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Interview with Genichi Taguchi

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Genichi Taguchi

(Interviewed on 19 March, Tokyo, Japan)

Video Roll # 23

Q: Dr. Taguchi, in English, say your name and also would you spell it.

TAGUCHI: My name is Taguchi. T-A-G-U-C-H-I.

Q: Your first name?

TAGUCHI: G-E-N-I-C-H-I.

Q: Is there a title or a position that should be used with your name to identify you?

TAGUCHI: Actually, I work for three organizations: one is Ohken Associate. I can give you my card. And the second card, I work also at TSA (?). And also I ... to American Suppliers Institute, ASI. Actually, I have three cards.

Q: Is there a way that you would prefer that you be identified on screen, on the video?

TAGUCHI: Perhaps Ohken Associate.

Q: We would like to talk about the Japanese quality revolution. We, in America, have watched Japan with the belief that the Japanese are almost magicians; they have made quality like magic. And we are very anxious to learn the secret. What is the secret of the Japanese quality revolution?

TAGUCHI: After the Second World War, when the allied group came to Japan, the occupation troop came of Japan, the first problem they encountered was the problem of telecommunications. This is communication through telephone or wireless communication -- was not functioning properly.

It was for this reason that in those days, the GHQ, or the general headquarters, had come up -- in order to complete its occupation plans, they approached the management in charge of technology of telecommunications companies or organizations in Japan, and also approached the high government officials in charge of telecommunications.

And had given a three-week quality-related meeting or seminar. And this was much more than the time of Dr. Deming. I'd say this was in 1946, this seminar was held. And, at that time, of course, quality control was included in this seminar course.

But one of the most important things was that the first research and development institute had been requested by the U.S. authorities. And, at that time, the Bell Labs' R & D organization specialist was invited to Japan. And it was at that time, for the first time in Japan that a major research laboratory was established in Japan.

And the budget for that facility was the budget amounting to 2.2% of the Japanese total governmental budget.

Q: That certainly talks about how the revolution began. Japan has now been involved with quality methods about 40 years, and many companies have done very well. What has made these companies so successful? Why has quality taken such firm root in Japanese soil?

TAGUCHI: You see, this laboratory was opened, and be it whether they wanted new product or to improve the quality of products. This kind of activity, I think, had started off from electric telecommunications lab.

And this facility is a place to do designing and development of technology and so forth, but the actual manufacturing would be done by the Nippon Electric or Hitachi or Fujitsu, these electric manufacturers. These major manufacturers would do the actual production.

And so these people at the lab would work together with the manufacturers and people studied to improve the quality of products. And this was in the 1950's. And, as a result, the cross-bar transponder was a new transponder, or a switchboard. The design of this new switchboard was developed, and this was better than the design by the people at the Bell Lab.

And it was through this that the designing of new products or development of new products. Many companies were able to learn a lot of this activity conducted by the manufacturers and the lab.

Q: May we talk about Dr. Juran, who did not come here as early as 1946, but came in the early 1950's. What

contribution did Dr. Juran make? What are the lessons that Dr. Juran taught to the Japanese?

TAGUCHI: You see, where telecommunications -- as I've explained, given you the explanation -- but other than that, like the automobile industry or chemical industries, these companies involved in these industries were not so aware of the quality problem.

And then Dr. Deming came to Japan and had emphasized the importance of quality of products. And so companies other than the telecommunications industry also came to lay more importance on quality of their products.

But in actually improving the quality of their respective products, not the management people, but maybe including the middle management people, they have to consider and have to come up with a strategy for quality control. And, in doing that, Dr. Juran had given various suggestions to these companies.

And Dr. Juran's Quality Control Handbook had been translated into Japanese, and many Japanese companies, I think, had studied from that handbook.

Q: What subjects that were present in Dr. Juran's Quality Control Handbook proved, and have proven over the years, to be most helpful to Japanese companies?

TAGUCHI: Well, I think that this quality issue is to monitor the quality and make plans of the quality of products. These plans and checking or monitoring is one aspect of quality control.

But I think the most important thing about quality is the improvement. The act of improving is, I think, requires a production technology and a designing technology.

But, other than improving the quality, I think the inspection of quality, evaluation of quality, analysis -- all these things is, I think, the role to be played by the management.

. Q: It is an honor to have your here. There are a very small number of men in this world who have made such a study of quality methods. As a colleague of Dr. Juran's, and someone who has grown up with him, how do you see the value of Dr. Juran's work?

TAGUCHI: Dr. Juran, vis-a-vis the Japanese top management people, and also the middle management people -- these people's awareness or consciousness of quality and administration, these areas are the areas that Dr. Juran had covered in terms of giving suggestions.

It was in this way that he was able to awaken or raise the awareness of the Japanese management people's attitude towards quality, to improve quality. I think he had proven to be a driving force for these people.

Q: In many years, someone will write a history of the quality revolution in Japan. There will certainly be a chapter on you. There will be a chapter on Dr. Deming. There will be a chapter, we hope, on Dr. Juran. Years from now, when someone writes the chapter about Dr. Juran, what will they say about Dr. Juran's contribution to Japanese industry, the

Japanese economy, and the Japanese role in attaining world leadership in quality?

TAGUCHI: Quality control, in reality -- you see, the control of quality and improvement of quality are the two issues. And, of course, if it is not controlled well, then the quality would decline. And so the control is very good. And it is this aspect of control of quality that Dr. Juran had given this big impact to Japan.

For Dr. Deming, I think he had taught the top management that quality is important. But if the middle management people do not put it into action, then it would be of no use. And so even if the top management knows about it, if the middle management doesn't then it would be of no use. And that's what Dr. Juran did.

Q: We have spoken to many people who have said that what started quality was a crisis. Quality was a response to a crisis. As we in the world look at Japan now, Japan is no longer seemingly in a crisis. Its products are world class, the yen is strong. And we in America look to Japan as a teacher. What is going to happen to quality in Japan now that there is no crisis?

TAGUCHI: I think quality issue is more of a general issue. And, you know, there is severe competition amongst Japanese companies domestically. And in this domestic competition, there is an issue of quality, cost, productivity, and so forth.

And in terms of productivity, within Japan there are many, many companies, and they are in severe competition with each other. And this kind of competitive environment had

strengthened the Japanese companies. And, in order to be more competitive than the others, the problem is a development of technology.

And this technological competition is very severe in Japan. It is for this reason that the top management people of the Japanese companies are always looking for improvement of quality and improvement of productivity, which boils down to the problem of product design or the improvement of production technology.

And the top management made investments in these areas. Compared to the United States, I'd say Japanese companies are using many, many more times the number of people than those American companies. And so, needless to say, Japanese technology had really made rapid improvement and growth.

And what I'm really jealous of the American companies is that the top management of American companies spent a lot of money for R & D. And R & D is more of a basic study. And the result of these basic studies would be commercialized, would be reflected in the production line. And this reflection of that study onto the production is not very smooth.

In Japan, we don't do so much of a basic study, but it's more a production design and improvement of production technology, and so forth. And so it's more investment on some things that are directly related to products. I think this is very unique of Japan.

But, from now on, what Japan should do is to do more basic studies, which should be reflected in the products. And the development of new technology, I think, is the place where more investment should be made.

And the development of technology also, the rationalization of development of technology is another issue that needs to be addressed by the Japanese companies.

Q: In our role as a teacher, you go out and speak to people. Sometimes they listen; sometimes they don't. In the 1950's, when Dr. Juran came to Japan, the Japanese listened, but the Americans -- where Dr. Juran grew up and lived and wrote -- didn't listen. Why is it, do you think, that the Japanese listened and America does not?

TAGUCHI: Well, in those days, the Japanese management were fully aware of the fact that be it in terms of quality or productivity, that Japan was behind other countries. And that's why, in order to catch up the United States, they had ears to listen to the American specialists.

And they had no intention, whatsoever, of just ignoring an opinion of an American. And that's why Japanese top management and middle management people really tried hard in order to listen to the United States and to give everything a try.

Q: Do top managers, very senior people in Japan, look at their companies and the quality differently than their counter-parts from the United States?

TAGUCHI: Well, in the case of Japan, because there is severe competition of the product itself for its quality and the cost of production, and so forth, and that's why the Japanese people have great interest in the product itself. Spend a lot of money, and invest, to come up with good products, like be it

the product designer or engineers for a production technology, and so forth.

They have many people, amongst the employees of these organizations.

But in the United States, they use so much money for basic studies. And that's why, in that sense, the United States, the Americans are doing more on the basic studies. And I think that kind of approach is better, and is correct, than the Japanese.

But the problem is, from the basic study to the commercialization of that study is a problem that needs to be addressed to by the Americans.

But, in Japan, we have two hurdles to overcome: one is to be it product quality or improvement of the production technology, and so forth, is the emphasis put in by the Japanese companies. But I think more investment needs to be given into basic studies. But even if basic study is done, if that cannot be commercialized, then that is going to be another problem, too.

And so, in order to come up with a practical basic study is one issue that needs to be faced by the Japanese. But, for the Americans, they've already been doing basic studies, and so they need to put more emphasis on how to, very promptly, commercialize their basic studies.

And so, in that sense, I'd say the American labs probably have more understanding to, for example, what we are promoting here in Japan.

Q: You have been -- here in Japan -- practicing quality methods for 40 years. But in America, in response to a crisis, we've been doing it for maybe five years or ten years

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at the most. You are much farther down the road. What have you learned most recently through your great experience that you could communicate to us in America that might help make our journey down the road a bit shorter and a bit more productive ?

TAGUCHI: As I've mentioned at the beginning, I first joined Telecommunications Lab and worked on switchboards, and so forth. I worked on the development and designing of these switchboards. And it was at that time that I really felt that a good quality, robust product is very, very important. That a robust, strong product, that has a long life span.

And I helped with the development and study of these products. And how we approached this was, of course, we studied using the actual product in front of us. But after that, I really felt that from the basic study level, that we should come up with a technology and design of a product, a better product, which is more robust, and so forth.

And I think- this kind of attitude is accepted by the Americans, too, and it is starting to be accepted by the Japanese companies nowadays.

So what I learned was that on the field, through actually getting involved in the development work, I was able to come up with various methods and ways of doing things.

Q: Sitting here now, it makes it appear that quality improvement is almost automatic. There is the wish, it's done. We know it's very hard work to make a whole organization move in the same direction.

TAGUCHI: I was directly in charge of those studies. If you go to the production line, it's the people working by the machines. But the product design and the production technology is the problem -- is the issue.

And the management people, particularly the American management, they cannot come up with a design on drawing paper. And in production technology, too, there are very people well versed in that area. Most of them are from business schools.

But the quality issue is determined by the design and production technology. Control is a problem that comes after that. Of course, it's important, but control cannot improve the quality.

And that's why, for example, the product design, to make it small in design, and so forth, is the designer's problem. To come up with a product that is very strong in a certain environment is done by the designer and the developer and so forth.

And this production of robust product, a robust production process, I think, right now is the issue faced by the American companies. But in order to come up with such robust products, and robust production process, manufacturing process, you need the engineers. And so it's a matter of training the engineers as to also ... the quality issue as they work in their designing and development.

Q: We talk about engineers, we talk about designers. In many companies, the engineers sit over there, the designers are over there, sales and marketing is there. How do you bring all these people together early in the process so that everyone works together.

TAGUCHI: In Japan, I think, that we were successful in that area. I think this was probably the real contribution to the top management, to come up with product plan, and then come up with this design. And then, after the design is completed, then to go into the manufacturing process.

This planning, designing, and production technology I think Japanese companies cooperated with each other. And I think this is one good point of Japan. But also is a short-coming, because where would the basic technology come from. That it needs to be brought from somewhere.

And when they get the basic technology, and to commercialize that into a product, this requires time. It's a time-consuming process. And, at that time, the Japanese designers and the engineers -- there are many designers and many engineers, I think, many times more than the United States, for example, it is said.

Q: Is it a process that starts designers, engineers, or do everyone work together, cross-functionally, in the beginning?

TAGUCHI: It depends on the company, I think. But not all. That's why production technology can be developed as a technology. But, in the United States, the study of production technology and the product designers, ordinarily they don't work together.

But there's a concurrent engineering is another focus of attention nowadays. This is consultation with each other. But they would, at the same time, go into their own development and study. But at time, the most important thing is the robust process and the robust product.

But I think it's very easy for the United States to surpass Japan. Because they can do the basic study. And to come

up with good basic study is very good. And that's why it will be easy for the Americans to surpass Japanese.

Q: How do Japanese senior managers decide how much improvement is enough improvement in a year? How do they select their targets for improvement?

TAGUCHI: I think there are two kinds of improvement: one is quality. Of course, for quality is to have the better quality than the competitor. And the result of it would be reflected in the market share. And so, in Japan, market share is very, very important for companies.

For production cost, you know, we have the labor cost rising on the annual basis and, in order to offset it, then the production cost needs to be reduced. And this is also another area of competition.

(END OF TAPE NUMBER TWENTY-THREE)

Genichi Taguchi

Video Roll # 24

*Q: -- for quality. How much do they spend on training?
How much time do they allow their workers?*

TAGUCHI: I think you should ask Japanese Standard Association. They're training engineers and management people.

But, in Japan, how much training is given -- how much training of engineers, how much training of management is done, and so forth -- I think all depends on company by company.

But, in Japan, you know, the competition is extremely severe in Japan. Like for example, for automobile manufacturers, there about ten of them. And for copiers, I had talked to Mr. Hicks from Xerox, and he said there are 43 competitors in Japan. And all 43 of them are manufacturing copying machines.

And the competition is, of course, technological competition. But, of course, when a company comes up with a new product, then this stimulates other competitors. And so domestic competition in Japan is really contributing to the growth of the economy.

This is not a matter of getting everybody together for a training session. But, in reality, in day-to-day business, the engineers are asked to come up with, or are pressured to come up with better designs, and so forth. And these

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engineers, when they want to learn something new, then they would refer to their competitors' new product, and so forth.

And so they learn these lessons in their actual day-to-day activities, as they work. And I think this is something very important. And so for formal training, too, the training is given to these engineers. Like, for example, for more than 20 years, at the Toyota Corporation automobiles, I had for more than 20 years given them training sessions, and so forth.

Right now, they have their own give these courses, and so forth. But for these training courses, the half of the participants are engineers from their suppliers, because they purchase their instruments and tools, 80% of them, from outside suppliers.

And so rather than putting effort into the 20%, they want to come up with 100% effort, and the suppliers, therefore, need to improve their own quality and their own production technology needs to be improved. And which would contribute to the growth of the company.

But in order to do that, they had to make substantial investment, employed a big number of engineers, so that their company, as a whole, would be competitive.

But, of course, this may not be very practical because, to be practical, I think you have to more emphasis on basic studies, so that you can come up with the technology where you manufacture different things all at the same time.

Or to come up with a technology that is sort of a few steps ahead of product development. And in that area, Japan is behind. But, in the United States, even if they have the basic studies, strong basic studies, then that cannot be easily commercialized and put into the production line.

And that's why, in the area of basic study, it's not the actual product that they're studying for, but they have to study things that are basic studies to come up with the

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technology to produce actual products. And this is not very successful in the States.

Another point I'd like to make is that the definition of R & D, in English, says that the R & D activity does not include quality control. That's why the R & D people think that they have nothing to do with quality control.

But, of course, I think quality control and technology is different. Control is to do things that need to be done. To check the process and control the production line, and so forth. This is the definition of control.

And technology is the most important thing. But if you come up with a good technology, a good technology that will not cause any problems later, on the production line, or functional-wise. To come up with a technology that functions all right all the time, this is one issue that needs to be addressed to by the American R & D.

But in Japan, other than the R & D organization, we need to do work on technology development, and so forth. And that's why I think that it's easy for the Americans to surpass Japanese.

*Q: Many times, when you take a trip for the first time, as you go down the road, sometimes you make turns that are wrong, and you have to come back onto the main road again. Japan has been on the road to quality for 40 years. As you look back, what were some of the roads that were the wrong roads that **if** you could wave a magic wand and say we should always have stayed on the main road, what would you have changed? What were some of the mistakes that you are now sorry that made you ... ?*

TAGUCHI: In the area of technology, I think there is no mistake. But one of the problems that I encountered in the

initial days, an impractical way of research, is in improving the quality, to study the quality of a product. And this is more important than the management.

And so, for example, to find out how faulty the automobile is, or how often it breaks down, or what is the annual fuel consumption of an auto. But even if you study these things, do research and survey of these things, you can't improve the quality of the product.

Like, for example, annual consumption, I think, for any Japanese auto maker, it's less than 30%. And why can't you make this 30%, 60%. The reason for this is because it's not a problem of quality control but technology. If you solve the technological problem in that area, then annual fuel consumption can be decreased by half.

And then it wouldn't necessary for the Americans by then to import gasoline.

But to come up with a technological development and then really put it into action. This is the problem. And this is more of the improvement of technology. And the Americans actually are conducting so much basic study that they are in a position to lead the technology of the world.

But, they have the problem in commercializing that technology. Japan is also not very good in doing that, too. But in the case of Japan, Japanese people are very good in commercializing certain technologies. Because this is where they have invested in terms of people and money, to improve quality, improve technology, and so forth. This is the emphasis in Japan.

But if you start off from the basic study and then go into further technological improvements and so forth, that's the most important thing that every country should be able to do.

And so it's not the quality that is scattered around, but it's more of an improvement in the basic area.

Q: We keep talking about technologies. If I understand correctly, then it's better machines, better processes. Where in all of this do people fit in? All of the workers who are employed? Where do they fit in, in quality improvement?

TAGUCHI: The workers cannot improve the quality. If there, for example, is the difference in the quality of something that is manufactured today and tomorrow, you can control those things. But a worker at the plant cannot improve the efficiency of an engine, for example. But engine efficiency, one basic issue is related to production technology.

And there is the problem of the cylinder bore, the shape of the cylinder bore, if it is not perfectly cylindrical of an engine, the surface is not cylindrical, then it means the surface -- or maybe if the surface is not very smooth, or the duct is not appropriate, and the cylinder bore, for example, is a little crooked, then it would not work and would not fit into the piston.

And there would be many spaces between the cylinder and the piston, which means that the shape would be not uniform. And this kind of disuniformity of the shape cannot be measured.

And that's why this is out of the realm of quality control, but it has to be quality improvement. And so be it the American or Japanese, the engine efficiency is just about the same.

The problem, for example, the shape or the form of the engine. And how to improve that shape is to come up with a good equipment to come up with these uniform shapes of engine parts. And this would lead to good functioning of the engine.

And this evaluation is not the product evaluation but the evaluation of the technology. And this evaluation at ... is very, very important.

And I think in February of this year, I had given a lecture at ASMA, and I had talked about that. This is an organization of engineers, and that's why, I think, the audience had really understood what I wanted to say.

Q: As more and more companies practice quality methods and improve their technology, what companies will get better and better? In the next ten years, what will distinguish the companies that are proved excellent from those that are only good?

TAGUCHI: I think, in Japan, companies should invest more in basic studies. And be it product design or improvement or development of production technology. This should not be done for each product by product.

Technology can be applied to different things. And the technology needs to enable a company to produce many different things. The flexibility of the technology is very important in that sense.

And companies need to come up good technology before coming up with a product planning. And that's why I think the Japanese companies should invest more in basic studies.

But when they conduct basic studies, I think there are problems with the attitude of the American companies. You know, the American companies have been doing a lot of basic studies. The invention -- the Americans are very good at inventing things.

But when you use that new technology, there are various problems of technology of cost and quality and so forth,

which means that the productivity is not very good or the quality of a product is not very good.

But in connecting with a counter-measure for these issues, what the Americans are doing is saying: why is it that there is so much scattering of quality of their products. And I think they should look for the cause -- and people would study the causes for these inferior quality, and so forth. And also study about the quality demands in the eyes of the consumers.

And so, in order to avoid these problems, in the future the people involved in basic study, are studying all these things. But these people in basic studies it's not to improve the quality but to come up with a phenomenal thing. But the robustness -- Americans to think of technology's robustness, not the robustness of products.

Q: Most of companies are publicly owned. They look at responsibilities to shareholders, they look at security analysts who look at their stock price. Three months, three months, three months.

TAGUCHI: Short term.

Q: With this orientation, can American quality ever become truly world class?

TAGUCHI: These short-term technology plans is not very good, of course. But in the United States, the Americans are spending more money in basic studies than the Japanese. And that's why to change the awareness of these engineers involved in basic study is very important.

Their past way of doing things may have been good, but as Japan had come to invest more in research and studies and

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improve its efficiency, and so forth, then the pace of the U.S. study is very slow. In order to make it more efficient, what needs to be done -- this is the issue that needs to be addressed in the States at the moment.

Q: Many people that we've spoke to in Japan have talked about the Taguchi method. There will be people in the United States who are not familiar with the Taguchi Method. Would you tell us what the Taguchi Method is. . . . understand what everyone ...

T AGUCHI: This term, Taguchi Method, has been coined in the States, actually. And I think the Americans are more aware and know more about the Taguchi Method, probably. And there is nobody who has defined the Taguchi Method.

And what's different from the American way of doing things is the Taguchi Method is that I think there are three points that I can come up with.

One is rather than studying the quality, look for the function. The SN ratio. The SN ratio is the technology robustness or the product's robustness or the process's robustness. And SN ratio is considered to be the ruler to measure these robustness in different areas.

And in order to improve the robustness, the design, I think a product design has been divided into synthesis analysis. And I also further ... synthesis into the both the parameter design and the systems design.

And the design of the parameter is something different from the United States. And this is not to look for the scattering of the quality of products, but even if there are scattering of the qualities, even if it is very stable, very functional, these products need to be developed.

And the third point is the calculation method. Is the economic calculation. Or to decide on how much money needs to be spent for administration. And, of course, if there is much more invested in administration, then that would improve the quality, but that would increase the cost, too, which means this economic calculation becomes necessary.

And this economic calculation I think is now very much used in the United States, nowadays.

And the design of parameter also is now another focus of attention in the States. And this SN ratio concept has not yet been totally accepted or understood in the States at the moment. Recently, I think, things are improving.

But these are the three points that are different from the American way. And all put together is the Taguchi Method, I think, so aptly coined in the States. And this term had been coined by an American. And so I don't know the exact definition of the Taguchi Method.

Q: A couple of questions about Dr. Juran. There are many people in the United States who will see this videotape, who are not engineers and designers or people involved in business, they're people like my wife, who turns on the television. What should my wife know about what Dr. Juran has done for quality around the world?

T AGUCHI: I think there's some difference in the quality issue and the technology issue. For technology, a certain function needs to be accomplished, regardless of the environment. A machine would work properly, it would function proper, and fuel consumption is very good. And so for these are the technology issues.

But these things, engineers don't need to be told by the consumers as to what kind of issues need to be addressed.

But, you know, whether a certain function needs to be added to a specific equipment or machine, or like, for example, a cushion of a chair, how soft it should be -- all these things -- this depends on the taste of the consumers.

Or maybe additional function may make a certain product more convenient for the consumers. All these consumer demands or needs, need to be produced in the product design or product planning.

And in this area of product planning, Japan has been emphasize the importance on. But even if you come up with a good product planning, you need to come up with a product that works okay.

If it -- like for example, a cushion of a seat, like if you sit on it and how soft it should be, and depending on the weight of the person who is sitting and how much cushion is soft and so forth, all of these depends on the taste of the customers. But we need to reflect those tastes of the customers.

But, for example, in a hot temperature environment or a cold temperature environment, then the cushion would not be as soft, and so forth. This functional scattering should not take place. You should come up with a product that, for example, even used for a long time, the softness of the cushion is always the same, or the function. And this would be a problem

It should not change with the time; it should not change depending on the environmental temperature. And technology is the area which would prevent the scattering of these kind of functionality of a product. And also to come up with a product that reflects the taste of the consumers.

And I was involved with this technology aspect. And the consumers' needs is something different.

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Also another important area that needs to be addressed to, in the stage of product planning. And so, of course, product planning is done by the marketing and sales people. Or maybe management class people.

But deciding on what material needs to be used, which is very stable regardless of the temperature, or which is very enduring, or the color would not change, and so forth, these are technical issues. And this needs to be done by the engineers.

Q: Howland, is there any area that you would like to lead Dr. Taguchi into at this point?

BLACKISTON: No.

Q: While Howland is looking at the list, as a teacher, philosopher, and thinker ... (LOUD BACKGROUND NOISE DROWNING OUT MOST OF QUESTION) what are your objectives? Where do you think your work will be taking you as time goes on?

TAGUCHI: My time -- well, yesterday, I gave a lecture here at the ... Association here, and at that time, I had emphasized the importance of improving the technology development in the future. And to start out from the basic study.

And this is what I always lecture and to teach the method of how to go into basic studies and so forth. Or, at times, I would go to companies and help them in actual technology research.

And when you conduct a study of a technology, not from -- and I really want to change this current of trend of studying of products to studying of technology. And I have

written a book on this which will be published this coming summer. And this would be, I think, translated into English at ASNA.

But taking Nissan as an example, its production technology. And what they are doing in Nissan is that they are working on the actual product and studying, not to conduct the research which would satisfy the needs of the customers, but they are studying using the injection molding method, using the carbon fiber in the production process.

And because of this existence of carbon fiber, injection molding becomes very difficult. This is very difficult, but before they come up with the actual product, or before the actual product is designed, they are working on the improvement and development of injection molding technology.

And this injection molding, technologically speaking, is you come up with a mold -- the shape of a mold. And you would inject a material through a hole into the mold to come up with a certain shape, which would be cooled. And a mold is made in that way.

But, at that time in the product, in that process, when the product is asymmetrical to that mold, it would be very easy. And so the size of the mold and the size of the part needs to be correlated with each other. And this kind of study needs to be done.

And in order to do it, you have to come up with various test pieces -- not the actual mold and the actual piece, but the test piece needs to be used for the development of this kind of technology.

And when this is done, then the relationship between the mold and the actual product that is molded -- for example, they can come up with a figure 0.5 shrinkage rate. Then you would even come up with the same size, same measurement

of these parts. A very uniform size of these parts can be made, using this kind of technology.

But in the United States, this is not done. For example, the measurement of the shrinkage of certain measurements, like for example certain diameter, shrinkage is 1 % and the outer diameter shrinkage is, for example, 0.5%. And around the gate, the shrinkage would be a certain figure, again.

And these kind of cause and results of this kind of phenomena is studied. But just studying this cause of this kind of phenomena would not come up to a commercial usable product. That's not sufficient.

(OFF CAMERA DISCUSSION)

TAGUCHI: So you want me to explain two reasons.

One is that, in Japan, we have many engineers. And these engineers and the Japanese management people, both of them, were fully aware of the fact that Japan was behind -- compared to the States. And when you're fully aware of that kind of situation, you would come up with a desire to catch up.

And when you want to catch up, you have to think as to what you should do to catch up. One was, as mentioned before, to lend ears to various instructions and advice of Dr. Deming and Dr. Juran.

And GHQ have invited many American experts to Japan to give us a course -- I think this was called CCS lecture, including quality control.

And so, throughout these different movements, through the management, the issue of quality came to be an important issue in the eyes of many companies.

But, at that time, what the engineers should do, in order to improve the quality, improve the productivity -- the

methodology had to be given to the engineers as to what they can do. And I think our responsibility was to give them as to what these engineers should do concretely to give them the methodology.

Engineers always are thinking of coming up with new, good development, and keep the cost down, and so forth. But they need the method to do it. You know, if they are not aware of the method as to how they can do that, then it only remains a desire.

But the management, they want to come up with the good products, too. And American top management, none of them would want to layoff when the company's making money.

And they have this desire, but, at the same time, I think what concrete measure needs to be done is product designing and production technology.

And the workers' good working record, and so forth. And I think when we compare the workers, Japanese and Americans, I think the Americans are more powerful and so they may be better as workers. But you don't have any problems with the workers.

But the problem with the engineers in the States. I think the company managers, they didn't really invest so much, and so forth, but more on basic studies. And that's why basic study is more practical, what they're doing.

But, therefore, in Japan, Japanese people invested more in the actual production line. And it is for this reason that the production technology organization has grown so much, and this is causing a problem for these countries.

Q: Thank you.

(END OF TAPE NUMBER TWENTY-FOUR)

