Tomo "Tom" Harada spent 35 years with Toyota Motor Corporation in a variety of management positions in engineering, maintenance, and manufacturing. Early in his career he helped start the famous Kamigo engine plant where Taiichi Ohno was the original plant manager. Kamigo was Toyota's first automated plant in 1965 and a pioneer site in the implementation of various TPS concepts especially Jidoka.

Summary Notes from Art Smalley Interview with Mr. Harada

TOPIC: TPS & Jidoka

Art:

I'd like to change gears now and talk about another underappreciated topic in TPS – the Jidoka pillar of the production system.

Mr. Harada:

You only pick the hard ones to talk about don't you. Why don't I get the easy questions?

Art:

I'll bet that you are up to the task. Let's start at the beginning. Who invented Jidoka?

Mr. Harada

Well the original concept is very old and it goes back to even before Toyota Motor Corporation was founded. Mr. Sakichi Toyoda invented an automatic loom that would shut down as soon as a single thread broke. This saved a lot of wasted material and helped highlight problems as soon as one happened. That was the starting point.

Art:

So how does this apply to TPS at Toyota?

Mr. Harada

There are two different parts to Jidoka. The first meaning is to separate man from machine. It was normal in the original parent company for a single young woman to operate many machines since they were automated. So when Mr. Ohno came to the automotive company after WWII and saw one man operating one machine tool he thought that it was strange and inefficient. He embarked upon a path of breaking down the notion of one man one machine in the engine shops. Instead of "monitoring" machines the operator was to walk between two machine tools and keep them both up and running. Then three machines and four machines and so on.

The second part of Jidoka is of course the concept of building in 100% quality every time at the process and not inspecting it in later downstream. This means you have to have a highly capable process and know how to maintain all the key variables in the process so that a good part is made every time. If a problem occurs the machine should stop right away.

Art

Jidoka is critical to TPS. So why is Jidoka such a mystery pillar and less popular than JIT?

Mr. Harada

It is just a strange word that is hard to understand and define properly for starters. Even to us Japanese it is a difficult concept to explain and it does not translate into English very well. Jidoka is also not easy to see by the naked eye since it takes an expert to locate it in many processes. By way of contrast with JIT however even a beginner can see it since material is moving around, kanban cards can be seen, and the system is very fluid. Good Jidoka on the other hand is more static by nature and almost invisible to the untrained eye.

Art

Can you give us some different examples of Jidoka both visible and invisible?

Mr. Harada

The most obvious example is on the assembly lines of Toyota. If an operator sees a mistake he stops the line and the Team Leader has to hurry over and quickly diagnose what happened. Either he has to repair the part in line in one cycle or tag it for off line repair later and then problem solve why it happened. This example is easy to see and relies upon the skills of the people in the work area to function properly.

Another simple example is the parts selection system on the engine assembly line. There might be six different types of alternators on a given engine line. A production instruction signal is relayed electronically to the assembly station and a small light bulb comes on to indicate the bin that the operator is supposed to select the correct alternator from for this engine model. There is also a small light curtain in front of the bin so that if the right part is not taken the line will stop automatically. This prevents many parts selection errors.

In various locations you have probably also seen simple error proofing devices used in assembly and on simple machines. From experience and analysis of past mistakes we can sometimes put a little device in place to help avoid repeating the problem again.

In machining it gets a lot harder however to see Jidoka and it depends upon the process. There are in-process gauging methods and post-process gauging methods. An in-process example is when we actually measure while we grind the final dimensions of the crankshaft journals. Grinding continues until the desired dimension is achieved. If the part is under or oversized it stops the machine right away and signals a fault. This is a form of Jidoka.

Other machines have air pads in the datum faces to verify if the part is located correctly or not. If not the machine will not cycle since something is wrong. Sometimes we use tool detectors to check if the drill is broken after drilling a hole on a transfer machine. If the dimension is really critical and can't be measured inside the process then we sometimes have to create special in line measurement stations to measure and record data. The automatic measurement stations stop the line if there is a problem.

Jidoka gets invisible and even more difficult however if you think about the machine conditions that sometimes have to be maintained properly . For example the quench concentration in an induction hardening process, the pre-load on the bearings in a spindle unit on a lathe, or the sharpness of a cutting tool all of these must be correctly maintained if the process is to make 100% good parts every time. It gets quite difficult to achieve Jidoka in practice and requires a very high level understanding of machine capability and what items to monitor and maintain.

Art:

What is the connection to Andon with Jidoka?

Mr. Harada:

Some areas have lots of machines and only very few people to operate the equipment. Once we began stopping machines automatically we needed a way to signal visually what process was down in certain areas so the supervisor or appropriate person could quickly respond. First we had lights on each machine. Later we made big plastics boards with light bulbs and put them up in the air above the machines to clearly show all processes and which process was down. Still later we figured out ways to use the boards to also signal the need for material handling and deliver, indicate that quality checks that were coming

up soon, or that tools changes that were about to occur. Then later counters were added to show the status of production during the shift in real time. It just evolved over time to be a very useful tool. The old ones were very dumb in comparison to today. Now we can use them to log data about the machine conditions and build a database for certain types of minor stops that don't make it into the maintenance downtime history system.

Art:

It is very difficult to conduct Jidoka indeed. So what happens in TPS if a company does not practice any Jidoka technique at all.

Mr. Harada:

They will struggle over time. If Jidoka is not practiced then you can not attain a very high level of quality and productivity will suffer since you are not catching problems. At least this is my experience in machine shops. Pull systems won't work well either I suppose. It takes a lot of labor hours to contain and fix quality problems and it is not good for morale either. Sorting and repairing parts is a non-value added activity and implies a fundamental disrespect for the human doing the work. Jidoka needs to signal a problem and then there has to be a strong culture of root cause problem solving to establish recurrence prevention.

Art:

So how do people get to Jidoka?

Mr. Harada:

Honestly I think it is a lot of hard work. There is no single recipe or secret advice for attaining high quality and learning how to stop machines. There is no simple single tool like kanban or a standardized work chart. Jidoka is part of the planning of the process from long before launch and continues all through the life cycle of the machine. Jidoka is now such a part of our equipment specifications that we sometimes take it for granted in Toyota. I would start by analyzing where the majority of defects come from or where process capability is lowest and ask why. Figure out the root cause for why a problem occurs and try to build the detection capability into the process somehow.

Art:

What is the number one key point to keep in mind about all of this?

Mr. Harada:

As counterintuitive as it sounds it is very important to practice stopping machines as soon as a problem occurs. Then the right people must go and look and see what happened. Of course you want to start the machine back up as soon as the situation is diagnosed and you don't want to keep stopping the machine. However if you don't stop the machine in the

first place the problem never gets surfaced and gets ignored. It is a catch 22. If you just rely upon quality data and reports that are even only one day old it is often too late to discern the root cause of many defects. The evidence is all gone.

The overall thinking behind Jidoka is the practice of making hidden problem obvious. If a problem remains hidden then it will never get solved. You have to bring problems to the surface and cause people to respond to them in order to get at the root cause.

Art:

So where is Toyota at with Jidoka today?

Tom Harada

Toyota is always improving the process. I recently helped in developing a better Andon system to collect data on minor stops and problems that were escaping notice. Machine tools are applying more specialized sensors to detect problems in the production process. Detailed study of our machines and tooling also helps us see the weak spot in terms of process capability. Decades ago 30 microns of tolerance on a finish journal was considered tough to maintain. Today it is ten times tighter. Toyota's close ties to its machine tools suppliers and the joint focus on improving process quality, reliability, and maintainability are secret advantages and not well understood by the external consultants and academics writing about TPS.

Art:

Thank you for your time and insights.