Six Sigma
Prof. Dr. T. P. Bagchi
Department of Management
Indian Institute of Technology, Kharagpur

Lecture No, # 01
Concepts in Quality Management-1

Good afternoon; this is Tapan Bagchi, I have a series of lectures prepared for you, it is on the topic of Six Sigma, which is right of the front here of quality management these days. I have actually three sessions, the material covers two sessions, but I am going to stretch it a little bit to give a little bit more time to understand, what is going on here.

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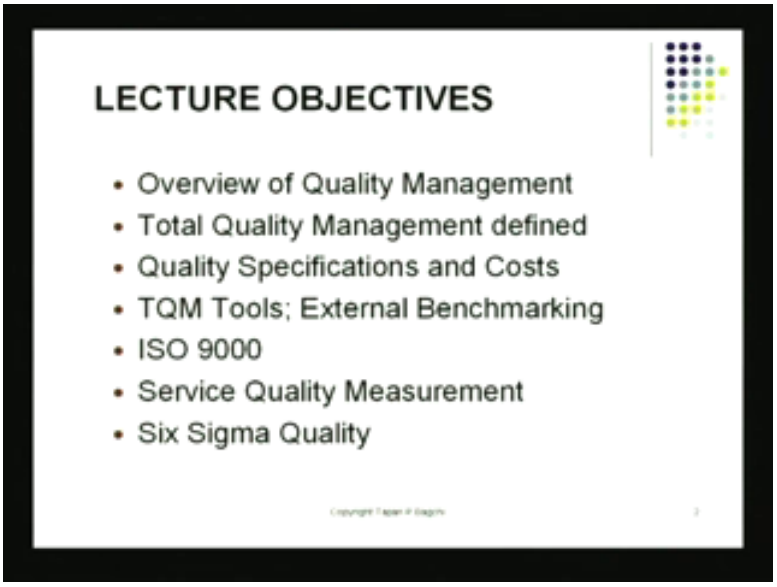

So, let us start with the very first lecture, which is going to out going to be outlined by this. The lecture objectives are an over view of quality management that is what I will try to do; then I will discuss total quality management. This is a special approach to managing whole activities that relate to quality. The third thing I will do is, I will discuss to some degree specifications, which are away to convey customer requirements, then something called quality cost, then also I would be a discuss right here. Then I will briefly outline some of the tools, these are called TQM tools, these have been popularized by the Japanese and we are now use worldwide.

And I will discuss the basic tools with you and you see their role in controlling quality. Then of course, I will give a little Grimes of benchmarking is; and will take a look at ISO

9000 very briefly. And the same thing, I will be doing with service quality management then of course, full round it off toward the end of the third session of this series, we shall discuss Six Sigma Quality. So, let us get on with this.

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Quality has been defined variously, if you see the definitions of qualities, some people call it perfection, some people what interested in getting delivery of goods some services. They would like to see quality employing fast delivery then of course, we got providing good and usable product of such actually, one of the requirements. That is all sometimes quality is defined. Fitness for use - this is the phase that was use by Juran, Joseph Juran is it this is a phase we should be using when we discuss quality. So, other people thought elimination of wastes thus something that link to good quality. So, that will be there. Then persistency or variance reductions that also turn out to be one of the objectives how perfect quality.

Then of course, you know, if you have good quality, you will do it right the first time that is like one of the objectives for some people. Then delighting of freezing customers particularly, when competition become strong that point people would select out your business out of the large number of choices they have, they are the people who would like to be delighted or they would like to be pleased, when they have it business transaction with you. In fact, this totality can be completed by this phase called total customer services and satisfaction. And of course, alongside go combines with policies

and procedures, these are these of the different indications of they have being quality that is what is meant for we discuss quality today.

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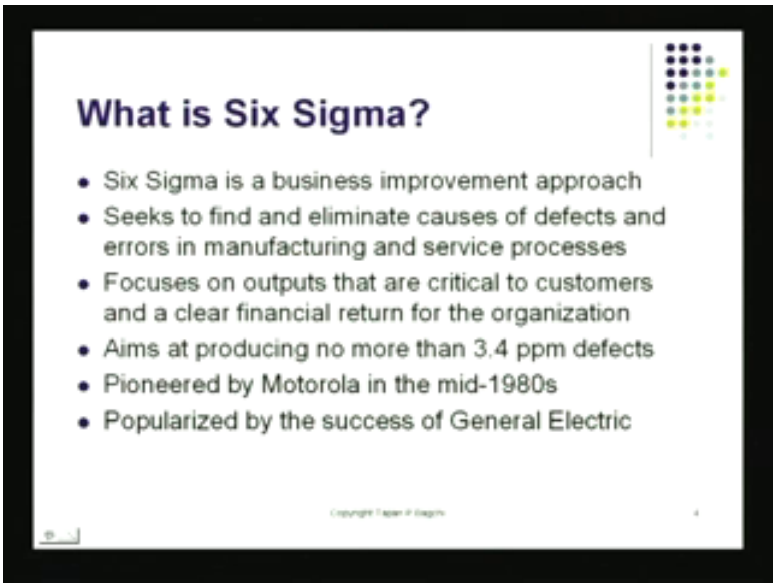

Now, what exactly six sigma, because this the theme of this particular lecture is six sigma, the full series addresses various aspects of six sigma, please take a look at what sigma six sigma really is. It is a business process improvement approach, the focus of six sigma is on improvement on the attainment of a quality of final quality level or defect level, which is in parts per million that is a pretty good level of quality. If you look at the products and services around us you probably you agree, that if I can deliver defect levels at (( )) level, when it is one three of four parts per million that is pretty good quality; thus the objective of six sigma, thus the ultimate objective of six sigma. What does six sigma really try to do? We try to eliminate causes of defects and any errors that there might be in manufacturing service processes that is something six sigma tries to do.

It focuses on the output and those particular outputs that are critical customers, and also six sigma tries to look for a clear financial return for the organization, just delivering this. And as already mentioned as I have already mentioned, the objective of six sigma is to reach defect level that is only in parts per million. Who is started all this, it was one company that was almost ready to go under they had loss their market shares from being ninety percent to ten percent.

And this was the Motorola Company that provided these handsets, they came way before your cell phones and mobile phones, these were handled telecommunication sets. These were there was a time when Motorola had the monopoly in this business, but there was a time again when the quality slipped and as a result the Japanese and other many others surprised they started providing the same product. And the quality was much better with them, these competition comparative companies and about (( )) started to lose it is market share and it came down to the point, when it have only ten percent with a market share that it usually, have that ninety percent level.

And the company that actually popularized six sigma was GE - general electric this one person, if I do not mention his name it is story will be complete that is Jack Welch. He was the CEO of general electric, and he saw the results at Motorola, and he decided this was the way for GE also to go and of course, many, many other companies they have followed the same route. So, the company that actually, started this was Motorola they started the six sigma movement; the movement toward excellence and the company that popular is the practices and processes, it was General electric.

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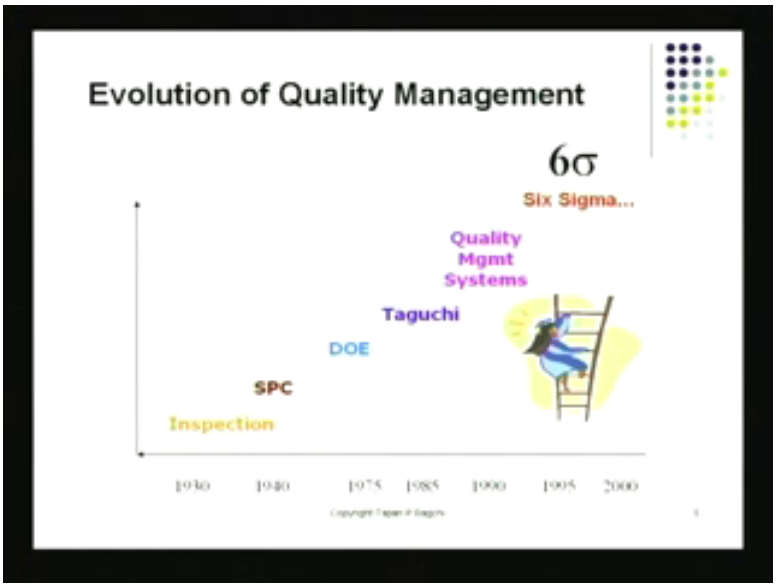

Let us take a look at the march of quality, and how the movement in quality, in quality assurance how it was evolved over years that can around ninety thirty, which is the time when long time back people produced items that were generally one of a kind like you built a particular building for example, like Taj Mahal is one of the examples or they

were a many pieces of hard that were produced one of a kind, they have of course, quality assurance first done by the inspection. Basically, it was either the (( )) itself he did the inspection or the receiver, the they gentlemen was actually, paying for this out of it, he would be doing the inspection.

And inspections turn out to be the only means to control quality that stage. And that was fine, if your production rate was quite small and it could is inspect each of the items. If we could do that there was generally no problem, but the movement it was a matter of mass production. You have to produce the same sort of thing in multiple, multiples, then you could not really inspect one, then the next, then the next and so on so forth; if you doing that forever you will be doing only inspection at that point people realized what we need to do is, we need to worry about the process also.

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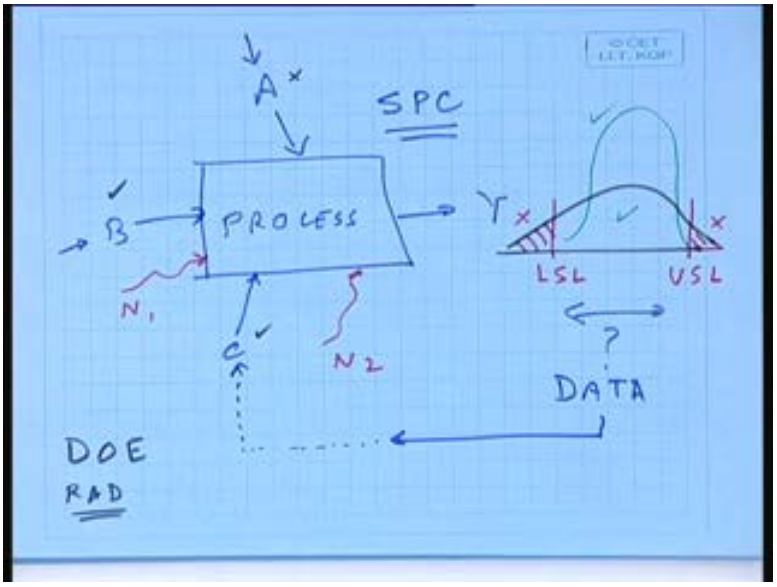

So, they looked at for example, I am going draw little box here, which is a process, any of the output, which is really, what the customers interested in and the process itself is basically, impacted by many different factors; alongside these factors that are public control factors you control them there are noise factors also. Noise factors are generally, not in a control; the result is this that in instead of getting one single output, output point, you will end up a distribution that will look like this, which are really showed variation. It turns out in such a case, that many times what is acceptable to the customer is not for this delivered by the process. So, if I draw these two limits and I call them upper split

limit, lower split limit, I notice that there are parts of production, there are fraction of production, there are not acceptable to the customer. Now, I cannot sell this stuff and I also I cannot sell this stuff; and what I can really sell is what is in the middle, this is the part I can sell. Now, couple of things we have to remember. This variation, the variation that you see here, this variation is doing call, because not all these factors they are in your control they do not stay exactly where you set them. They tend to change a little bit this way or that way. That actually is meaning; that actually is suggesting that the process itself is causing some variation.

So, is there some way by which I could control the process, and I could make sure most of my production is in this range, which is the acceptable range. Can I do that? That was a question. And there was a gentlemen, and he work for the western electric company, his name was Walter Shewhart, Shewhart came up with the idea that if I observe the output, and I collect some data from there and depending on what I want to adjust, if I can utilize that data to come back and control these factors or we controlling the process and there, by I will be controlling the output. And it is very possible, if do it well my production would all turn out to be acceptable and my production would be sort of like this, which is ok, because I could in business with this sort of output.

What I am doing? I am collecting some data; then I look at some aspects of that data, which is going to be useful for me. So, I take some (( )) aspect of the data and I basically, do this statistically a look at the aspects of the data that really have some value to be then I use that feedback and I do that a utilize that feedback to try to control. This process where will solve it, sometimes controlling this one, sometime I will be controlling this one, sometimes are we controlling that one what I am doing is? I am using data to produce the feedback and the control action takes place based on the deviation from when you expect the output to be of this deviation. Of course, it is detected statistically by using what we call control limits.

This whole approach is called SPC stands for statistical process control and as you notice here on this chart that I have here SPC turns out to be right here and this is the notation basically. This actually tells you the I am not just inspecting the product, but I am looking at where to control the process this was one way. Of course, for a long time people then started using SPC, there is what was done in the 1940s in the fifties also. People were using SPC, but at that point a question came up as to how do you know, if

you go back to the figure here, how do you know whether should I control factor A or should I control factor B or should I control factor C. This was not known that point was there are methods or could we device a method by which we could really say.

We can leave A alone, because they really does not have much impact on y, but yes you have to control b and you have to keep an eye on c also, because these two are factors that have an impact on y. So, here when I am talking about is I am caught I am discussing basically, I am mentioning a cause on effect relationship. These are the causes there is a effect there what basically, would like to do is would like to find out. First of all, which of these control factors really have as an impact on y and which has a strong impact, which factor and which factor has not such a strong impact. This can be found a technique that is called DOE design of experiments. So, then SPC moved up to DOE the job of the COE who will be doing this DOE, SPC could be done by production people. But DOE is more of a research nature DOE is to be done by r and d people research and development people.

Their job is going to be to discover knowledge really to find this dependency between the causes and the effect, this is to be done by r and d people they are the one you utilize this technique of DOE. And you will see right about the middle of the page this phase DOE is written that design of experiments is the special way to try to improve a process. I will be discussing, this as be go deep into this I will be discussing, various things about DOE, then I will do that and in the lectures itself, in the third part that I have here I will be giving you some glimpse of how DOE is actually utilize.

Now, there was somebody his name was Genichi Taguchi in Japan he utilized he utilized DOE in a very clever way he said he found out the two third of the problems. That actually, was found in the field with bicycles, cars you know plastic products watches you name it, two third of the problems could be trace to what we call the design of the process or the design of the product.

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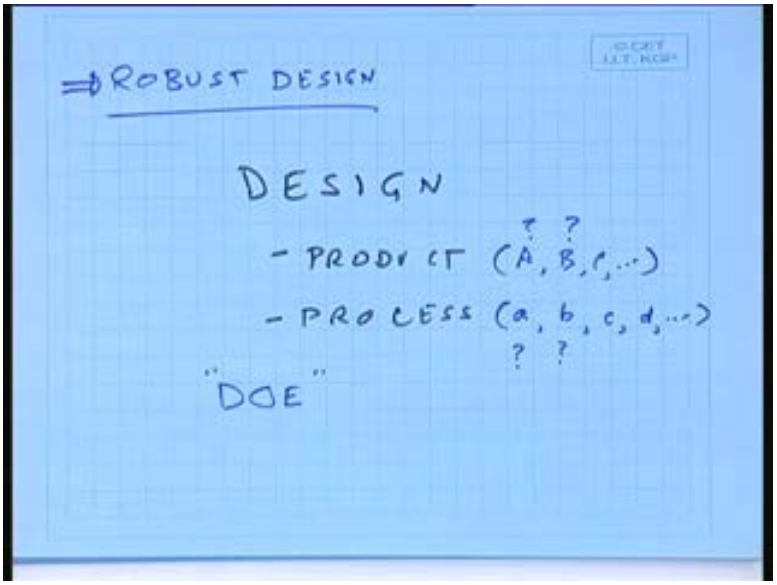

So, design then became major culprit the focus they shifted from that being on the process people started to worry about optimizing the design. The design of the product or the design of the process these, two then became the target. If their purpose (( )) was what I described to you just a little few minutes earlier, they try to find out which of the factors which of the design factors A, B, C etcetera, which of these freely work the influencing factor as for the response of that product was concerned. And the same thing, will go for the process also I have other factors little a, little b, little c, little d and so on. Again the question was which of these really was the critical one? This could be found if I did DOE.

So, turned out that in design development DOE became a big tool DOE or design (( )) became a big tool to try to come up with good designs. This was done the first time for this gentleman, their name is Genichi Taguchi, Taguchi was the gentlemen who for the first time he came up with this idea of trying impact design, and he came up with some very special designs. One of the designs from the kinds of designs he came up with is got robust design all given an example of robust design as we go into the thing you will find. These are very special designs and they hold down to their performance even, if the environment becomes hostile.

Even, if there is dust there is humidity there is high temperature low temperature whatever vibration and so on so forth or component qualities are that god even then a

robust design will retain it is performance does something that is a very special type of design and Taguchi was the father of that kind of creation. Of course, you will have all these techniques, but we all know you can put things together, you can put people machines materials all those things together, but unless we have proper management system think study will port very well.

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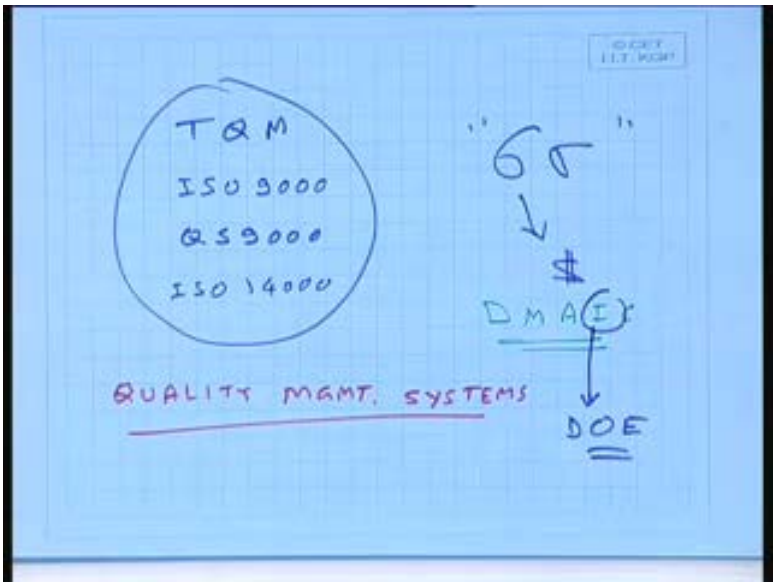

So, their people again, shifted their gears and they figured out for (( )) is needed to do was have appropriate quality management systems. One of the quality management systems that is actually, pretty common most of you heard of it is called TQM total quality management. And there is something all be talking about as we go through this particular lecture are we discussing TQM that is what all we doing. And there are of course, systems which are not as comprehensive as TQM, but there are also pretty decent systems and one example is I S O 9000 it is also a quality management system.

So, neither TQM nor I S O 9000 does directly control quality it does not do that, but it provides you with a favor provides you with a management system. And if you go through the process of TQM or you go in to the steps of ISO 9000, you will end up with good products good output high level of customer satisfaction and high profits also. This is something that invariably comes around, if we use a good management system and of course, other systems are also there for example, QS 9000. Then of course, you got something called ISO 14000 with a slightly different agenda.

So, I will be discussing these of are we go now, but do remember these all different things they are different they distinct quality management systems. Thus for these things are these, are quality management systems. These are systems within which we operate and we try to get good performance and they covers various things may it turned out in the sixties and seventies and eighties may people they try to go TQM route many people in the eighties many companies they try to get the ISO 9000 certification and many part supplies they went for QS 9000 as an example.

So, various systems for tried on the shop floor in the management of quality many different systems were tried, but it turned out into in many cases. This freely did not and peg the bottom line of the company; that means, the profits of the company it did not did impact that much otherwise a reason. The reason was most of this was sold most of this was presented in the form of philosophies they really not given as two's they have to directly impact profits it was not presented that way. The agenda actually, was something different what ended up happing was people well started looking for wage two basically, lead TQM aside I know about companies that you should official they must first to say that yes people should go through the TQM training.

Then after sometime after couple years they said we are going to stop all these TQM meetings, because they are just a waste of time. We do not say results impact in the bottom (( )) then of course, a bit problem came along people then say started saying how do we change things then how do really impact that bottom line that is when this six sigma movement came along. And you will see as we going to this six sigma is a procedure that really has an impact on the bottom line, which is dollars, because six sigma is conceived land in prevented executed in a special way you cannot start a six sigma project unless you can foretell unless.

You can project the impact of that particular project on the bottom line unless you are able to do that justification. You are not supposed to really start to six sigma project and when the project is complete. You are supposed to do a audit go and audit and figure out really did I get those saving, this is something that is must four six sigma projects. So, this is now quite different from the TQM approach, in TQM you essentially talked about good practices you. It is for good health you have to take a walk in the morning you have to avoid cholesterol you have to do a bunch of things, but really as far as in our normal life is concerned.

We really do not come back and see make a measurement of our blood cholesterol for graphic after taking a walk we do it on faith. And TQM was suppose, to be it was actually package and presented that way, if you do certain things it will be good for the company it will impact quality and so on. But people were not able see those results on the bottom line this changed the movement people moved on to six sigma. Because six sigma was launch project by project by project and I will give you the framework per by I will show how you the pick the project how decide what project toward to work on how you work out the justification how you execute the project.

Now, you come back and verify the (( )) s indeed of got those materials those results materialized. How I do that this is done again, for six sigma with a special framework at that framework is called DMAIC define measure analyze improve and control this is a special framework that is used in every six sigma project. And this is not a easy process the denote process is not a easy process obtain about a does not denote project and (( )) is not very easy. First of all, to retain the discipline make sure that you can get the justification done, justification worked out in real rupees and paisa, this is what you to do before you start the project.

Once you done that you have to define, really what is critical for the customer, then you have to go into this measurement business, then you have to do some analysis and you might be using some TQM tools like the cause an effect diagram the you know, the fish pound diagram for example. You that you do four charting, you do mapping of the process and so on, then you identify factors for which will be playing. Basically that is when you enter kind of the r and d shop from being in quality management. You enter the r and d shop and it do some actual experiments, this is how improvements or sort improvements or sort in the six sigma framework by going to this step which is called I, I is the improvement on I utilizes DOE I utilize what we called earlier design of experiments DOE is the tool at the I s I of the stage.

Once you identify the right settings for the parameters then of course, you set them at their optimum now. Optimum values and you make sure that you control them and that could be done by utilizing control charts or SPC once, if settle down basically, what the best settings have going to be for these process and thus you ultimate. So, if you come back to the slide here again, you see the March inspection basically, is the point when I am doing nothing expect just checking. If the product is accept acceptable or it is not

acceptable, if I move up from that this is just fine, when I have got a few parts to produce then this is fine.

The movements we move up from there to what we call SPC or focus I shift my focus to the process I try to do statistical process control. To try to find factors there are important in controlling the process I may have to use a technique called DOE design of experiment on if have to produce good designs. Good designs of parts products or the process I will be using the Taguchi methods then of course, the next thing is to move up to a good management system and for that we may utilize TQM or we may utilize ISO 9000 these are couple of systems that work pretty well.

But exactly only having those systems it will not produce the profit that is done by this latest system call this six sigma way to manage your quality. Six sigma is the focus of this series or lectures (( )) visiting various parts of it what we are doing that of course, we will be looking at inspection, will be looking at SPC, will be looking at all these different things, then only will be moving up to their.

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So, again, to rehash what you done so for, the very first point was skilled craftsmanship this was find in the middle ages when the product was basically one of a kind. Then when industrial revolution came along inspection the volume inspection went up. And the problem was there were many items to be inspected at that time different quality department for set up there were accepted from production departments. But their job

was basically, focus on inspection only nothing more then came along the twentieth century, when people realized particular in the bell telephone company. That what we needed was something was suitable for mass manufacture their people devised this method of SPC statistical process control.

And that continue till world war two about that trying people started looking a little deeper (( )) into the process itself. And they started to experiment with products they start to experiment for product designs they start to experiment with the process and they utilize this technique or DOE design of experiments. And of course, at this time if you remember the Japanese had nothing standing of up ground, because most of the factory there been smashed upon they wanted to come back their business you know, it is a small country.

And the only where they can survive and is to get into trading that is produced something that other country is probably do not have, but they are the consumers of those products. And they have basically, quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality opened called of big push it turned out that they hired Americans , quality 0 Td (d16e30 T6x11 J 0 Tw [(842(t)-10.009(y)]TJ 0 T4)-1dd7,du

If you look at the parallel of it the way things went on in the U S for a long time U S had monopoly basically, did that for U S was only country were most of the production machineries survived. There no bomb fallings on New York there were no bomb fallings (( )) transport. So, most of those factories survived (( )) no bombing and therefore, of course, cost could be produce machines could be produced and this could be sold world over. So, the market was there waiting for them. So, whatever, and because of their agent technology and surviving technology whatever, the Americans could produce that can be sold. So, really there was no particular need any country would have done the same thing, if I am able to sell whatever, I produce what is the need for me to improve.

And that was the reason unfortunately the Americans continue to operate that way even in the 1950 and 1960 that was the time when other countries became active. They also started producing good cause, good production everything else this was actually big problem. And it turned out in that case, something have to be done, and this started looking into other means to try improve quality; and thus when the Americans also they started to bring in a awards and rewards and so on. They also started to see what is did the Japanese were doing or Germans were doing on the started to do this. This is the when the quality management system overall it was also criticized a lot and many people they were disappointed with a quality systems that were in place in those days.

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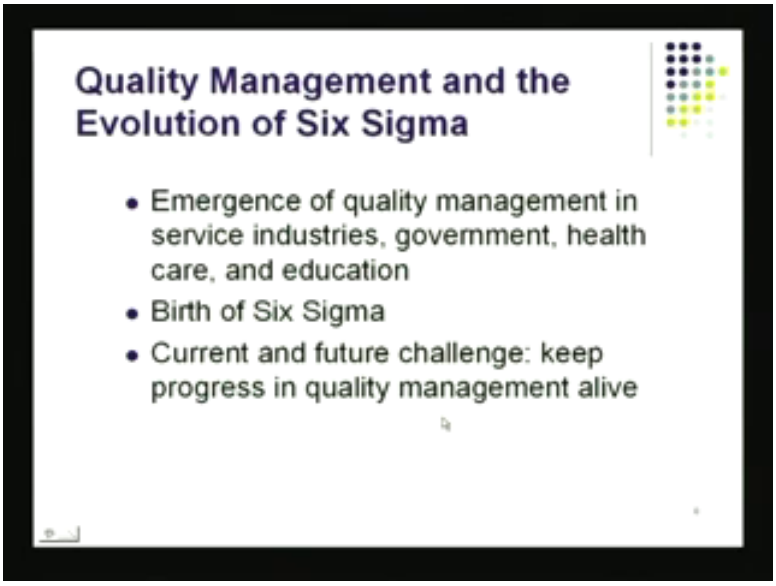

Then of course, came the time when management systems were putting place things like TQM as an example. And quality was required not only for production quality was also required for services for the of services and many of these organization that were engaged in services they also started looking at TQM tools and so on so forth on the started to impress them, they started to use them that was the time, because of competition some companies were almost on the brink of going out of business one of them was Motorola. And Motorola was the one that actually took the initiative and they thought they have to rise their level of quality to the point further level of defects claim down to the level parts per million.

And that is for the took their production and the regained a lot of business. If they had not done that they would be out of business many companies in the world they gone out of business, but very fortunately Motorola people recognize this on the use this powerful method called six sigma. Six sigma started their and six sigma was carried further into a very mature process by GE and in particular by the chairmen of g e that was Jack Welch he make sure that his vice presidents they picked up the black belt methods and so on. He himself got trained in statistics and DOE and so on. And he became an example, he became a personal example that look I can also learn, I can also conduct these securing a projects, and I can also really make an impact on the bottom line that really was the goal.

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If you look at quality management the total process of quality management it has gone through a tremendous amount of maturing how is this happen in the old days they only it manage quality was quality control which is by inspection. Quality control was the only way to try to control quality then of course, people became a bit more proactive. And they got into what is called quality assurance, which is that look at the parts before you put them into your measurements system before you do this for many look at the quality of parts that you have do more extensive inspection do sampling and so on so forth do those things. Then of course, people realize that because there were so many activities to be managed in the delivery of quality at have a planning system implies.

And such planning systems are brought out in systems like quality management systems such as ISO 9000, they give a formal stage. In fact in the total process ISO 9000 commissioning you go through a stage and at some pointing time. You say I am going to be doing planning of quality, I am going to really figure out all the different steps that are go got to go through for example, a lot change my people or to calibrate by instruments how to check by some plus how to check by process have to make sure I do some trials. All those things have to go through in a very systematic way and this can be done only, if you got a good plan. So, that is the higher level of maturity you have and once you got a plan at that point, you realized, you need some special tools special training and so on so forth that also would be coming as you go along as it is indicated by your process plan.

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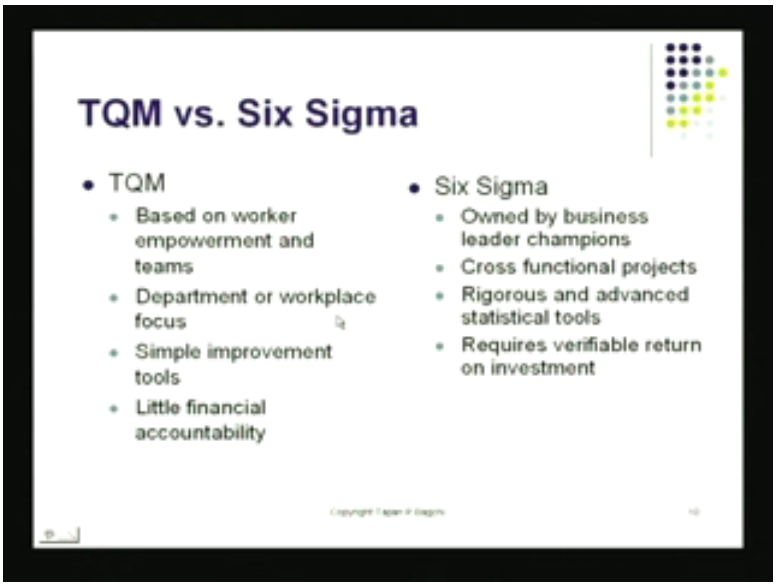

Let us take a look at a couple of things for example, let us look at the distinction between TQM and six sigma. This probably has been the biggest revolution in the world of quality management in the old days like I said in the forties and fifties and sixties TQM was the way to go. In fact, in the sixties and seventies, most companies, they did a lot of TQM training the train people on the seven tools and so on and so forth, they set of quality circles they do a number of other things that would be consistent with the TQM philosophy, but the state at the philosophy level.

In fact, a turned out TQM says the following things it says you should empower the worker. So, that he can discover problems and he can fix the problem themselves he should also TQM also says, the focus training should be the workplace, because that is for quality can have can be impacted in the maximum to the maximum extent. If you doing TQM you will be using some simple tools of improvement like the seven tools of improvement and I will give some examples of those, but unfortunate TQM does not really worry about the dollars and cents or rupees and paisa. TQM has nothing to do with financial accountability, if you do TQM you are doing it, because of faith you that you have in this quality management system contrast that now with six sigma.

Six sigma is lead by business leaders or champions not only by workers basically, six sigma is launch project by project and each project is approved at the highest level. But people who understand what is going on they no quality they also understand basically, finances and so on. They understand rupees and paise and they are the people who basically, own the process owner, they become owner, they become owners of this thing. Then of course, we have got close function projects almost no problem can be solved by one department, there is just not possible.

Now, what we have to do is, we have to really bring people they will come forward verity of different places, they will from production they may come from purchase then come from accounting and so on and so forth. They bring their skills and need to put it all together in a manner that is cross functional, then you get best results and of course, one thing six sigma does is if you look at TQM tools and you can trust them with DOE tools or six sigma tools. There is a vast difference in this statistical capability, this statistical sophistication of six sigma tools versus those tools that are used by for example, the pare to chart and the histogram and so on, which are used by TQM people

and of course, one thing that really six sigma requires that is distinct from total quality management is it requires verifiable return on investment.

If I spending some money to try to make sure, then I get an improvement, I should measure the returns in rupees and paise. I should at some point quantify the returns and that is must with six sigma project. Each six sigma project must impact the bottom line you cannot escape that. So, the distinctions again, TQM is a philosophy and sixth one is it is focus on business and in particular the bottom line bottom line is a profit line.

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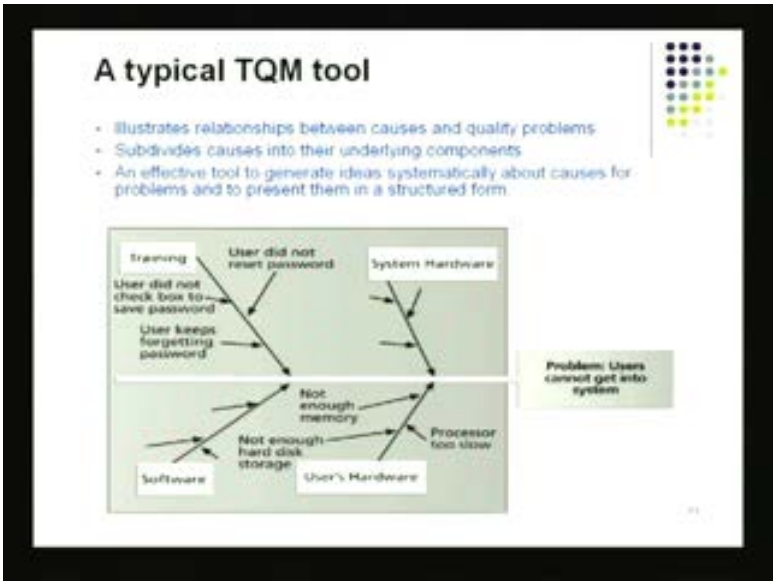

Let us, take a look at on the tools you will probably recognize this tools this is cause and effect diagram, which is also called the fishpond diagram it illustrates, the comparison the cause and effect relationship between causes, which are on the left. And the effect, which is on the right and this tool of course, is a great tool to try to do brainstorm. If you got a situation, when one has a lot debate about what might of gone wrong use the cause and effect diagram, it is very effective tool.

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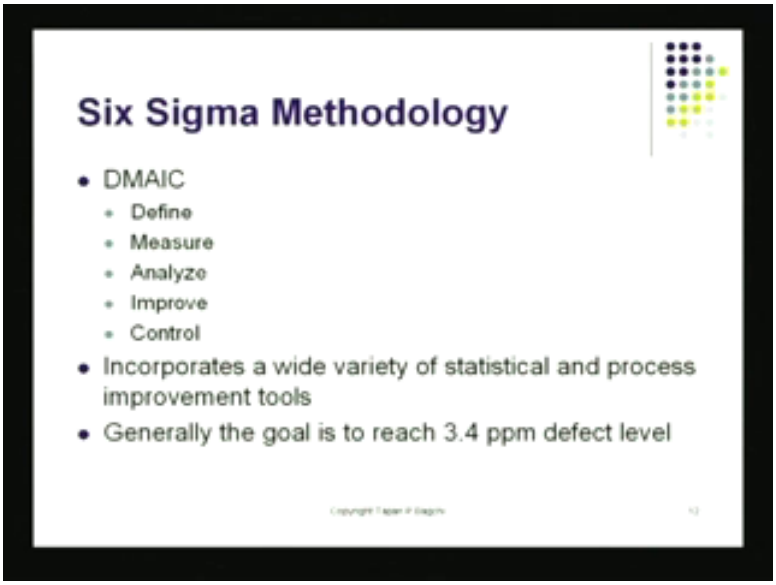

So, that is something that is take typical tool that is used in TQM total quality management. Six sigma is quite different, six sigma uses a framework and like I mentioned earlier it uses a particular framework called DMAIC. What does this stands for? It has special rules that are split all between these different steps for example; D is define what is critical to the customer and defines the deviation that his expecting that is experiencing. Then M is the state for you measure the deviation, you measure what is expected what I am getting a actually. So, define the issue other I made a measurement about it.

So, moving along this six sigma step, the third step is you analyze you try to get in you try to utilize on the TQM tools. And you try to find out, what is the extent of this problem? This is something that recursive everyday every in every piece there is a problem like this, anything that are produce it has problem like that may by the pens, if I look at the tips of the fade pens may be those tips are not good enough or something like that is that really happening to one or two pens or to all the pens that I produce stuff like that. This is when you get into analyses at this stage you could also draw cause and effect diagram and you could that that is the analysis stage.

Once analyzed and figured out that certain factors might be causing certain factors might be causing the problem you then get into problem solvent and you get into this improvement on the big tool. That is used with improvement is DOE design of

experiments, which I mentioned, if you go back to my slide here I mentioned here DOE design of experiment that is a very powerful method. What it really does is it looks at a process? It is it looks at a process, which might look pretty complicated. This process looks pretty complicated there are so many factors influencing this and if the prescription, if the experts say try to control all the factors it would not be very efficient therefore, I need this technique called DOE.

To tell me, which of these factors really is the culprit, which is the factor that has got the stronger effect and is there a factor that I can completely ignore when I am trying to really control the process? If I do it this way I can do divide and rule and if I do that I can start with a poor process a bad process like the black line. There I can get to this green process, which has got most of the production well within this specification limits this is the advantage of doing it by following the DMAIC procedure. So, let us get back to the slide here again notice here I defined, what the issue was I made some measurements then I did some analysis I might have used cause and effect diagram.

Then I do improvement for which I am, when I am using DOE and probe some of the statistically methods, then I do control, which is like when I find the optimum setting for those with different variables. And I start controlling the process to be there and one is easy way to do that is to apply SPC at the input stage also. If I do this of course, I may actually have to utilize some other statistical tools also. The result is generally that reach the defect level of parts per million. I should mention something here it six sigma does not really require all processes to be driven to the six sigma level, because there are processes existing right now that are far better than six sigma.

My digital watch this has performance that is far better than six sigma. When I it losses a microsecond or a nanosecond in some god knows, how many years? So, this is giving me performance that is far better than six sigma. So, they already got many processes that are far better than six sigma then of course, you got many other processes like for example, filling a certain amount of water in a bottle, thus probably at the percent level of defect. If this was if this distilled water was expensive all have to control the amount of water that goes into a bottle.

And they probably being off by two or three or four percent would not be very desirable in that case, I would like to reduce that to a fraction of a person still it is not really it is

not necessary, then I fill water in a bottle at parts per million level, it is not necessary, it all depends on the application. So, people say in my company, can I use six sigma? I say yes, as long as, you getting an improvement a measurable improvement and that has an impact on bottom line. You are using the six sigma philosophy and (( )) someday you will be best in town and best in the country and perhaps best globally and most of the business will come to your water bottle.

Because of the purity of the bottle there, because of the quantity that is so there and the seal that you provide and so on people would be preferring this to some other bottle that is there. So, this is something we got to keep in mind six sigma does not really mean that everybody has to go to these parts per million levels that is not necessary.

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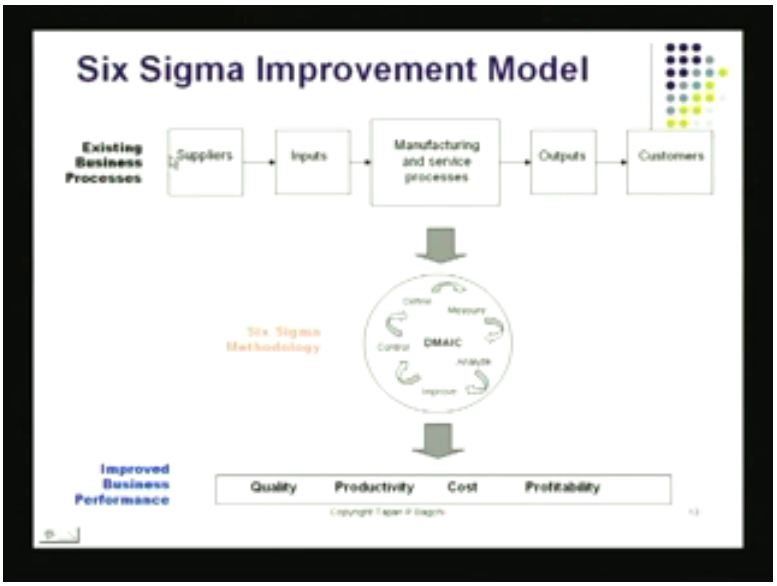

How do I do that again, if we look at the top line there that is an existing business process, it shows your flowchart. In fact, if you go from the left to the right it shows you suppliers are supplying some parts or materials or labor. And those constitute the input then I got the conversion process, which is the manufacturing or service process, I produce outputs and those are sold to customers. I take this process and I applied the six sigma of the DMAIC framework on it. What are the results? If I take this process and apply this the results are higher quality, higher productivity lower cost and obviously, higher profitability.

This is the outcome I take my process I put it to DMAIC and I end up with this. If I conceived the project correctly, if I conceived the six sigma project correctly, if I defined the charter, if I design define the scope, if you got it detailed into work breakdown structure. If you assign the task to the right people, if the using the right tools you will end up with the bottom line impact is just no escape. Because all this is based on science you cannot argue with science this has been taught through this been looked at by number of people. They have looked at these different techniques and isolated situation and what they found is yes. The tools are very effective they just have to be sequence correctly and that to be applied exactly when they are needed that is what needs to done.

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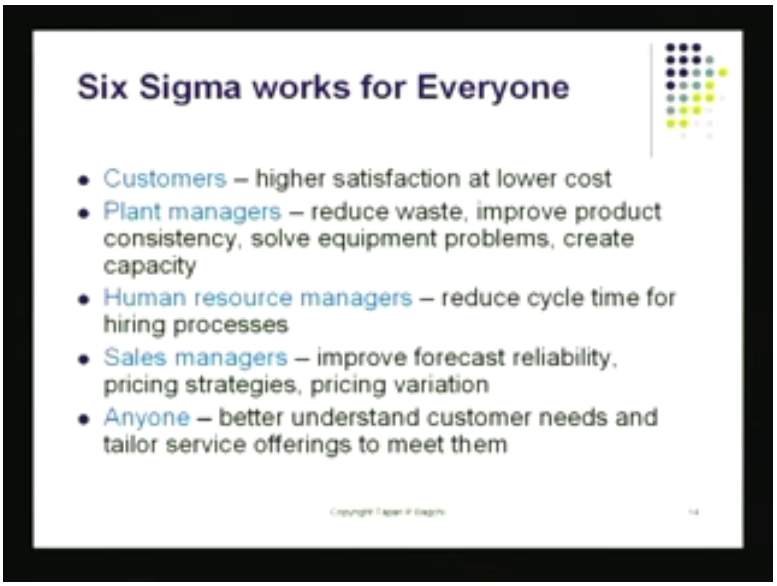

Who does six sigma work for? Six sigma now is a business process, who does it work for, who does it benefit? Clearly customers they end up with a higher level of satisfaction, plant managers, because they have less waste. If you look at if I go back to my diagram again, my little favorite diagram on the screen here. This red part is waste, this red part is also waste, because I cannot sell those parts, I cannot sell these parts these and I found assembly my parts are coming out like this. I cannot really put them into the assembly shop, because many of those parts will not pick the next stage and therefore, it is going to be waste.

So, this is a loss and this is also loss what six sigma? Does it helps you reducing this and also reducing this? Because the total curve shrinks, because the process that was the wide

like this it picks up a lower variance and if smaller variability there is a only within your requirements that is one of the objects of six sigma. So, plant managers they end up benefiting like that human resource managers, it has been seen that if it use the DMAIC procedure. They can reduce the cycle time for hiring people you are more focused you ask the right questions you are pointing things that are really that really matter. So, that is something that is done quite easily.

So, that is something that has to be kept in mind then of course, sales managers they improve a lot, because they produce they end up with better forecast. They also better pricing strategies they and pricing variation also reduces. If they are using the six sigma approach and almost anyone who wants to better understand customer requirements as an example, and he wants to (( )) their service in a way that is good to delight. The customer is really good, if you utilizes it is really going to be useful, if we utilizes the DMAIC framework that is like one of the reason why DMAIC has becomes so so important.

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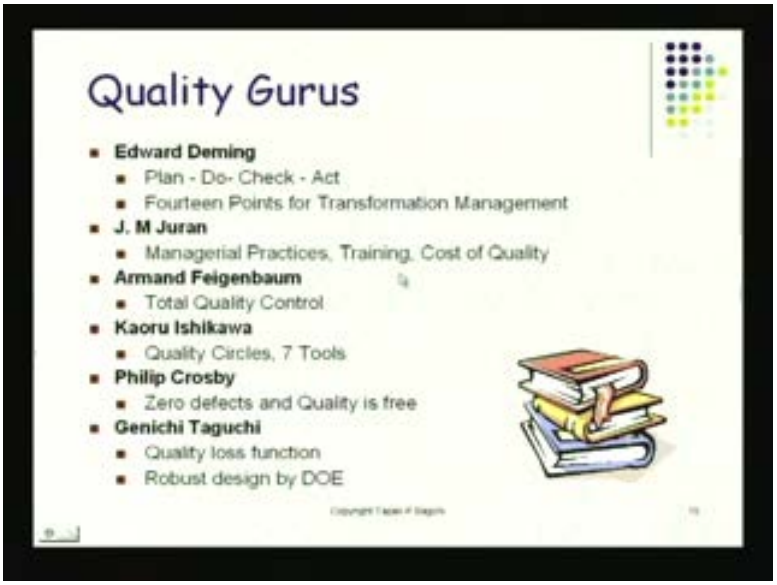

Something we have to remember of occurs, all these things they were not conceive like one night somebody went to bed and he had some dreams and he had all these flashes and so on and came up with all these different ideas. Because there are many good ideas there whole lot of good ideas is there and these ideas there have been compiled over decades and they started with what we call Deming the father of one quality movement.

And he came up with this PDCAO operating practice and also he had a lot to tell management and as I get into TQM. I will tell you exactly, what he had to say to management then came Juran another guru of quality and he also talked about management practices.

And he also talked about something very important called the cost of quality Juran also highlighted. The value of training this is said was something that many companies miss out one then of course, there was a this gentlemen his name was Armand Feigenbaum actually, was the gentlemen who conceive this idea of TQM. He could really see that TQM was not something that could be done by one person or one group or one department. A lot of people had to be involved they all had a distinct function and they have to make sure that those function they were all carried out the way in a manner that was like a people working together.

And the totality of all this was probably something that could not be substituted by no matter how much effort want particular department division made? It had to be total involvement of basically, everybody in the company. Then of course, (( )) Kaoru Ishikawa a Japanese he came with the idea of quality circles, which involves people. And people are involved in a voluntary manner Ishikawa also provided us what became later known as TQM tools. The seven tools of quality control, quality assurance, quality management that also was a gift given by Ishikawa then of course, there was a this gentleman Philip Crosby utilize the idea that was given by Juran, when he talked about what cost of quality.

So, Philip Crosby utilizes the idea of cost of quality and he said ultimately that quality is free, because you do not have any defects anymore. And the defects that you done over with the loss that you had, because you defects the rework and the scrap and bunch of other stuffs that actually, happens in the customer shop. If you are able to afford all that then the effort that you put in to delivering good quality that is really free, because you do not have these, losses and anymore then of course, the last gentleman in this string, his name is Genichi Taguchi.

And I mentioned he gave us a couple of things one big thing he gave us was the idea of robust design the other thing that Taguchi also give us was this idea of quality loss function; that means, as go away from the target. I am going to give you some examples

of this and I will give you some real life example, how they people realize that yes it make sense to go this way it make sense to go the Taguchi philosophy way that is something that will be done.

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Now, what about consequences of poor quality suppose, I do not have good quality what are the consequences let us take a look at it the very first one. And I put that in red ink the product fails my god in the hands of the customer. When the customers try to utilize that product the product is not functioning the way it was excepted to be and that really directly lead to loss of business. The product does not meet requirement that is also a result very clearly of poor quality I purchase a product no matter, what I purchase? I might be purchasing a pen, I might be purchasing a mouse, I might be purchasing a PC, I might be purchasing a piece of writing paper any of these things.

There is a requirement there is a purpose for my buying these things, if those requirements are not made. What good is this? See, if a poor quality that actually, means some of those requirements are not being made for the product, what the service? For example, haircut you know I have a certain particular requirement I want to look in a certain way I want to look like somebody perhaps or I have a peculiar style. And I wanted to be that where I want mustache trimmed in a certain way. If I do not get that, if end up with a you know, kind of mustache that it does not suite me will I be happy, I will not be.

So, there are requirements all around and I have to be mindful of these requirements. So, I am thinking of quality are to be mindful of those requirements, if not I am really moving toward what we call poor quality then of course, loss of business that is something very, very important. I have to remember that I will definitely have loss of business, if I do not really worry about quality, I will definitely have loss of business liability is of course, a big business for people who are in the insurance business. It turns out liability is such an issue it could be worth you know, the (( )) story and number of other stories, where people were taken to the court, because quality was not there. And it really had some pretty bad impact people probably loss their lives and so on.

So, forth so liability is something that was goes hand, in hand with poor quality then of course, productivity loss again, if you go back to my little favorite diagram. Here I cannot sell the stuff that is one this side I cannot all the sell stuff that is on this side. But suppose, a worker produced only this stuff, for this stuff is it really being productive forming it is only those workers were producing the green stuff. They are the once were productive in my eyes and it is worth paying them something, but the guy who is producing stuff that is landing up in the aspect area here or the aspect area here that really no good for me.

So, as far as I am concerned the productivity zero. So, I should not really at this point I should emphasize I should not measure quantity only I should really see quantity yes. But let us make sure every item that I count has quality others I have quality as number one my quantity count is going to be wrong. That is something we have to remember then of course, the bottom line is cost is also impacted, and there is something that I am going to discuss, later on which is call the cost of quality thus something also as pretty way impact if have poor quality.

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Responsibility of quality can read this it actually, says responsibility spread all around top management; obviously, they are in charge of things, they are the once call the shots; designers in the company, people who manage technology, they are the once who should also be concerned with quality; procurement people would purchase parts and labor for us, people who manage contracts for us, those are the people they should also be concerned about quality, and clearly production operation, people and inspectors they trying job is basically, quality then quality assurance people these are the people who take preventive action they certainly have a very big role to play in the management of quality.

And they are definitely going to be responsible for this then packaging and shipping people that also can be pretty vital when the package is open. Suppose, there is some damage and so on that is also is going be important marketing and sales people. They are ears and eyes as far as my business is concerned marketing and sales people they have the direct contact with the customer. There are the once who get could direct contact with customers and they are the once have to make sure that they really carrying back some messages for me. And I am going to repeat this again as going to this going to be one issue, which is like finding the requirements.

Thus one of the key jobs of marketing people and sales people finding the requirements they should also make sure that they set up a system whereby they are able to register

complaints. So, there are two reasons why I should be talking to customers the first is after find out the requirements. And the second one is to the have any complaints is the something that complaining about my process or my product these two together are pretty strong reasons why I should be talking to customers and the best way to do that is to have marketing people. And say people involved with them of course, I must say this at this point many times production people or purchasing people they know nothing about our real customers that also is not.

So, good once in a while, you should expose your people who are in the back rooms like production people the factory people and so on to the real customers; so the fellow, who drives the motorcycle on the road; and the fellow, who is assembling the various different parts, who is assembling the engine at some point in time. The user and the engine builder they should come in contact with each other, because then the engine builder will know, while here is a customer is going to be using my product his going to be much more sensitized. If you come face to face with this customer then of course, the story does not end here. Customer service and after sales these are also vital as far as responsibility for quality assurance is concerned that is also there.

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If you look at the total experience today, whether it is a car or anything else there is a product component, then with that there is a service component also. When we purchase something today, when we purchase this PC? This PC was purchased from a shop, but what we have to remember is not just I was happy just unpacking the PC and getting it started, what if I have some problem with it is that going to be services provided with this. If it is not provided probably, I will look at some other brand of PC, where services also pretty good, so not only I want to see any good product also I have to make sure along with the good product, I also get good service. This is true for automotive that couple of slide here you can see look at performance, look at aesthetics, look at special services, look at safety, then I look at liability, look at deliverability and durability and perceive quality and service after sales, all these different things are look at there is always a project, product component, there is a service component for any of these.

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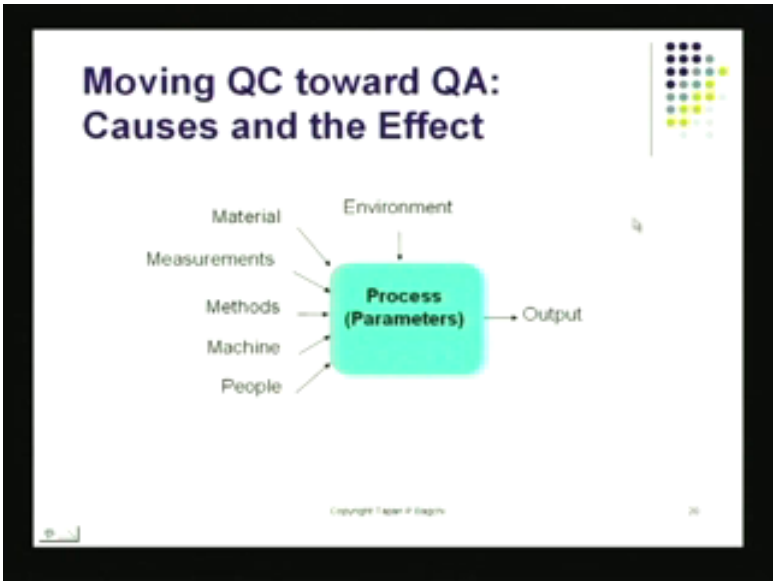

This pretty well completes the first part of what I wanted to tell you about getting on with six sigma; we will be moving pretty soon, need to how do we control that and I will be starting with this slide here, which is a system that is now taking various inputs as try to convert all of that into an output that I can sell in the market place. Thank you very much.