Economic measure of manufacturing performance in advanced manufacturing systems

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Abstract
Advanced production systems have a great potential for improving the manufacturing performance. However, a well-defined indicator for comparing such systems and for supporting the decisions concerning the large initial investments are not yet developed.
The purpose of this research is to arrive at a manufacturing performance indicator which includes the flexibility and the quality of the production system and the products.

1. INTRODUCTION

As a performance indicator, Son and Park [1] come with the so-called 'Integrated Manufacturing Performance' which is a combination of the productivity, the flexibility and the quality, where the quality consists of the process and the product quality, and the flexibility consists of the machine, the process, the product and the demand flexibility.

However, the combination of productivity, quality and flexibility is expressed in costs which results in opportunity costs. As in the productivity concept the costs are input quantities, they use the opportunity costs also as inputs, although these costs have to do with the output. This gives results which describe the performance in a wrong way [2].

As quality and flexibility influence the output of a production system, we have derived a concept by considering the dependence of this output.

2. THE INFLUENCE OF QUALITY AND FLEXIBILITY

The output quantity of a production system as used for defining the productivity is the real result, that is the nett
production quantity. This quantity differs from the gross production quantity as a result of imperfections of the quality and the flexibility.

If we call \( \alpha_q \) and \( \alpha_f \) the fractions of the production losses caused by these imperfections, the relation between the nett production result \( (R_n) \) and the gross production result \( (R_g) \) can be expressed by:

\[
R_n = (Q + F - 1)R_g
\]

where \( Q = 1 - \alpha_q \) and \( F = 1 - \alpha_f \).

By dividing both production results by the productivity costs, we obtain:

\[
P_t = (Q + F - 1)P_{t,0}
\]

where \( P_t \) is the total productivity and \( P_{t,0} \) the theoretical productivity which could be obtained.

Eq. (2) shows that the productivity can be improved by increasing the quality and/or flexibility and the theoretical productivity (by decreasing the production costs).

By using simulations, we have compared the productivity from eg. (2) with the integral manufacturing performance (IMP) for a job shop task and the same task using FMS.

These results show that our method can be used fruitfully to indicate the quality and flexibility influences [2].

3. CONCLUSIONS

By considering the output of a production system we have derived an expression for the productivity including the flexibility and the quality. Simulations show that this indicator can be used well to express the influence of the flexibility and the quality.

4. REFERENCES


2 De Ron, A.J., The influence of quality and flexibility upon the productivity of a production system (in Dutch), Intern rapport TUE/BDK/FT-9201, Eindhoven, University of Technology