

## **Eiji Toyoda on the Roots of TPS**

While on a recent trip to Japan I ran across an old article written by Eiji Toyoda about the roots of TPS and its early development. Quite some time ago I was fortunate enough to meet and help translate for Eiji once when I still worked for Toyota in Japan. On that afternoon he patiently answered questions about the company and talked briefly about the origins of its production system with some American visitors from the U.S. Consulate Office in Osaka who came to tour Toyota's Tsutsumi facility. The topic was very interesting to hear about and to help translate. It struck me recently in hindsight almost twenty years later that we still really don't know all that much about the historical development of TPS. Mostly we have a lot of superficial knowledge regarding "what" some of the production system tools are but not exactly "why" they were developed or even "how" for that matter. Partly as a result I see a fair amount of misapplication of the tools in the United States or at least usage in some ways that Toyota never envisioned.

Additionally there are just a lot of incorrect anecdotes that float around the lean community about the history of TPS. For example over the years I have heard and read different commentaries about how Taiichi Ohno first envisioned pull and kanban while visiting an American supermarket, how Henry Ford or W. Edwards Demming directly taught Toyota, or how Shigeo Shingo somehow invented TPS and later taught it to Taiichi Ohno. All of these anecdotes are actually quite flawed if you bother to stop and check a few historical facts. The situation is unfortunate in several respects. First it just shows how uninformed we are when it comes to the historical facts about TPS development. Second it means that hard working contributors are getting short changed in terms of the proper credit and recognition they deserve.

Oddly there actually exists quite a lot of good factual reference material pertaining to TPS development in Toyota. However the reality is that most of it is out of the reach of lean practitioners since it is in Japanese. For example several volumes of internal Toyota history totaling well over 2,000 pages with pictures and text exist in the company archives and are updated at ten year intervals. Toyota has also created an entire museum in Nagoya Japan dedicated to the commemorative history of industry and production technology pertaining to the company's development. Additionally several fine books by Japanese professors exist depicting the origins and development of TPS. I have read and viewed most of these materials at different times over the years as a matter of historical interest. With the help of the Lean Enterprise Institute I've agreed to write a series of articles designed to bring some better historical light on the actual facts about certain parts of Toyota's famous production system.

I thought the best place to start would be with a simple article written by Eiji Toyoda. For those who are not familiar with his background, Eiji Toyoda was born in 1913 near Nagoya in Japan. He is the first cousin of Kiichiro Toyoda the founder of Toyota Motor Corporation. After graduating from Tokyo University in 1936 with a degree in mechanical engineering Eiji soon joined the newly formed Toyota Motor Corporation working for his cousin. Eiji's initial job assignment was to run the company lab in Tokyo, and he set about lining up mechanical and

scientific specialists to join Toyota. Shortly thereafter however he worked on the shop floor in charge of machinery and production planning. While in the machine shops he recruited Taiichi Ohno to work under him to improve the efficiency of operations. In the 1950's Eiji studied engineering and manufacturing at Ford Motor Company for several weeks as a guest of Henry Ford II. In the 1960's Eiji Toyoda played a leading role in improving manufacturing, engineering, product development, and quality functions at Toyota. In October of 1967 after 30 years of effort and accomplishments Eiji became president and then later chairman of Toyota Motor Corporation. Today he is retired and only serves the company in an honorary capacity. Of all the Toyoda family members Eiji was by far and away the closest to manufacturing and played an active hands on role in the development of Toyota's overall system.

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The Roots of TPS  
By Eiji Toyoda

At the same time we established Koromo (later called Honsha) Plant in 1937 we decided to officially adopt the metric system for the company as well as to introduce the concept of flow production. In order to accomplish this latter goal Kiichiro meticulously created a detailed manual on this topic. He had a clear notion in his head even before we built the automobile plant in 1937 about how he wanted to establish a better flow of operations.

At the old Kariya plant (where the Toyoda Auto Loom parent company and initial automotive division existed) we had put semi-finished items from the casting shop into a warehouse. From there we took them out to be machined. For each part whether it be for a piston or some other item a slip of paper called a “denpyo” would come around and state how many to make. Then when that was done an instruction would come around with the directions to drill holes, etc. It was so called batch production but it was Kiichiro's plan to switch over entirely to a flow style of operations at the new facility. Doing this would stop the build up of parts and the storage warehouse would no longer be needed. The amount of inventory would be reduced and this would decrease the amount of excess capital being consumed. In other words we would be able to sell our finished products before we would have to pay for the supplied material. With this method in place we would require less operating capital.

If you summarize the style of production that Kiichiro thought of back then it boils down to “everyday make the necessary items in the necessary quantity”. In order to make this a reality all the operations had to be converted over to his notion of flow production. The words Kiichiro

used to describe this in 1937 were a sort of Japanese English phrase he coined called “just-in-time.” In other words it means it is good if you are right on time. Do not over-produce or make things too early. Back in those days we did not yet have kanban so everyday the necessary figures for production would come written on slips of paper. If you produced the amount required you could go home early. If you did not finish then you had to do overtime.

A key issue was how to make this new concept stick within the new company. First before anything else we had to thoroughly educate the employees, namely the supervisors and managers. It was an epoch making change for us so we had to essentially brainwash the people accustomed to the old style of production. Kiichiro’s manual was impressive. A full four inches thick, it described in meticulous detail the flow production system we were to set up. We used this to teach the new production system to the workers. This manual was the actual roots of the Toyota Production System.

Toyota has used just-in-time methods ever since that period and even the United States is using it now as well. Unfortunately the new production system that Kiichiro tried to immerse in the employees was interrupted by World War II and he thus could not get it to fully stick. After the war ended it was Taiichi Ohno who worked for me in the machining shops who revived and further refined this style of production that had temporarily stopped by using something he developed called “kanban.”

In the completed Koromo (Honsha) facility I was responsible for machine shop #2. Establishing a better flow of operations was also part of my direct job in production. There were three machining shops with the first making engines, the second making gear parts, and the third making chassis related parts. In each section there were three foremen and one of them was a foreman in charge of inspection. It was Kiichiro’s intention also that as soon as inspection caught a defect we should fix the responsible machine right away. It was not the inspector’s job to merely just sort out good parts from bad ones.

After the war ended we studied QC (quality control) methods and positively introduced this as well in our system. This concept is the same essentially as our Toyota way of thinking about building in quality at the process (jidoka). I suppose this is all something that anyone would think of and I am not calling Kiichiro a genius. What set him apart was his initiative in putting the idea into place.

Incidentally just-in-time is not a phrase used only in Japanese English anymore but one used in America as well. However if you ask Mr. Ohno “just-in-time” more precisely means “exactly on time”.

*Note: Translated from Setsuo Mito’s book “Why Produce the Right Part in the Right Amount at the Right Time” ©Diamond Publishing Japan, 1986. Originally published in Nihon Keizai Shimbun September 1985.*

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The article above written by Eiji Toyoda in 1985 is highly typical of what I find in my research efforts about the history of TPS. I thought I would share it first since it comes directly from a key person who was actually there when the company started in 1937 and one who helped contribute substantially to its development. The T in TPS stands for Toyota and in case anyone forgets it also stands for the Toyoda family name. There is no real mystery about the roots of TPS. The basic concepts trace back to the efforts of Sakichi Toyoda in developing jidoka on his automatic looms in the early 1900's as well as Kiichiro's advancement in the company of his particular notion of flow and just-in-time in the mid 1930's. Mr. Taiichi Ohno in his own words built upon those ideas after the end of the war in 1945 further incorporating the concepts of takt time, kanban, leveling, and pull replenishment using a supermarket mechanism. In later articles I'll shed more light on the actual development and implementation of these concepts internally at Toyota.

Did these two aforementioned Toyoda gentlemen or Mr. Ohno "invent" these concepts all by themselves in a vacuum? No, I am quite certain they did not. Frankly, the word invent does not really apply here too well in my opinion. In the strict legal sense invention usually implies a patent or invention record and in Toyota's case Sakichi and Kiichiro only have patents on certain features for their auto looms which did include over twenty four different items such as the jidoka technique and a non-stop shuttle changeover mechanism. Production system advancements on the other hand are generally adaptations and reactions to the circumstances around a company at the time. It is a stretch to call all of these changes an "invention" as they were merely seeking ways to improve upon the current condition. This process was called kaizen and various forms of it were conducted in Toyota long before any external consultants ever appeared on the scene to start studying or writing about what Toyota was doing.

The managers and Toyota's internal company history books openly acknowledge different influences on their system. The influence of Henry Ford and Fredrick Taylor for instance are obvious examples that every company including Toyota has mimicked in some fashion over the years. The company is also very open about the inputs it received via the American occupational force in Japan and General Headquarters (GHQ) after World War II. As Eiji notes in his article they eagerly studied the emerging concepts of quality control from the U.S. as they became more available. The company's official history also notes the various professors and engineers that were trained by the Japanese Union of Scientists and Engineers (JUSE) and acknowledges their assistance. Toyota's official history also specifically notes that the Training Within Industry (TWI) material was the first regular management and supervisor development held in the company in the early 1950's. Two American consultants named D.P. Gorham and N.G. Koppinger are generously mentioned as well in the same internal history book for their contributions in the area of improving efficiency in stamping operations.

Kiichiro Toyoda visited Ford Motor Company in 1930's and Eiji Toyoda personally visited Ford as well in the early 1950's and spent three weeks studying there as a guest of Henry Ford II. Toyota's renowned suggestion system is a direct result of a program Eiji observed at Ford during this time. Eiji saw enough at Ford to realize that Kiichiro Toyoda was right. The company simply could not compete with the likes of Ford on a mass production basis. However they both felt they could compete by emphasizing their own unique style of low volume production with a better flow of operations, just-in-time manufacturing, building in quality via the jidoka concept,

as well as utilizing different forms of small group activities and practicing what was called kaizen even back then. History proves that they were both right. Toyota's unique self developed style of production proved to be a powerful force to reckon with as time went on.

As Eiji Toyoda stated above the basic "roots" of TPS and the Toyota Way that we read about so much about today came from his uncle Kiichiro and some of those in turn from Kiichiro's father Sakichi. In reading the history of the company the influence of these two great men cannot be overstated. Eiji himself played a large role in the implementation of their concepts although by his humble nature he is reluctant to emphasize it. It was Eiji's decision for example to recruit Taiichi Ohno to the machine shops to help improve production further between 1945-1955. Using some of the Toyota Auto Loom factory concepts and Kiichiro's pamphlet as a point of reference they directed experiments and made many changes including the layout of machines, the flow of materials, producing to takt time, standardizing the work content, implementing pull and leveling concepts, increasing the number of machines each person would run as well as thousands of other small items. Eiji was Ohno's boss and had a large influence on what he did and later promoted Ohno to increasingly higher positions in manufacturing.

As in most cases in life however the managers such as Eiji Toyoda and Taiichi Ohno were not the ones doing the "hands on" work between 1945-1955. At the suggestion of a managing director named Shoichi Saito they put five engineers into the machine shop supervisory ranks in 1951 to help lead the improvement efforts on the engine plant shop floor. These five men are famous among company old-timers as they were the first actual disciples of Mr. Ohno and they worked to make improvements in machining and assembly in accordance with his directions during the decade in question. The unsung heroes of this work were men named Mr. Kikuo Suzumura, Mr. Itsuo Mamiya, Mr. Yukio Arima, Mr. Takeo Watanabe, Mr. Masanobu Morita, as well as one more person named Mr. Yoshi who stayed in engineering to summarize all the changes they were making on the shop floor. In addition to these supervisors were of course the shop floor employees contributing thousands of suggestions once they were tapped into for ideas.

The net effect of all this work from 1945-1955 was a tremendous explosion in improvement in the machine shops of Toyota especially after the domestic economic crisis of 1950-51. TPS was not a finished product by any means at this point but it had clearly taken basic form by 1955 in the areas where Ohno was in charge. Concepts such as flow, takt time, basic pull, leveling, standardized work, separation of man and machine for multi-process handling were all piloted and subsequently established in the machine shops to great effect. As a direct result Eiji promoted Ohno to overall plant manager and instructed him to spread the new system throughout the rest of the company a task he reportedly took to with relish. Eiji meanwhile moved on to take up leading roles in product development, engineering, and quality. The manufacturing transformation task assigned to Ohno kept him quite busy in production up until the mid 1970's as TPS spread through the various departments in Honsha Plant, Motomachi Plant, Kamigo Plant where I later worked, and then other new plants as well. Ohno exited Toyota Motor Corporation in 1978 as executive vice president of the company.

As mentioned above, Ohno had quite a lot of help during his career. In addition to the complete support and backing he received from Eiji Toyoda he had the five lieutenants I mentioned above whose words carried his virtual stamp of approval. After these initial five leaders however there

were then hundreds and hundreds of other younger managers, engineers, and production employees that contributed to the Toyota system and company way of doing things. I think it would be useful to bring to bear some further light on the facts of just how TPS developed at Toyota and why it took so long to flourish even for them. Not much is available in English in a factual context about Toyota's history aside from Michael Cusumano's fine work on the history of the Japanese automotive industry. I think that is a shame as there is a lot to learn from the history of how TPS unfolded, what problems were being solved, why certain paths were taken and just what improvements were made.

Fortunately more content about the history of TPS is becoming available every year due to the efforts of the Toyota and other authors as I write. If possible I highly suggest reading the accounts of different Japanese professors and authors about TPS development that have been published in the last few years. I will list them at the end of this article for those interested although they are mostly in Japanese. The works are quite enlightening and well documented with footnotes and references. Most of them have interviews with Eiji Toyoda, Ohno, Suzumura and many other key figures that are quite revealing about how TPS developed. I would also suggest looking at the various historical biographies of Sakichi, Kiichiro, and Eiji Toyoda that are available as well.

Quite a few more articles by Eiji Toyoda, speeches, interview summaries, and conversations with other key managers still exist. I am tracking them down as I am able. During the next few months, I'll pick a topic to highlight such as JIT, jidoka, standardized work, SMED, or value-stream mapping for example and tell you some of the actual history behind the development of the tool. I'll also create a simple timeline of the order in which things developed in TPS. I won't bore you with "what" the tool is or by defining the concept since enough is generally known about most of them. For this sort of information you can also view the *Lean Lexicon* published by LEI. Instead I'll focus on the "why" tools developed, the historical aspect of "when" and "how" it developed and to the extent possible "who" was involved in its success. It is my small hope that in doing this a few misapplications of the tools in your lean efforts will be prevented and proper credit will be given to those who richly deserve it for their contributions.

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## SUGGESTED HISTORICAL READING

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## **OTHER**

**Toyota Commemorative Museum of Industry and Technology.** 1-35 Noritake Shinmachi, 4 Chome, Nishi-ku, Nagoya Japan.