything that turns out to be on the left or on the right of what we call the spec limits. Spec limit is the range that the customer will accept anything that goes outside this spec limits, I cannot sell that product or I have to basically scrap it or perhaps rework which is going to raise my overall production cost. So, that being the picture it is not really such an easy job to try to control it, but there is no choice. If I am going to be in business, I will have to do it.

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What is been the traditional focus? If you look at the traditional focus of quality management, it is being really to try to look at short term profits. And, many times people have looked at stock price, instead of trying to do something what they are process the manufacturing process or the service process; they have looked at the market.

They are trying to get signals from you know Dalaal street or some other place to try to get a signal or look at the Dow Jones and so on. From that they are trying to get signal, how they should be operating their company. Is that the way they should be really be operating their company? After all the low price in the market, low price for the stock and the market that is a reflection about customers or I mean share holders they expect to come out, out of the company in future. That is what is reflected there.

If I do not control the process that is good to deliver good products or good services; obviously, prices they are going to crash. So, it is almost like the tail trying to wag the dog that is what is going on. So, that is the traditional view, no clear strategic position. In fact, there is very poor comparative positioning, with respect to your customers that is very poor comparative positioning of the company. That is the traditional way of ruining the company; they would try to clamp down cost regardless of what kind, what is the nature of those costs. If these are preventive cost, should I also shut those down? Should I also try to make sure? I do not do any training and so on so forth, I do not use good quality materials, I do not use good quality tools and so on. Because that is good to save me some money, should I do that, should I go that way? Obviously, these are some of the problems with traditional way of managing it.

And then of course, in some businesses the situation is, that the attitude is because of the monopolistic situation take it or leave it that is the attitude toward customers. We do not really care to hear what they are saying, pretty soon they will start voting with their feet, they are going to walk away, they are going to go somewhere else. Also, try to buy things at the lowest price; we buy cheapest materials, cheapest Labor and so on. And, many times what happens, the real knowledge to fix the process is really with the people who are working on the job, they are the guys who are operating the machines. But what happens? People sitting in air conditioned chambers; they are the managers and so on and so forth.

They are the guys who are trying to look for problems and they are trying to look for solutions. Many times they will snoop around they will locate a problem; they will try to solve it in their own way, without the involving people who are on the shop floor. That is also one of the things that is wrong with the traditional way of doing it.

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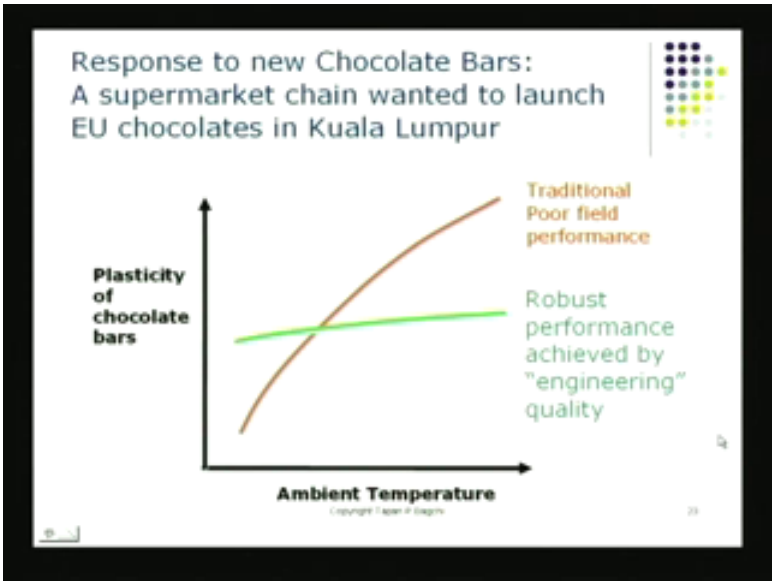

Here is an example. Here is an example that required really a different approach all together. There was a company; this company was in the trading business. They operate at a very large super market in Kuala Lumpur, they were like sort of the Wal-Mart and the big bazaar and so on they are the, that is the kind of scale at which they operated. And, what they realized was there was a big market for chocolate bars in Kuala Lumpur. There were lot of little kids and they all wanted to get a good chocolate bar, that is something they that was very favorite, a big big hit in the market place.

So, about these folks, these people who were operating the super market, what they thought doing was (( )) they would get some European product, they would get some European chocolate box and they would just bring them to Kuala Lumpur and sell them. And, yes some kids loved them and so on the taste was good and everything else. But pretty soon, their moms mothers started to complain about this chocolate bars. It was not so much that the mothers themselves they were chewing on the chocolate bars. No. Mothers were not eating those chocolates, what mothers were most concerned about was,

when they put the chocolate bars in the pocket, the bar started to melt and that kid came up with the big blob chocolate stain on his pocket.

And, this is something that happened because the European formulation became very fluid at the high temperature, high ambient temperature in Kuala Lumpur. As you probably know, Kuala Lumpur in summer days has temperatures that range between 95 and 105 Fahrenheit that is pretty high temperature that is almost like 40 Celsius. That is pretty high temperature and most European chocolate formulations they basically melt, the bars were first bend then they will just drop off. That is not something that obviously mothers would like.

What about kids? Well, kids had going hands all over the place they had chocolate, they had chocolates on their shirt, they had chocolate on their hand. So, this was the product that quickly turned out to be not a very successful innovation, in the market place in Kuala Lumpur. Somehow, they started thinking about it, what could I do with these bars, should I try to package them better? Should I put like insulation around the chocolate bars? But when the kids start eating them they will have to take them off, they would be basically they will have bare chocolates in their hand and again hands would be going and so on.

So, what could be done? They did something called quality engineering; they changed the recipe of the chocolate bars. So, the red line here it shows the performance, the high fluidity of the European bars. As temperature went up, the European bars became more and more plastic eventually they ended up melting. But a better formulation that was found by doing D O E was the robust design that is this green, green one here, green bar. This bar had certain different recipe, the recipe itself was different and it would hold on to its firmness, it would not be something that would become just melting and so on and so forth. It would not become a blob; it was something that could retain its shape that was the robust chocolate bar.

And, this was the product of starting with a red bar, starting with the red bar that went like this and converted into a green bar. So, the red bar got converted into a green bar, then of course you had a robust and a very successful product. This product sold very well, because it now listened to the customers, it picked up the signals from their indoor r

and d, it did the De Mac, it did the De Mac all the way from the beginning to the end and the impact was directed on the bottom line.

Let us take a look at what is a good point to shoot at for example, when people talk about specifications, when people talk of customer requirements, where is it that the customer is going to be maximally happy? My shirt size is size 42, my shirt size is 42. The shirt that I am wearing is size 40. And, just look the way when I try to put this last button, I cannot even get it here. Because this is a shirt that was gifted to me by somebody, who did not really know my correct size. And, he just saw a nice shirt, it is a lovely shirt I adore using this. Whenever, there is a like a fancy party and something, I put on this particular shirt.

So, I have it always washed, pressed and ready for me whenever have I have to go to a public place, provided I do not have put on a tie that of course, is critical thing. Because the size here is this size is 40 and my real size is 42. So, what is the point, what is the shirt size that will make me in the happiest? That is size 42, not a size 40. And of course, if I get a [FL] shirt if I get a loose shirt which is size 44, again I will not be using that shirt. Because it will be hanging, it will be hanging and it will be something that I cannot use in a formal occasion. So, what have I to do is, what the supplier has to do or the purchaser has to do? Someone is trying to make me happy is to provide me a shirt that is of size 42 that will make me that will really raise my satisfaction to the highest level.

Who recognize this? It was this gentleman Taguchi, in Japan. He is the one he said and if you look at the diagram here, there is a point here that is called the target.

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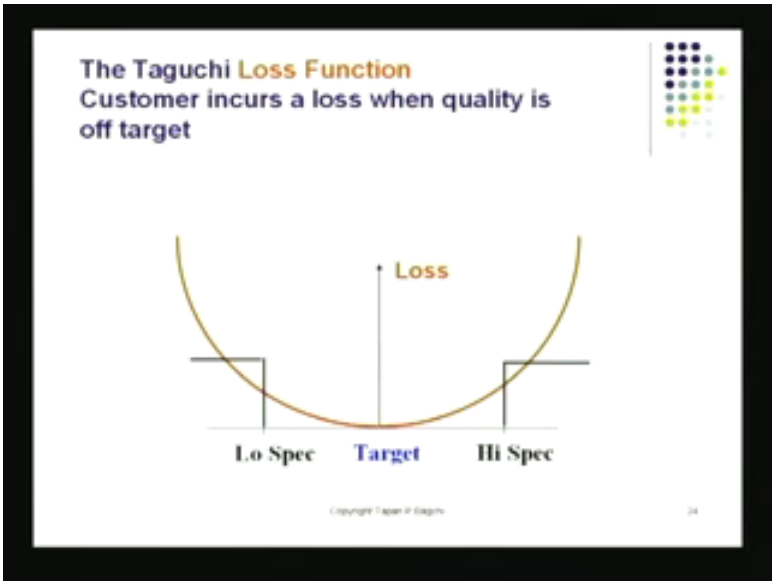

The target is the value of the quality characteristic, if you deliver your product at this level the customer is going to be happiest, like professor Bagchi being happiest when the shirt size is 42, that is this point. So, this point for me is 42 centimeters. What about specification limit? Is it possible that I specify my shirt size to be 42 plus minus one or plus minus two? Suppose, somebody loosely specifies my shirt size to be plus minus two, so then, someone who is buying to, trying to buy a shirt for me he will probably buy me a size 40 shirt or a size 44 shirt. Because they are all within spec limits, so spec limits have been given as plus minus two.

The problem is this; my dissatisfaction is going to rise. If you look at the red line, if you look at the red curve it rises on both sides away from size 42 that is actually a loss. What this is showing is, the y axis is the loss, loss is minimum right at the target and loss rises if I go away to the right hand side of the target or if we go away to the left hand side of the target. Now, what has been the traditional view of quality control? When you locate these spec limits god knows why these, how these spec limits are fixed. But somehow you locate the spec limits or you just put them on the drawing, you write down plus minus two.

So, there will be a shirt drawing there some dimension will be given there. And, some fellow is doing the drawing from his own head he will put down plus minus two, as if I am good to be equally happy with the size 40 shirt or a 42 shirt or a 44 shirt. That is not

true, I am happiest only at size 42, 40, 42 basically. 40 is no good for me, 44 is also no good for me.

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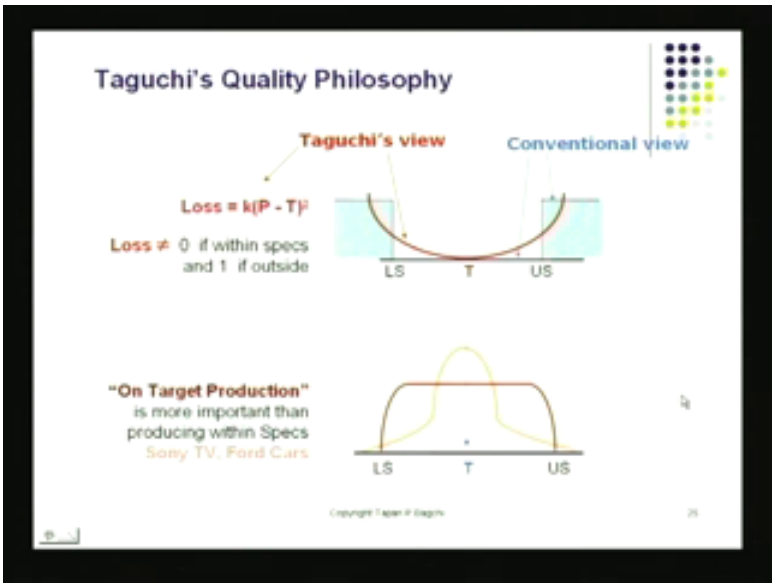

So, my satisfaction is highest when the performance delivered is right on target, this was realized by Taguchi. Taguchi also said something more. Taguchi said when you are trying to do production, please try to make sure your production is also as close to the target value as possible. That is the ideal quality point and if you deliver your products right exactly at the ideal point, the customers going to have maximum satisfaction. The moment you go away slightly to the right, slightly to the left as I show on this curve here, as the cursor moving to the left or the right, dissatisfaction or loses they increase, it increases this way, loss increases this way and also loss would increase this way. And of course, if you go too far it is going to be (( )) anyhow.

So, there is not much sense in trying to produce something that is going to be (( )). But even if you watch your specification, the best thing to do is to try to produce products that are right at the target and neither to the left nor to the right. Let me tell you this little story, this is about Sony TV's. You know Sony is a very successful TV company and this story is given in Juran's quality control hand book, if you at Juran's hand book you will find the story there. The Japanese they produce to produce TV's like they produce cars so and on so forth, they produced a lot of electronic things and they also produced cameras, optical products and so on. They produce TV's and one of the kinds of TV's

the model was called Sony Trinitron, it was very popular in the U S, it had very fine performance.

When we were students we all lined up to buy a Trinitron TV, so we tried to save enough money to be able to afford may be a small size, but perhaps only a small size, but a good Sony Trinitron TV that was our dream. Like it was to try to get an Asi Pentax camera, it was like one of those elite things or perhaps a Toyota car today. That would be the target that would be the ultimate that we would like to get to, because these had quality reputation. And what about this Sony Trinitron TV? It certainly was a TV that was liked by a lot of people. What happened was, these TV's basically they took over almost 50 percent of the U S market. And, this was complaint about why many others who were actually producers of TV's and they started complaining.

They started saying well the Japanese are doing dumping here, they produce whatever they produce but they are basically taking away our market. And, that was a proper call because that is what was happening in the market place. And, what did the Japanese do, they said fine I think what we will do is, we will bring the parts but we will let the American workers to assemble the TV's. So, yes, they will be still be Sony TV's, Sony Trinitron TV's. But the assembly will be done right here in a town called San Diego, which is in California at the southern tip of California. That is why Sony they set up a factory, a Sony TV Trinitron factory there and they started producing their TV's there.

Everything went fine for a short time, pretty soon the moment the Japanese in trainers and so on they left the factory and they went back to Japan, the San Diego factory it had all American workers, they started producing TV's, like routine for example. Now, something funny happened in the market place. People when these TV's they reached the market place the shelves, people started to complain about these TV's. They were certainly Sony TV's, Trinitron TV's they were not as popular, they were not seem to be the offering the same quality, the same clarity at the as the older Trinitron TV's were doing.

What was the problem? Well, the Sony people they came back, they took a look at the practices, they took a look at the assembly practices in the San Diego plan. And, what they found was that there was some quality characteristic, I am going to be showing that in the lower half of the screen there. Some quality characteristic, it could be may be the

sharpness or something let us say it is sharpness. Now, the engineers in San Diego they yes, they understood what the target was. So, they knew this point, but they also you know put up on their own pretty well, they put up a spec limit. They said as long as sharpness is the final sharpness of the TV that is just been assembled, it stays within this range you can ship that TV.

So, they set up this limit which was specification limits. It is not very clear how these limits were set, but they are set for convenience, otherwise forever you will be doing quality control. So that, to try to make it easy for production people, what these supervisors did was in San Diego, they set up these limits these were specification limit, the upper spec limit and the lower spec limit. And, they started their routine production to just make sure that sharpness stayed in this range that is all. Now, the curve here inside that is typically the distribution of TV's, the sharpness of TV's that are made in Japan. The reason was this, in Japan they tried to fine tune the sharpness of the TV. So, as to make the final sharpness come as close as possible to this target value, to this target value. That was the goal, that was the goal of the production in Japan. But in San Diego it turned out to be just tried to be within these specifications you would be ok.

Now, naturally when this San Diego TV they hit the market place, there would be some TV's that would be a marginal in performance over here and some TV's that would be marginal performance over there and people would not be happy with them. Same sort of thing also were found with automotive parts and many other applications, when the shift went away from being trying to produce on target to try to come within some spec, the same problem was seen. So, this again there was a theoretical idea, Taguchi said he was somewhat theoretical, he was saying please try to produce on target.

But some people said, well traditionally we will be produced with the producing within specs, what is wrong with it? The customers provided the signal; the customers said we are the happiest when my shirt size is 42 and not 40 or 44. Because I find in one case I cannot put on the tie and in the (( )), it is so loose that I cannot really use it in a formal occasion. That is a message that has come along.

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What is the current situation worldwide? There is a lot of competition. No matter what you are looking at, what they are looking at, paper, pencil, you are looking at computers, you are looking at water bottles and so on. You look at furniture, you look at electronics, you look at cars, you look at steel there is a tremendous amount of competition worldwide. So, there are many suppliers. So, it is a very fiercely competitive situation and financial system size you know they become fluid. So, it is difficult to get money to build your plants.

Customer expectations are changing, this is happening worldwide. Employee expectations are also changing; they want more empowerment and so on and so forth. Investors obviously, expect more because our horizons have become shorter, our investment horizons they have also become shorter. We would like to get more returns in a shorter period of time and technology is changing very rapidly, that is also is something that is has started to happen.

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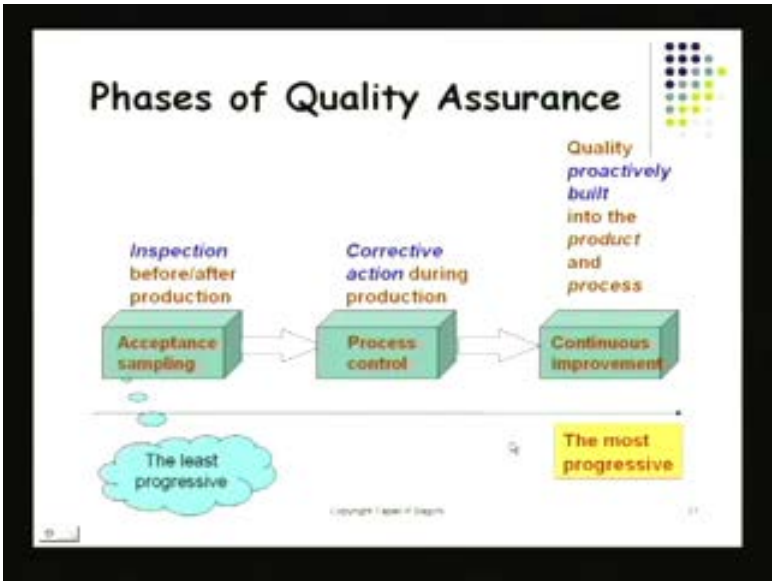

If you look at various strategies, various approaches to try to do quality assurance, the least effective one is when you are trying to count everything based on inspection only, when you are trying to give a quality assurance based on inspection. It is somewhat better when you are trying to do as p c process control. But it is best when you are trying to do proactive; trying to take proactive steps in doing continuous improvement, you are doing basically taking all those preventive actions and so on. We will try to see how we can leave this behind, how we can leave this behind and how we can move toward this which is like taking the preventive actions. In fact, it turns our six sigma focuses on this last stage and that is one of the secrets of succeeding with six sigma.

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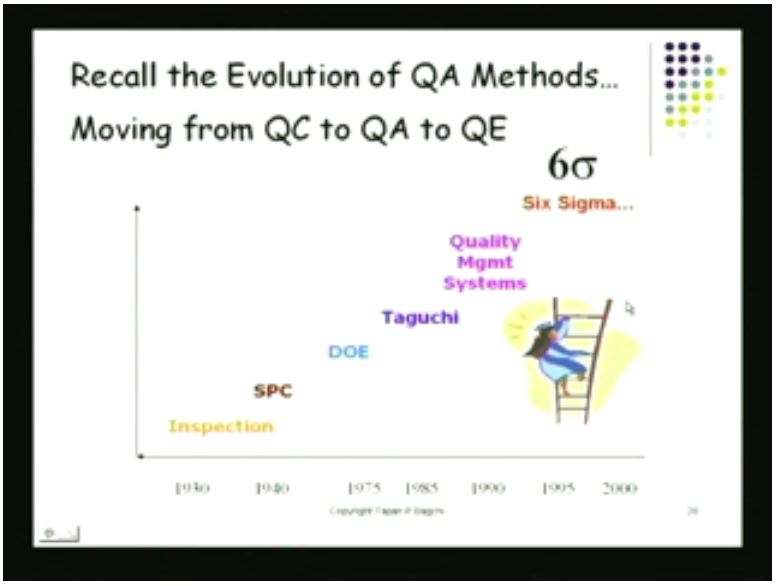

So, again that picture is there as you can really see, we have moved from quality control which is what we are inspection. We went to quality assurance which was sort of with SPC and d o DOE, we moved to quality engineering which was the Taguchi. And, now we moved up to six sigma which is like the ultimate the frontier of quality movement today.

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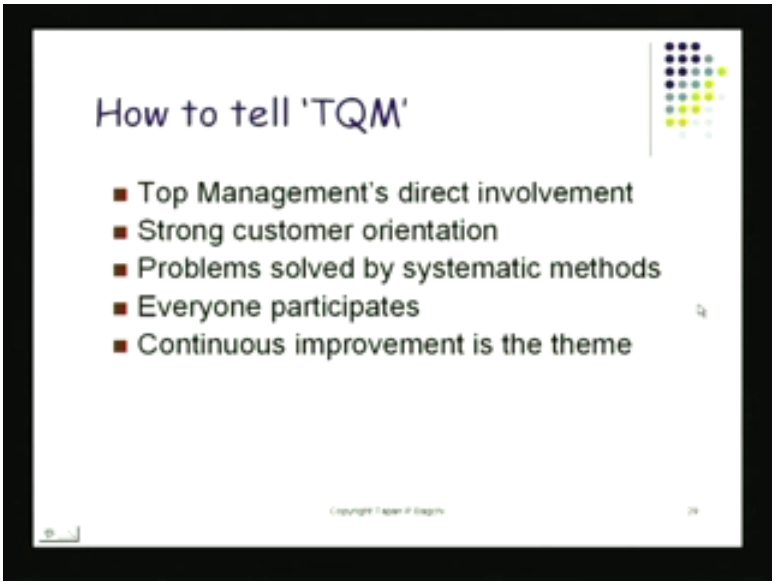

How do you tell us that a company is doing TQM, is there some magic way? Is there something that you can just basically, just take a look at the company and say, yeah these

guys seem to be practicing TQM? It is like you walk through IIT Kharagpur. It is just something that will tell you right away that director believes in TQM, the people they believe in TQM. Is there something some certain things you can notice? Obviously, something you have to remember is most organizations exist because there is a stake holder, there are people who are interested in the delivery of the service or the product that comes out of the innovation.

There of course, there are many other stake holders as well. But I am just talking about the customer, customers have to be there. Now, how do I tell that an organization has a TQM? The very first thing is, is top management talking customer satisfaction? Is top management talking customer delight? Is top management directly involved with the delivery of quality? Top management's direct involvements that is, one sure far way say that this company probably does have TQM. The second is strong customer orientation, again does top management talk about customers? Do they actually talk about customer requirements, customer complaints and that sort of things; do they interface with their customer? This is very very important, unless you do this you will really not know what customers really want and what are they complaining about, that you will not know unless you have strong customer orientation.

Then problem solving, should problems be solved only through experience? All you really need is some [FL], some expert and he is kind of the, you know master of the process and so on. And, till he is there everything works fine and the moment he takes leave or goes on holidays or something things kind of collapse. Should it be experience based like that or should I be using scientific approach? So, many things we do today because of science, because we are people and you will see this later as we go into the subject here.

With the experiments you can also build up experience, you can build up experience very rapidly. If you do the right set of experiments, you can build up your experience very rapidly, you do not have wait for 20 years. And, again everyone participate that is also a sign for TQM. Everyone means everyone, right from the top which is the top director, the director of the institute, all the way to the person who is believed, who is delivering. Perhaps, he is the person in a school, he is the one who cleans the boards or he arranges the chairs for example, he is the kind of person, is he also involved in the delivery of quality? That is also very important.

Just imagine, coming to a class and finding that the black board has not been cleaned or the white board has got streaks of all these things that basically stain the board. Is that going to be good for those who are going be looking at the board and trying to understand what is going on in the class? Not so good, right. The thing is you know, even that gentleman who is basically in charge of cleaning the place and organizing the doing the house keeping and so on, he also should be concerned about quality. Is he oriented that way? And, whose job is that? It is the job of top management; they should do it by setting examples.

And of course, the last thing that comes along in TQM is, do not be happy with what you have, think of continuous improvement and the Japanese have a phrase for this, they call it Kaizen. Kaizen is something that looks at small improvements may be small improvement, but done a little improvement everyday or every week you got some improvement done every day. These are, if these things are there if these five points are there, then you really say is top management directly involved do I have strong customer orientation or problem solved by systematic methods, which could include statistical methods. Does everybody participate when there is a quality problem and do we really have continuous improvement as the theme? If these things are there the company is practicing TQM.

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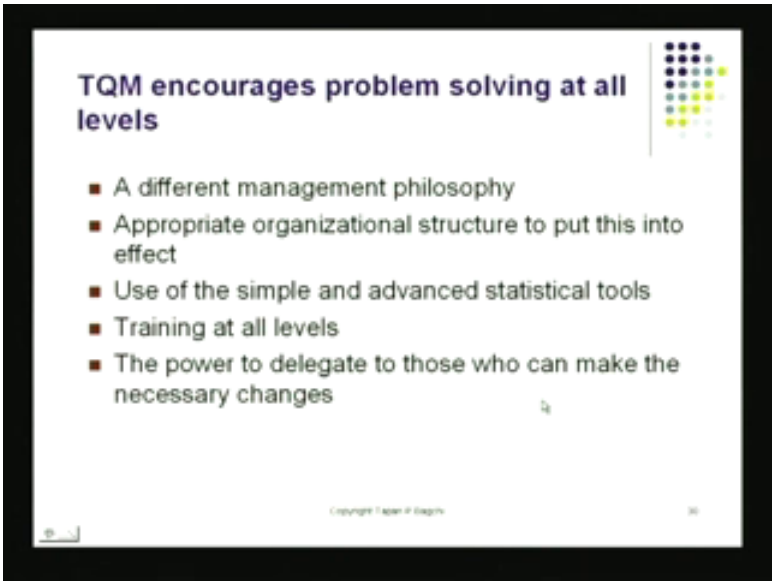

TQM really encourages problem solving at all levels, whoever has a problem let him go ahead and find a solution, you encourage people, you empower people to be able to do it. And, they could use simple tools or they could use some very sophisticated statistical tools, there is no problem at all. Delegation is their power the power is there and so on so forth.

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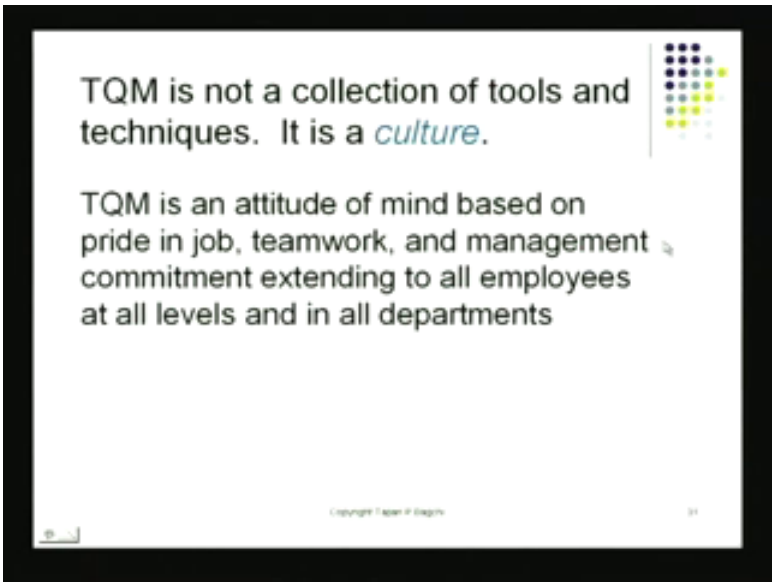

And, people take actions based on that. But TQM by itself is not just a collection of tools, it is a culture, it is way of way of acting, way of behaving, way of interacting, way of viewing the world, way of viewing the customers, way of viewing yourself, that is TQM. It is an attitude of mine and as I have shown here in this slide, it is based on pride in the job, team work, management commitment, extending all the way to all the employees. And in fact, every department recognizes that this is the role it has to play in achieving that customer delight.

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TQM therefore is a culture, it is not a program. It is not something that you go through step a step b step and so on and so forth. If you go through those steps you will have TQM, it is not like that. It is a state of mind, it is a culture.

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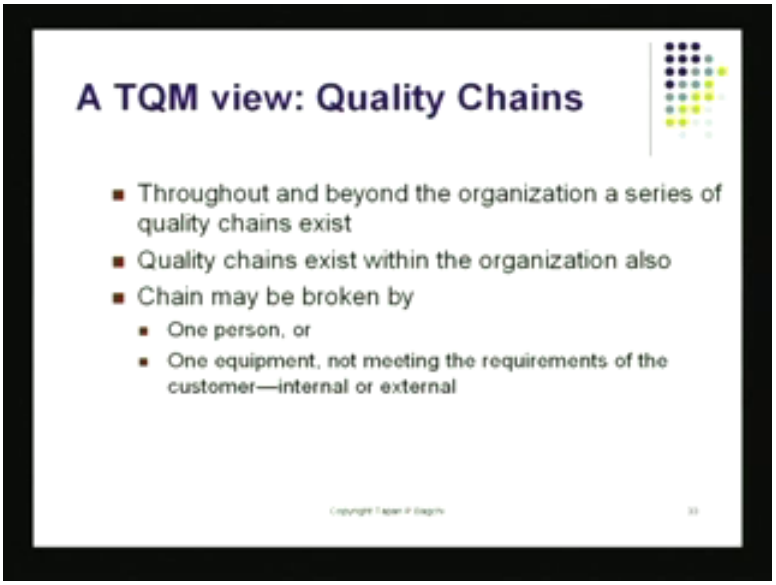

TQM verses quality chains, now; there is something where TQM is extending itself. Quality chains let me just actually show you the chain and you will know right away what I am talking about.

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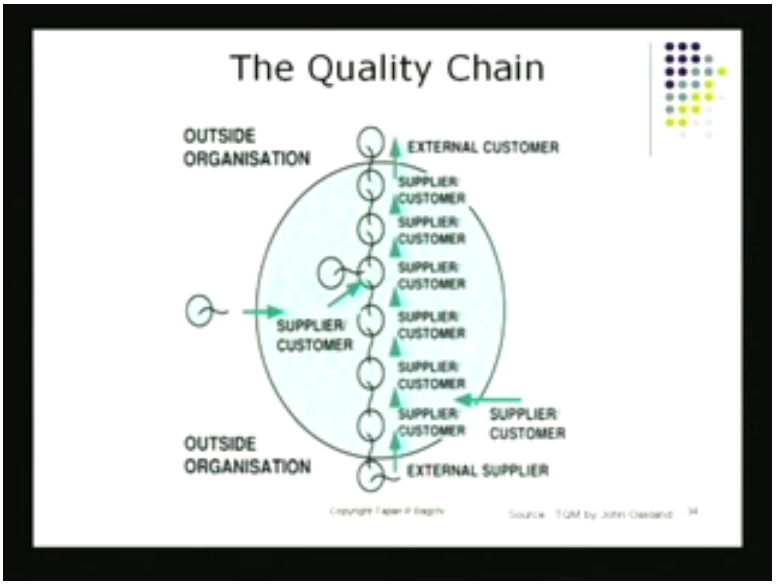

You look at any organization; there is not a single department that does everything. There are many departments; they have stages of production and the transformation of the final product starting from the input all the way to the final product it takes place through stages. And, these stage themselves they are customers and suppliers of each other. So, if you look at this quality chain you will notice I have written there the external customers who is right at the top, then I am going to a supplier who is supplying these external customers. Then, I am going to customer, because the same supplier is a customer of the previous stage.

At this stage here is the customer of the previous stage and so on. And, all the way I have got an external supplier at the bottom; I have got an external supplier. So, this guy is going to ship his products to this first person, he does something to it, then it is moved to the next stage and the next stage and the next stage and so on and so forth. That is how we found the total quality chain; this quality chain is very very important. Why it is important? Because if any of these steps stops functioning, the chain is going to break.

You will not going to be able to deliver the final product the way you would want it to be delivered, you would not be able to do that. And, that is actually what highlights the idea of this quality chain, quality chain is very very important. If any link is weak or if any link breaks down you will have big problem in supplying, in making sure everything is straight supplied. There are these internal quality chains of course; there are external

quality chains also. There are certain stages where you got to make sure that the chain is intact, the chain is functioning and that can be done through inspection. You do the process inspection of the right places and it can be done.

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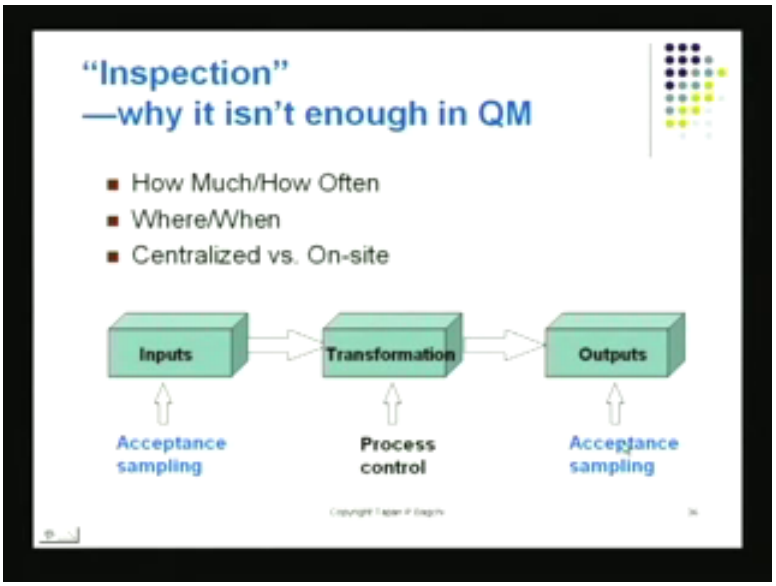

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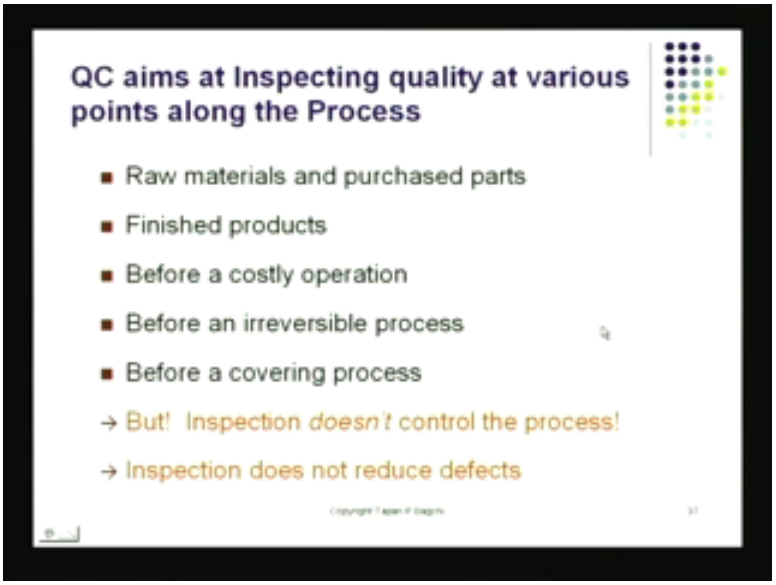

But something you have to remember. Remember, inspection is done only at the last stage or may be the first stage. Inspection does not impact the process itself, the process carries along unless you do SPC. Unless you do SPC, inspection which is being done at the last stage or the first stage, inspection does not really impact anything inside. Unless I

utilize the inspection data and I ping back by that feedback control, which I showed you in a system here, I had my diagram, I have the output coming out, then I had this data collected and I utilize that data in a feedback mode to try to control these variables C B and A.

This feedback loop is, till it is completed really there is no really sense, no kind of conduct, no change in the process. And, that will take place only when I am using the inspected data in a feedback manner, in a feedback fashion to try to come back and control these processes, these process variables B and C. It turned out in this particular case A was not very important; A was not very influential in impacting the process. So, I could just I, all I needed to do was I would collect the data, do a statistical transformation to get my signals. Once the signals come along, then I will control the appropriate variable either it will be B or C these are process factors, those are the one-third we controlling.

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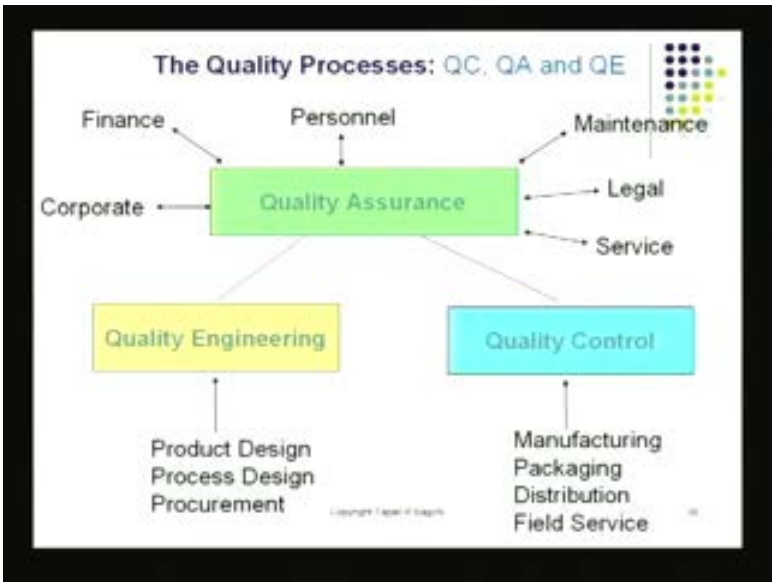

Something I have to remember is, quality control by itself is not good enough and that you see in the blue box there. That is quality control by itself is not good enough. Quality engineering is charged with coming up with good designs in an organization and then there is a huge area called quality assurance, that involves many different departments. They are the ones, the action of assurance is prevented and you will see that as you go into the process itself you will find quality control is the consequence of the process.

Quality control, quality assurance in some sense controls the output, controls the process whether it is going on. And, before quality assurance can begin which is at the process level, I have to do what we call quality engineering.

This is what we come up with the design of the product or the design of the process. All of them they have a role and this then flows from QC to QA to QE, QE is the highest level. QE, quality engineering is the highest level at which you are dealing with quality management. So, again the same climb again, around here I am doing QC quality control. Quality control is still pretty much up to this, at this point and here on I am trying to do a bit of quality assurance, at Taguchi I am doing quality engineering and the total thing taken together, if you go all the way I am taking a lot of preventive actions. And, this guy is trying to deliver a level of quality which is at parts per million. That is your six sigma process.

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If you do a good job in quality assurance and you wanted to be known by the world outside your customers, your competition and so on and so forth, then you get yourself audited. One way of course, for doing that is to apply for an award, like for example the Baldrige award. The Baldrige award is a US award and it is based on the TQM, TQM philosophy. So, if you are practicing TQM to the last piece of the concept, you could apply for the Baldrige award. The Deming award is a Japanese award and the Deming award looked, looks at a different dimension of quality assurance. The Deming award

looks at statistical methods are you using statistical methods in controlling your quality, in assuring your quality and so on and so forth. In your preventive actions, do you really have actions that are based on statistical methods? If you are doing that, you probably should apply for the Deming prize and that is done like that.

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The Baldrige award it came from the U S and you can see the slides and I will give you the details where it came from. That it could be done quite easily.

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Then of course, I have got certain criteria and these are aspects of TQM that are checked by the auditors.

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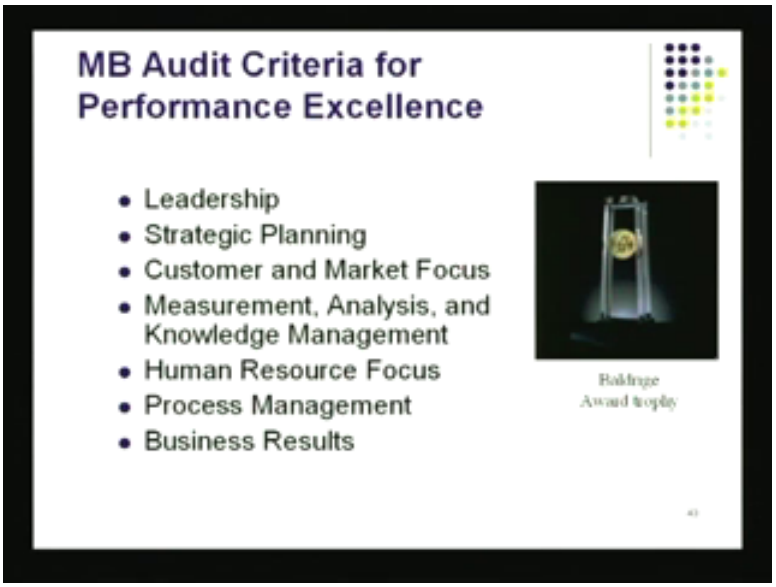

They come back and see are you doing these things? If you are doing these things, they might consider you for the award of the Baldrige award. And, it is a very fancy award and if you win this award, you can publicize and lots of things are tested. The auditors, they are going to check and all these things and they are going to see, are you really meeting with these things, if you are then of course, you get the award.

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And, there are benefits there is clearly the financial benefit which is like you will get more business, more you know more customers would be coming toward you and so on. That is like something that you do. And, many times if you are a Baldrige award winner, their practice has been, they have shared their knowledge, they have shared their good practices with the other people. And, there are some other advantages also in winning the Baldrige award.

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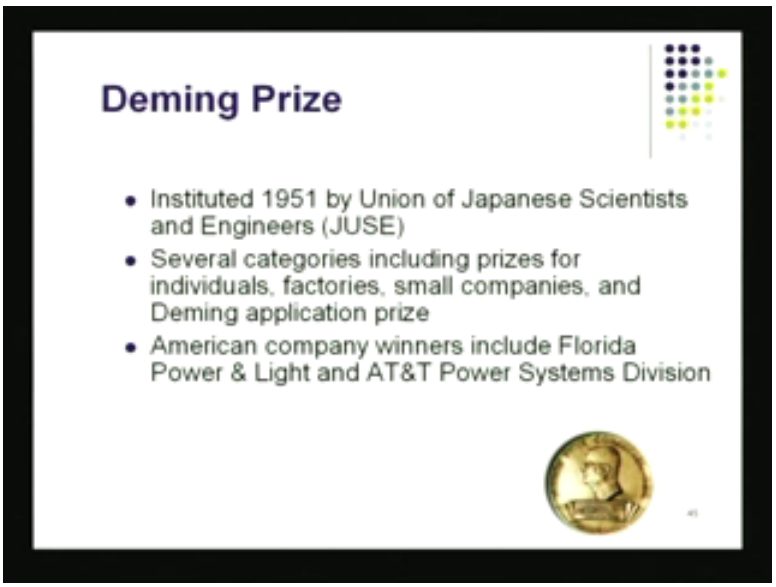

The Deming award is somewhat different; this was pushed by the Japanese. This is pushed by the Japanese scientists and engineers union, they actually pushed this award. They said, what is really critical here is, application of statistical methods. And, there are obviously, there are some American companies also, they have won the Deming prize and there are some Indian companies also that the, that have won the Deming prize. They are masters in (( )) statistical methods, in process control, in design of processes and a variety of different places, where you need to optimize the process. That could be done there.

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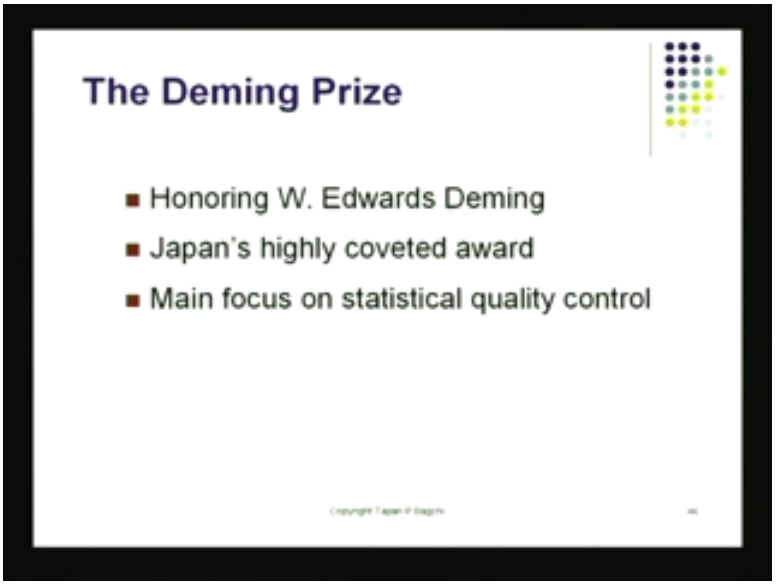

So, the Deming prize basically, it is a Japanese award and it is focused on statistical quality control.

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Similarly, there are the European quality awards, those are there.

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And, there are other awards including the Rajiv Gandhi quality award; that is also there. That is patterned after TQM or patterned after the Baldrige award; that is the Indian award for excellence in quality.

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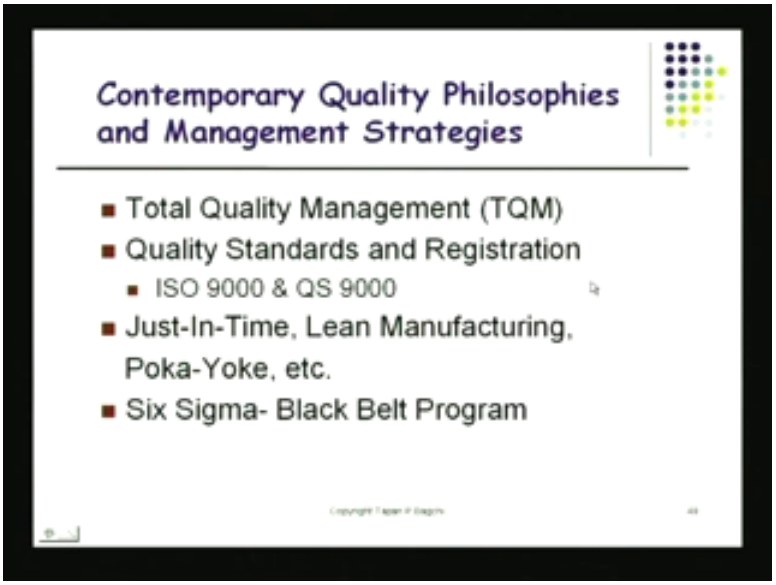

So, there are now other methods that are besides just purer TQM, you got ISO 9000, you got just in time, then you got lean manufacturing, you got Poka-yoke, and of course you got the six sigma black belt programs these are besides TQM. TQM, in some sense is now an old approach, it is very powerful and so on and so forth, but it is not good enough by itself. So, many people who were doing TQM they also got registered by ISO 9000. And, many moved up to JIT, something that I should remark about JIT is, JIT basically

means, you get the parts in into your factory. Unless I receive these parts, I receive these parts and I see the caps and I see the body they came from different people. So, I have my caps and I have my parts, I as a user, as an assembler I will not have to assemble these parts again. I will just take the part, I will take it out of a box, I will get the body and I will get the cap from another box and I can just put them together.

They arrived exactly when I needed to I am doing JIT assembly, which basically says I can count on this supply, I count on the quality of the supply that I have received as these parts. I can count on the supply of parts that I have received as this body and I can just assemble them, I can focus on assembly. I need not worry about the quality of those parts coming in and anymore. And, this can be done in a JIT mode, because what will the supplier do? The supplier will not stock pile stuff here, that I pick from and then I do my assembly. They will not put that way; they will just say our quality is perfect, if you take our bodies, our bodies will be perfect to enter directly into your assembly shop.

If we get caps from us, the caps can come in with perfect quality you will not have to worry what their quality. Just bring them in and take them to your assembly shop and just put them together, and your product would be just fine. This is JIT, just in time. What it requires? Perfect quality on the input side, perfect quality on each of the components be it part, be it whatever, it requires you to have perfect quality on the input side, only then you can have JIT.

So, JIT by itself cannot be done unless you got perfect quality, again defects at parts per million levels. Because suppose you find that this cap does not really fit this body and you have to hunt around for another piece of body which is going to fit this cap, is that not going to slow down your process? How could you do JIT, just in time? Because your customer also expect just in time delivery, you would not be able to do it unless these parts themselves they were supplied in perfect order and perfect quality. That is something I have got to keep in mind.

This six sigma black belt program and this is going to be the focus of our lecture, we will be getting into this deeper. It is a specialized program, it requires a lot of good training and only then it get it can get into impacting the process. So, impacting the process is going to be very important, I have to really be mindful of that the goal really is to reach that ultimate high level of quality, the low level of defects that is what I want to get to.

And, you require some special techniques, some training in statistical methods or other training in team building and leadership and so on and so forth, those all will have to be there. And, we will find them as we moving to this program, as we go through the lectures you will find all those things are gradually being brought into the thing.

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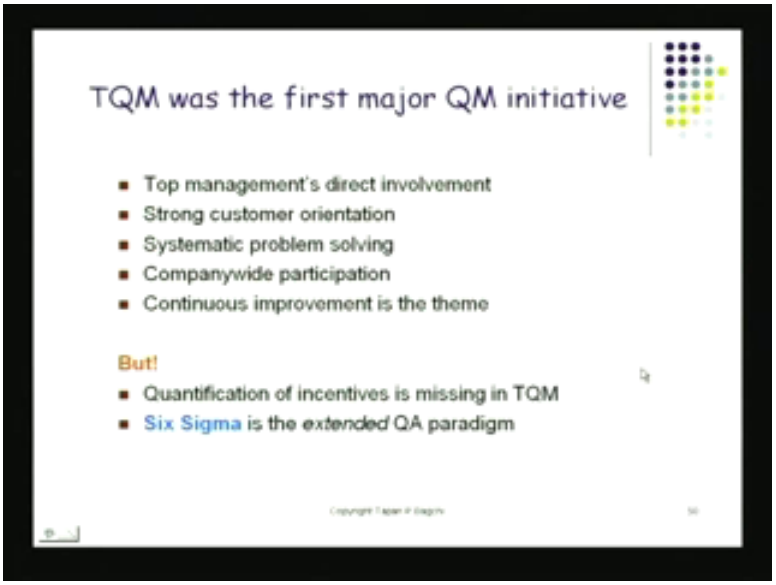

What was wrong with TQM, could we not just try with TQM? The big problem was that TQM did not quantify the incentive for improvement. So, quantification of incentives that is something, that was missing in TQM. This was something that was missing in TQM, it had all the good stuff, but was missing this quantification incentives.

So, what ended up happening was, when six sigma came along that gap was filled. That gap that existed, because there was no incentives quantified by TQM. When I did TQM I took it on faith that this is going to be good for my company. It is only when six sigma came along, I could see there was a reason for me to do this project, this improves my project. So, that is how six sigma ended up with an edge over TQM.

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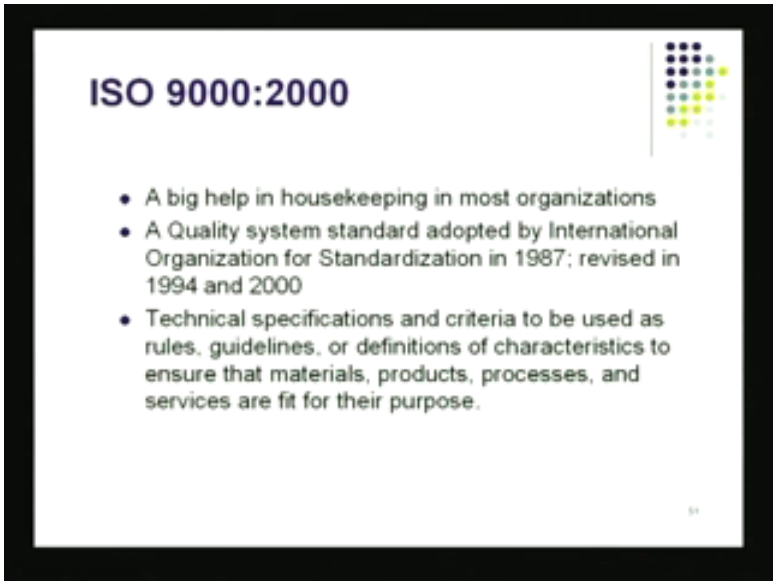

Then of course, you got ISO 9000. I should say very briefly this is a good way to put your house in order. It has got components, if you go through them your equipment is calibrated for example, you have an idea of your CPK, you have a system by which you select your vendors and so on, how you approve your vendors and so on, there is a set process for it and so on, how you control your process and so on and so forth. So, basically all your quality assurance practices, they get organized. Once you have ISO 9000 your house, you know it is set up in a proper order housekeeping really improves.

Something we have to remember of course is that by itself ISO 9000 does not guarantee quality. It only looks at activities that might be impacting quality, but it does not relationship, does not really work out the relationship between your actions and the final product quality, it does not do that. That is not the chartered of ISO 9000. So, for that you have go into other methods and you have to basically do that.

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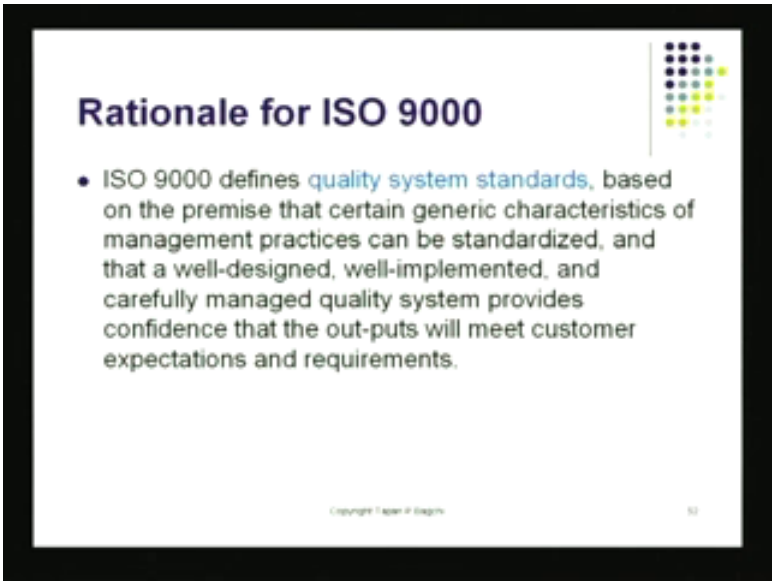

So, there is ISO 9000 2000 which is the latest model for it. And, there are other methods also that we will be looking at. The rational for this of course, is if you have no systems in place, then you start looking ISO 9000.

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That is going to be useful to you and there are certain specific objectives you can again see, you can stop the system and you can actually see what they mean.

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And of course, this can be found in many different books. We will keep moving here and we will try to see what are things could be done, as you go into other systems.

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Quality management principles in ISO 9000, again they are available in many different places and you can see that customer focus leadership involvement of people. These are all requirements in ISO 9000.

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And there is of course, something new called ISO 14000 which is not so new really.

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Because what ISO 14000 does, it looks at the obligation that you have towards the environment. So, it is not true that, you know I have to deliver products no matter at what cost, what impact on the environment, that is not allowable. ISO 14000 brings in regulations and it actually says, there are these practices that are as far as environment, the environment is concerned.

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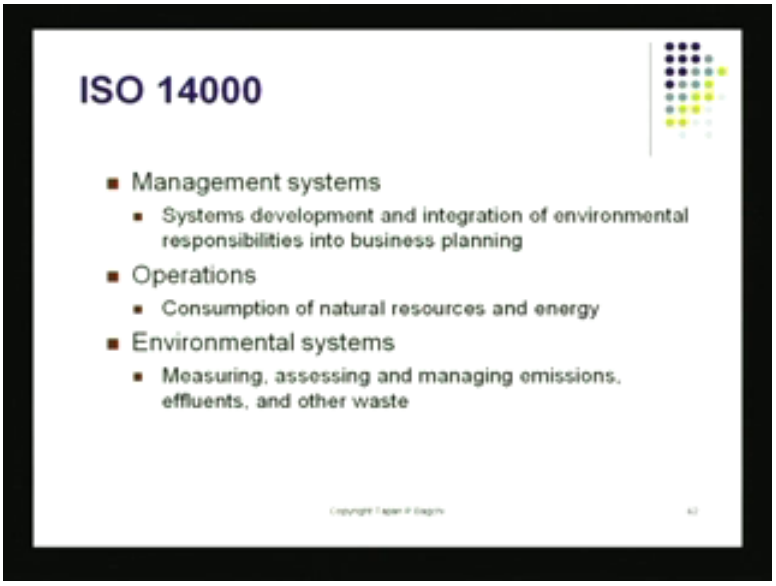

These are the practices they are not ok. You got to make sure, you fix your process to make sure that you confirm to the requirements of ISO 14000, that is to be there. So, again you can take a look at these they will give you this thing.

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Where do you start given this big huge scenario, where do you start? You got to make start of your journey, your journey toward excellence in quality, where do you start? The most effective approach actually is the DMAIC project approach. DMAIC has the approach. That is propagated by this six sigma philosophy and I will give you the details. And, the second thing is of course, you got to recognize your customers. So, first you decide that, yes I am going to following the DMAIC process. That is going to give you a lot of things to do, lot of training and so on and so forth, those would have to be done if you are going to be doing things in DMAIC way. And, DMAIC is the core of the six sigma process.

You have to recognize a customer that is something that is to be done. You have to set performance standards and these performance standards should be such that they will meet customer requirements, they can deliver them and there is this concept of capability, process capability. So, if you have a process you got to make sure, it is capable of satisfying customer. That means, it is capable of producing shirts at a size 42, that come well within specs, that is something that will have to be done. You will have to probably establish some management systems, quality management systems and you will

have to set the quality policy, some of these are required by ISO 9000. And, you have to empower people who can really impact quality; these are the people you have to empower.

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There is a method to try to find out what really the customer is trying to get from us, we are the suppliers, what is it that the customer really wants? So, finding what the customer wants and also a comparison of my capability to that of competition, I apply a process called QFD, quality function deployment. I am just going to give you a glimpse of this. This is the process by which you can start with customer wants and convert those into specifications for your final product.

So, let us say a customer wanted to get a writing pen, that would write in red ink it will writing would be in red. I will have to interface with the customer, I will have to find out exactly what does he want. Let us start with the pen itself. Well, probably if it is going to be a red pen and not a pencil, it must have a cap otherwise it is going to dry up. So, the customer does, what does the customer want? He does not want the pen to dry up, number one. He probably wants a certain fineness in writing; he probably wants a certain life of the pen. He probably wants to make sure that his hands do not become wet when he starts writing with the pen, he probably wants to use a kind of thing that does not go through the paper, these are different requirements.

Giving these requirements, then I start working with my engineer. And I tell him, well look these are the things that the customer has said he wants, how do we deliver them? This is where you bring in engineering in generality basically, you bring in real product design and you try to come up with specifications for the final product. So, you will probably say, will the vapor pressure of the solvent should not exceed this, the cap should have a certain kind of sealing capability and so on and so forth. All those things you spell out, these are going to be now technical specifications.

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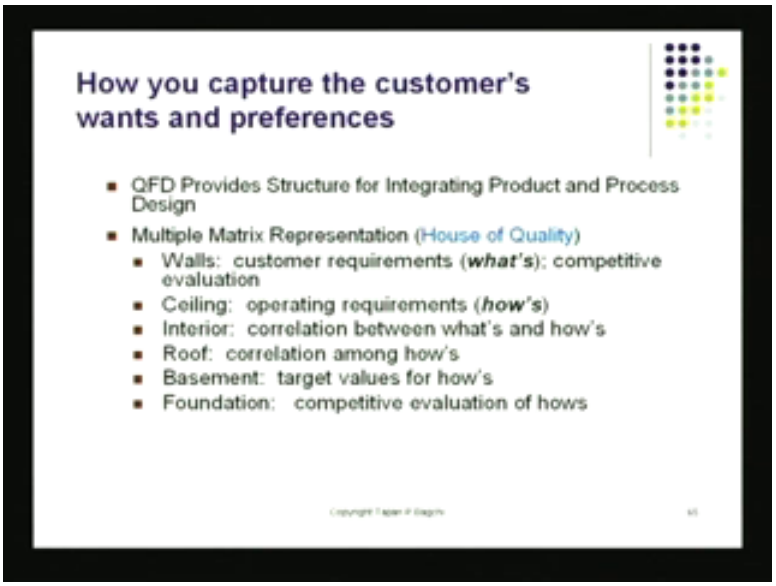

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Let me jump a few slides here, let me go to an example and you will notice how this is to be done. Let us say somebody wants to set up a dry cleaning shop on the IIT Kharagpur campus. All he knows is there are enough people here and if he sets up a dry cleaning shop, he is going to have good business. He is checked around the area and he has gone to the tech market and he is gone to the Puran gate, he has gone Prem bazaar and he has found, yes, there are a few guys who are also providing dry cleaning service. So, he has got a competition there at Puran gate, he has got another one at Prem bazaar. And, he has got another guy who also has a Mickey Mouse kind of dry cleaning shop, he is really a [FL], he is really a washer man, but he also does dry cleaning on the side. And, he takes a look at and he makes some notes there.

Then, he checks with people the users and he starts talking to the users, what does he find? He finds certain things which are customer requirements on the left hand side. This structure by the way is a matrix that looks like a house, which is by this QFD procedure. Sometimes it is also called the house of quality; we also call the house of quality. You see the roof there, you see the walls, you see a foundation. So, these are the features you find in a house, therefore, people started calling this the house of quality.

Let us take a look at what does it consists of. On the left hand wall, I have written down customer requirements and this would to be found by a focus group study or in some place where you can get these customers to come together and provide you an input. So, what are those inputs it turns out? The customers would like to see their clothing's perfectly clean, completely clean, then would like the press of the clothing's to be perfect, that also is something they would like to see. They would not like to see a delay at the counter, when they come there to either to collect their shirts, collect their garments or to deliver the used garments. They should have no problem there, there should be quick turnaround. The service should be friendly; this is also something that they would like to see having put these down on a piece of a paper.

I can then ask them to prioritize, sir or mam what would like to see done as far as priority is concerned which would you value the most. And, then she says probably I wanted to be completely clean, number one. I wanted to be pressed very well. The third thing I want is, I want quick turnaround. The forth thing I want is, friendly service and of course, I also want this which is like no delays at the counter, these are the priorities. These are the wants of the customer, these are the whats. Then, I assemble my

engineering team, I enter the house and I ask my engineers, how do you think we will be able to provide these facilities, these services?

How will I provide completely cleaned garments? How will I provide well pressed garments, no delays at the counter and so on and so forth, how would I do that? They start, my staff starts brain storming. Some of those are technical people; some of those are people with dry cleaning experience. They say well, sir we should have good training, we should have very clean dry cleaning solvent, we should have again filter should be the dry cleaning filter, the solvent filter should be very clean, there should be no rust in the different pipes, that basically carry these solvents from one tank to the next. The press should be very firm and also, we should have good equipment. If we have these things, we feel we can deliver these goals, we feel we can deliver these goals.

So, these become then the specification, they come down to a specification. And, I end up with certain very technical, highly technical aspects for example. How much training four hours of formal training and two weeks of on the job training for the guys who are going to be doing this dry cleaning. They have to be trained this way, only then they will reach a certain level of training. The cleaning of the solvent, how should it be checked? Well, if you could do visual checking, if you pour that in a test tube and then of course, you look at the clarity and so on, you should get a pretty decent idea, whether this solvent can take another round of dry cleaning or do I have to change it that could be done.

Again, the filters how would you check their quality? We could do visual checking every day, that we could do. No rust gain, a good check is going to be of course, doing the proper rust checking. But we could do it in a shortcut manner; we could do it by doing some visual checking that could be done. What about the firm press? If he changes them every month, they are going to stay firm. If you go beyond one month with the same presses, they are going to become a little loose and soft and so on, they would not probably provide the kind of pressing that I want on my shirt. And of course, we have to also have to make sure that we maintain the equipment in a good order and for that we should probably have maintenance done on every month basis, plus on a as needed basis. Then, what I do with the QFD process, with the house of quality process is I also snoop around I do a bit of intelligence gathering.

And, I perhaps talk to the workers who are working in these other two places, other two or three places and I ask them what about you guys how good are you, how good is your cleaning? And, for this what I could do is, I could do some mystery shoppers, I could send some mystery shoppers they will carry some you know some dirty shirts and so on. And, they submit to those different business and they look at their performance they will come back with some ratings, that is basically industry intelligence which I have got on the right hand side. And, there they will try to judge the performance of my competition. With that what they will try to do is, they will try to set my own target. My target is x, x is my target. What I am trying to do is, I am trying to set a target relative to the other guy, so that I can outcompete them in the market place. That is what I would like to be able to do.

I do the same thing for specifications also. Having done this, I have a design for my shop. I know what kind of training I require, I know what kind of solvents I require, I know how frequently it has to be checked, I know how it is could be a basically look at how I am going to be looking at good equipment and so on and so forth. All these will be done stepwise. And, you will end up with a design that is bound to succeed because you are taking look at all different things and you are looking at in the end, you are also looking at performance. This is something that was actually innovated by the Japanese.

Let me give you a little story here. The Japanese as you know they are value add people. They will bring raw material convert it into some product, they will sell the product. For example, they buy iron ore from India and they take this iron ore back to Japan they will load up the ships and take them to Japan. In Japan they refine these ores and they raise the concentration raise, the iron content of these and they have a rich set of ore. Then there are certain plants worldwide that can only work with these rich ores and the Japanese then sell these rich ores to those companies. Indians do not do that. Indians are happy just selling it to Japan and the Japanese take these concentrated ore they sell it to those business.

Then they begin some special type of ores and they produce some special steels and they sell those steel then to other countries. They will bring some special type of steel, they will convert it into some machine tools or something, they will sell them. So, every time they are bringing in something, they are adding some value and then they are making the sales. At one point they realize they produced a lot of steel and what they really found

was that people did not really want raw steel, they wanted products made out of those steels.

So, immediately struck them. Well, what can we produce that could use a lot of steel? We produce a lot of steel and one product that uses a lot of steel is the ships, ships use a lot of steel. So, the hull of the ship for example, it uses a lot of steel. One ship uses thousands and thousands of tons of steel. So, that is like if you produce the lot of steel, why do not you make some ship hulls? And, if we just thought of ship hulls, why not make a full ship. So, they in fact, started producing full ships with the steel that they were producing.

But what happened was, when these ships they obviously, had to be sold, they were not used for domestic consumption. These ships had to be sold, these Japanese brought in the customers they showed them the different ships that they had in their yard. And, they said in the Kobe ship yard they showed the variety of different ships that were there and the customers they looked at those ships. They said well, the ships are fine, but I do not like the three layers of decks that you have there and I do not like the mask there, I do not like this, I do not like that.

What the Japanese found was, because they had no contact with the users, they had basically produced the wrong design. They had produced a ship for which there was no direct market. They had to make some, make some changes on the finished ship and that would cost them a lot of money. This is something what the Japanese ran into. So, they said how do I prevent this? There is a one way to prevent that is to do this, is to do QFD or do this house of quality. We find out we start by talking to people who are going to be purchasing those ships, we find out their requirements. Then, we plan the details of the ships and we try to find out, what the competition is doing? We will produce the ship that is going to meet in the requirements of my customers better than how it has been done by other people. Then of course, I will have a ship that will sell better, they started they started this practice and they succeeded with this.

This is how they still produce their automobile, their electronic parts, their cameras and whole lot of stuff is done by doing this QFD process. And, QFD is a very popular process in Japan, many of the countries they have also looked into this, they have also started using bits and parts of this and this by far the most effective way to try to

maximize customer satisfaction. This is where you set targets, remember, I told you about target like my size 42. How would a person design a shirt for me? He has to talk to me, if it is going to be for me the custom design shirt, like they do in Bangkok for example, they will do a custom design shirt. They have to talk to me, they have to make measurements on my body, only then my satisfaction is going to highest. I will continue with this. Thank you very much.