Mr. Minoru Haga was the top tooling expert in machining operations for Toyota Motor Corporation over the past several decades. He was a veteran leader in Toyota's tooling engineering department with 40 years of experience. For most of his years he was the head of the tooling section of Production Engineering Department #1. After retiring from Toyota as a general manager he became President of Fuji Seiki Ltd. a maker of precision cutting tool holders and cutting tools for the automotive industry. He is now retired and consults part time in Japan regarding tooling engineering.

Summary Notes from Interview with Mr. Haga

TOPIC: TPS & Tooling

Art:

What was your role in Toyota?

Mr. Haga:

I was head of tooling engineering in Production Engineering (PE) department #1 for engines and transmissions.

Note: The Production Engineering (PE) groups in Toyota are centralized departments in Japan that plan and develop production processes with Toyota's core equipment suppliers. One PE group exists for each type of process technology. The first group established in the 1960's was PE Department #1 to plan and develop machine tools for engine and transmission related processes. Other PE departments were later created for departments such as stamping, casting, forging, paint, plastic injection, welding, and assembly as well. Each PE group consists of a couple hundred engineers. They play a critical role in building the state of the art production processes for Toyota's world wide production facilities. The groups are a strength of Toyota's production system that is not understood outside of the company.

Art:

What groups reside in Production Engineering (PE) for engines and transmissions?

Mr. Haga:

At the time the department consisted of process planning, tooling engineering, gauge management, controls engineering and specifications development. Tooling engineering had several sub groups and functions including tooling research and development, cutting tool regrind, tooling planning, and technical support for engine and transmission plants.

Art:

How important is PE and tooling in Toyota?

Mr. Haga:

It is the most important part of manufacturing. In machining operations the value add part of the process is the removal of metal by cutting tools such as drills, reams, taps, broaches, mills, inserts, grinding wheels, hones, etc. The tool is the most important part of the process. It is not like assembly where people can just put parts together with their hands. Without a good tool operating under the right conditions you can not make a good part.

Art:

How does Toyota control tooling for engine and transmission plants.

Mr. Haga:

All tooling related matters are initially handled by my former section. We run tests in conjunction with tooling suppliers and approve what cutting tools can be used in Toyota's plants. For each machine tool installed at Toyota we supply the tooling for the equipment vendor to use. We have an extensive database for tools and can decide for each application and type of material what will work best. All tools have to be approved by my former section for use in a Toyota plant before they can be purchased and put into production.

Art:

What factors are considered before a cutting tool goes into production?

Mr. Haga:

Many factors have to be analyzed and decided so it a difficult task. For example will the tool make a quality part in accordance with the tolerances required by the design? Will the tool wear well and how will we regrind the tool in-house if needed? Does the tool perform within cycle time requirements? Does the tool meet the cost considerations? Under what conditions will it operate best in production? There are many technical considerations that must be considered.

Art:

Why is tooling so important for process planning / production engineering?

Mr. Haga:

In the case of machine tools the tooling engineering is the start of the whole process development sequence. The tool is what cuts the metal and performs the value added part of the operation. We essentially plan the production process off the product drawings from the tool backwards. We have to decide what tool and set of operations are required to make the exact product characteristic. Then we decide what type of holder is required to hold the tool. There are many other related factors as well. For example what type of coolant or cutting oil is needed for the process? What type of spindle is required for the tool and tool holder and how rigid must it be? What type of cutting conditions (speed, feed, RPM's, etc.) are required. What type of locating device and fixture is required for the part? All of these tooling and production engineering related decisions up front are what drive the planning and determination of the actual production process at Toyota.

Art:

How is all this communicated and managed?

Mr. Haga:

We have an internal tooling database so that we maintain a set of standards. Of course there is always on-going tooling development regarding materials, cutting conditions, ways to improve quality, and ways to reduce cost, etc. This is just an on-going process in conjunction with tooling suppliers. Also there are Tooling Layout Drawings (Hagu Haichi-zu) that summarize all the essential tooling information for each operation in a plant. We issue one of these for each operation and it includes all the needed technical information (i.e. the tool part number, dimensions, cutting conditions, coolant conditions, etc.) to use the tool correctly. Using this critical information operation drawings (Kosaku-zu) and other important documents are created that form the basis for the machining process.

Art:

Who wins in technical arguments between product development and production engineering – especially tooling?

Mr. Haga:

Short term tooling engineering wins. You can not deny the physics of the production process and force a tool to work when it is not capable of performing the required task. This will just harm quality, damage equipment, curtail productivity, etc. Everyone at Toyota knows this simple fact and hence nothing gets through into production without our approval. Medium to long term however if product development wants to introduce some new material or a feature that we can not yet machine in a proven fashion then we must develop a tooling solution as quick as possible. There is pressure both ways.

Art:

It sounds like there is a lot of know how and technical knowledge involved?

Mr. Haga

Yes it is a highly technical matter and it is kept highly confidential inside Toyota. Very little of tooling engineering is communicated to the outside world because of its proprietary nature. We have many patents and technical specifications that we have built up over decades of study and improvement in conjunction with our core suppliers.

Art:

So how does tooling relate to TPS and Toyota's success?

Mr. Haga:

I have a tooling centric view of the world. The most important part of the process is the cutting tool. With the right cutting tool and conditions it is easy to make a good part in accordance with cycle time requirements and maintain low operating costs. Use the wrong tool and no matter what else the process will not work right. In equipment intensive shops tooling is a chief competitive strength of Toyota.

Art:

Why does the outside world hear so little about the importance of tooling and production engineering in Toyota's system?

Mr. Haga:

I guess there are a couple of reasons. For one tooling is hidden inside a machine so it is not externally visible. Second you have to be a technically competent person to begin to understand the nature of the content. The average person touring a plant or looking at TPS from the outside probably doesn't understand tooling. Finally Toyota does not make much of this type of engineering knowledge public since it is an advantage. All the tooling engineering data is closely guarded and considered proprietary information.

Art:

Thank you for your time.

Note: The preceding is a summary of a conversation I had with Mr. Haga several years ago regarding the importance of tooling engineering in TPS especially for machine shops. As such it is subject to my recollections and notes from the actual discussion. Since Mr. Haga was one of the true experts in Toyota and a leading figure in the technical dimensions of tooling I thought it worthwhile to summarize his comments. His blunt thoughts regarding what is important in manufacturing and TPS are refreshing, logical, and reflect the company priorities while I worked there. Any unintentional mistakes or errors from the conversation are entirely my fault.