

Problems with capability and performance indices in practice

Dr. Jiří Michálek, CSc

Institute of Information Theory and Automation

Czech Academy of Sciences

Abstract:

The contribution deals with typical problems that occur in practice by evaluating the capability of a manufacturing process. The kernel of problems is hidden in the fact that on one side there is a customer's demand presented by a required values of capability indices C_p and C_{pk} , and, on the other side there are estimates of these indices obtained from a collection of process data by the owner of that process. Usually, the customer wishes the estimates of indices must be greater than the required values. It is shown that this demand does not warrant the requested state of the process, i.e. the inequality can be valid but the process can produce a greater number of nonconforming parts. The correct answer about the situation in the process is given by the construction of the confidence interval covering the actual value of the index with high probability. This case is analyzed in a simple example. When the process is set up on the required value of index C_p then this value presents the median for estimates of the index, i.e. we can expect approximately 50% values of estimates are lower than the required C_p while 50% values are greater. We see that this fact is in the contradiction with the inequality mentioned above. It implies that the fulfilling of that inequality in any case of capability evaluation makes the owner of the process to ensure the expected number of nonconforming parts much more smaller than the required value of C_p means. The only solution of that problem is to keep the process in control with a smaller level of variability, i.e. the process must be more precise. Again, this situation is documented by an example. With an application of index C_{pk} the situation is very similar. The demands put on the value of C_{pk} need the position parameter to be under control. By the end of the contribution the introduction and application of performance indices P_p and P_{pk} are discussed. These indices were introduced at the beginning of the nineties and, e.g. AIAG (Automotive Industry Action group) in 1991 recommends that the automotive manufacturers in their alliance with their suppliers use P_p and P_{pk} when the process is not in control. It means there are no assumptions about the behaviour of the process as, e.g. probability distribution of a quality variable. The application of these indices is strongly criticized by mathematical statisticians because their estimates say nothing about the behaviour of the process in the future. But, there are situations when indices P_p and P_{pk} can be useful. In some processes there exist systematic assignable causes that cannot be eliminated from the process. Such a process then must be in control using extended control limits, and the quality variable must be normally distributed in the total sense, i.e. without respecting subgroups.