Process Control And Toyota Way: Why SPC Is Not A Part of TPS

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Abstract

The Statistical Process Control (SPC) objective is to monitor the performance of a process over time, widely used in many manufacturing cooperation. But in Toyota Motor Cooperation, it is not a part of TPS (Toyota Production System), to approach manufacturing quality control. Actually, in the 1950s, there was a Control chart that showed up in the Toyota manufacturing process which is a part of the SPC application, but it disappeared in the 1980s. The reason why Toyota does not use SPC as part of its production system because it wants to find the root of the problem instead of using statistics to monitor the problems that have occurred, Toyota has its own method. In the future, data analysis will be more suitable for quality control as computer technology is developed.

keywords: Lean production, Toyota, Statistical Process Control

1 Introduction

Statistical Process Control (SPC) as a quality control method, using statistics to monitor and analyze manufacturing processes, is wildly used in American companies and was introduced to Japan as a method to manage the process in the 1950s. At the same time, Toyota developed its way, using JIT, one-piece flow and such Toyota original methods (14 principles) led to its success. But to people's surprise, SPC is not a part of the Toyota Production System (TPS). According to Michel Baudin (2020), "Toyota achieves quality with methods that have nothing to do with SPC". That means, there must be another method in the Toyota process system to approach quality control. So what is the difference between the TPS method and SPC in process control? This research is going to determine why TPS does not include SPC and performance.

2 SPC and Brief Introduction

Statistical Process Control (SPC) is a method or a tool uses statistical analysis to deconstruct manufacturing or non-manufacture process, reducing the variation of quality. SPC uses run charts (line graph) and control charts to evaluate the manufacture process, find systematic factors predict the risk, and eliminate their influence, to achieve the purpose of quality control.

When the process is only affected by random factors, we call it in statistical control state (controlled state). When the process is affected by system factors, the process is in statistical runaway state (referred to as runaway state). Due to the statistical regularity of process fluctuation, when the process is controlled, the process characteristics generally follow the stable random distribution. When out of control, the process distribution will change. SPC uses the statistical regularity of process fluctuation to analyze and control the process. Thus, it emphasizes that processes operate in a controlled and capable state, so that products and services can steadily meet customer requirements.

The process of implementing SPC could be generally divided into two steps: first, analyze the process with SPC tools, such as drawing control charts for analysis; Based on the analysis results, take necessary actions: it may be necessary to eliminate systematic factors in the process, or management intervention may be required to reduce random fluctuations in the process to meet the requirements of process capability. The second step is to use the control chart to monitor the process.

The control chart is the most important tool in SPC. At present the traditional control chart based on Shewhart principle is widely used in practice, but the control chart is not limited to this. In recent years, some advanced control tools have been gradually developed, such as EWMA and CUSUM control charts for monitoring small fluctuations, proportion control charts and target control charts for controlling small batch and multi-variety production processes. A control chart for the control of multiple quality characteristics

3 Toyota With SPC: Why IS SPC Not A Part of TPS?

TPS is known as Toyota production system, is the Toyota manufacturing method success applied in management, production organization, logistics, quality management, cost control, inventory management, site management and site improvements, relatively complete system of production management techniques and methods. Jeffrey K.Liker described TPS "is Toyota s unique approach to manufacturing. It is the basis for much of the lean production movement that has dominated manufacturing trends (along with Six Sigma) for the last 10 years or so." With its success, Toyota lean manufacture experienced continously development

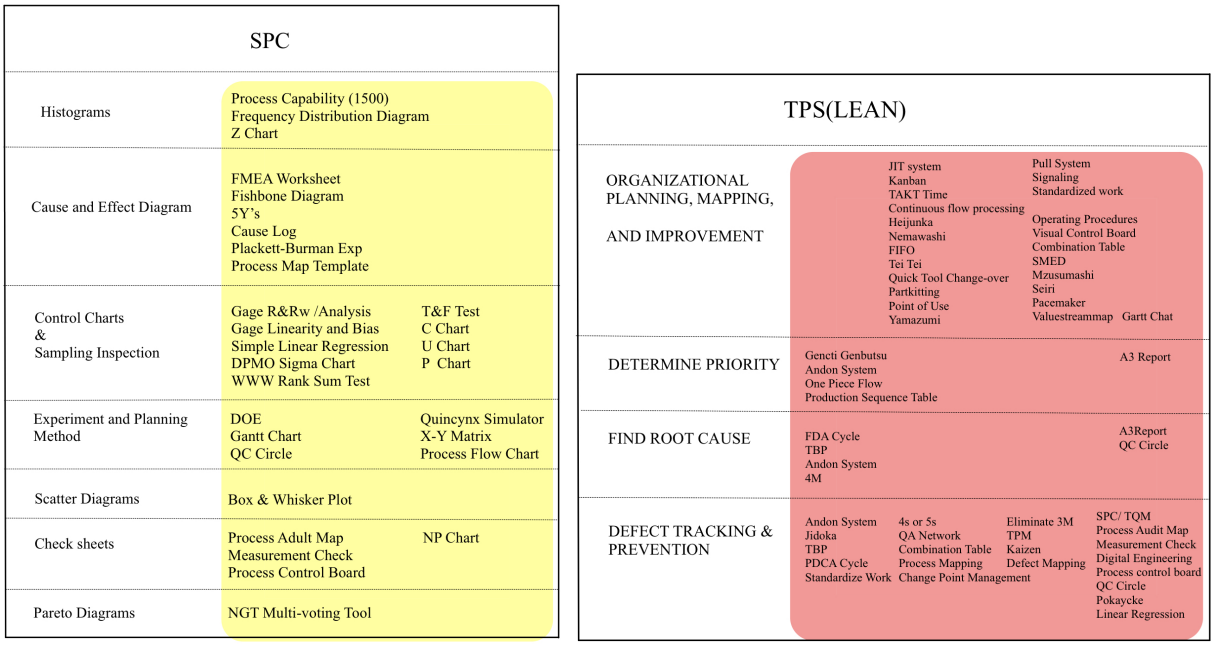

Figure 1: SPC and TPS tools (Hallam, 2010)

in the last 50 years,

3.1 Toyota Quality Control History

In Toyota history, there was a period when Toyota used SPC for quality improvement. Toyota statistical quality control started at the beginning of 1949, and later used P-chart and control chart—which are symbolic of using SPC—for machining defects.

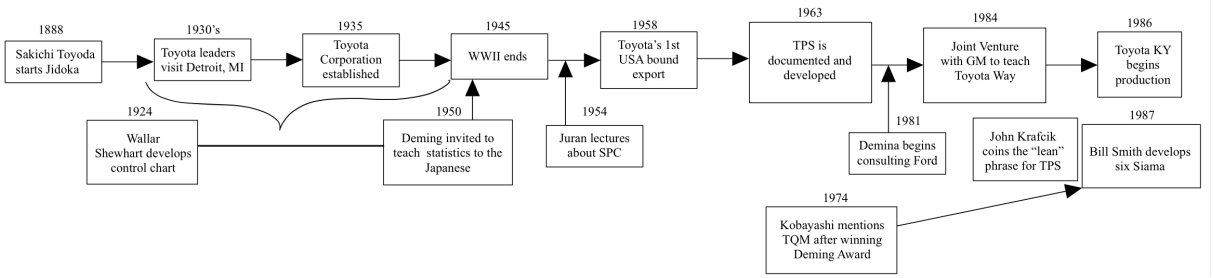

Figure 2: Timeline of quality control movement (Hallam, 2010)

"When the control charts were first put up on the shop floor, the reaction of the workers varied from complete indifference to resistance to being restricted or an excessive sense of nervousness." In 1961, Toyota introduced Total Quality Control (TQC).

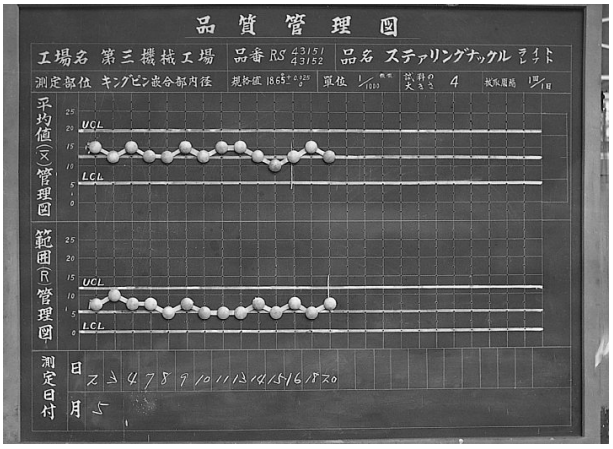

Figure 3: 1950's Toyota Control Chart (from Art of Lean.com)

3.2 The Reason Why SPC Is Not A Part of TPS

We could see Toyota used SPC for the quality control method in the Mid-20th century, but later, it disappeared in Toyota's quality control process. "By the time I worked for Toyota in the latter part of the 1980s these manual charts were essentially gone." says an employee who worked in Toyota. He pointed out the reason: "Toyota had worked hard for decades at removing the sources of common cause and special cause variation to the point where process control levels were extremely high." The book *The Toyota Way* shows the same meaning: Toyota focuses on the root causes of the problem, digging deeper, leads upstream in the process. (Liker, 2004, P253)

Toyota wants to make sure that they solve the root cause of the problem, rather than source the static shows up. That means they need another method to dig deeper since statistical tools could only find the source of the problem: today maybe a machining center, next day maybe a manufacture factory. The sources of the problem are different, but the root of the problem is always the same. To find the root of the problem, they need their method in the process, a detailed process. This is the *kaizen* and its famous five-why analysis. These methods using detailed analysis to analyze the whole process flow, identify the weak point in the program, and change it, is a detailed program instead of statistical analysis skills. Likely, the author of *The Toyota Way*, explained: "Yet most problems do not call for complex statistical analysis, but instead require painstaking, detailed problem-solving."

Michel Baudin once said: "SPC is about process capability and the quality problems Toyota addresses in 2020 are not due to lack of process capability."(2020) Toyota's capability is perfect and the was etched into its culture. "It is a matter of discipline, attitude, and culture."(Liker, 2004) But is Toyota not using any

statistical tool in quality analysis? Not. "You can find an example of every Six Sigma tool in use somewhere in Toyota at some time."(Liker, 2004, P253) Toyota use statistical analysis tool in quality control, but a tool is only a tool used in manufacture, it could not replace the whole problem analysis process, but just a part of it.

3.3 SPC: Replaced By Data Analysis In Information Age

SPC is just the tool of data analysis in the 1950s as machine calculators were not strong enough, now data science replaces it, says Baudin. (2007) With the development of computer technology, there is no longer a need for humans to calculate by the hands-on chart. SPC starts in the 1920s, reached its peak in the 1950s, and as technology developed, there is no longer a need to make control charts by hand, data analysis can show us anything on the screen.

3.4 Conclusion

In short, the reason why statistical process control is not a part of TPS way is that Toyota needs to find the roots of the problems instead of just finding the source by statistical analysis. Kaizen and its five-why analysis is a good method to identify it and works on and only on the required level of thinking team, are the discipline and culture. As time goes on, SPC is going to gradually withdraw from the stage of history, the data analysis will replace it as the analysis tool in the new edge.

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