

Equivalence Unit Assumptions on Productivity and Capacity Evaluations

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ABSTRACT

In addition to providing a wide product range and meeting individual requirements of the customers to make the companies able to orient themselves to the competitive conditions in the automotive industry, properly structuring a capacity-productivity calculation algorithm is of a great importance in obtaining a competitive price advantage. In cases product diversity is too wide, and finished products cannot be measured with a single unit, measuring the production efficiency gets complicated. In addition, the ability to analyze all the inputs and outputs of the production with a single unit based on the same value for enterprises instead of analysis of combined units carried out based on a single perspective when calculating the production efficiency of the enterprises underlies continuous improvement and being able to set goals for the processes.

This study describes an integrated system design based on equivalence logic, which can set forth production efficiency and the capacity utilization level in many aspects. First, equivalence situation of the finished products compared to one another was evaluated based on parameters such as the machine time, the labor time and energy utilization, and efficiency criteria have been developed according to the equivalent product regarding these parameters. Efficiency and activity criteria, and globally-accepted metrics (for example, from OEE) have been utilized in the study. Furthermore, the metrics that have been developed concerning measurement of the labor productivity, and could not be explained by OEE are remarkable.

The enterprises that can express their outputs in multiple units, and use only one of these units in productivity measurement will measure more accurately their productivity and capacity for their enterprises, and set their targets more realistically by applying the model created in the reference study.

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INTRODUCTION

The routine approach in enterprises having a lot of product groups and a wide product range under these groups is the tendency to express the production level with a single unit. Generally this unit is the unit that forms a basis for pricing when selling the products. Besides, pricing in enterprises varies according to the product group or the sales distribution channel.

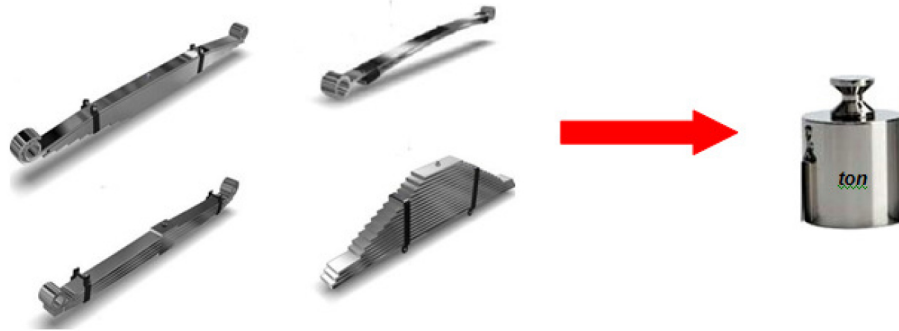
Measuring the products having different production routes with a single output unit brings along a number of mistakes in the analysis of integral capacity utilization of the enterprise, in the analysis of the production resource utilization and the dimension of the cost assessment.

For instance, in the production of the leaf spring the outputs are expressed in weight unit (Kg).

The performance differences occurred as a result of measuring the output quantities of the springs produced in different production routes having different raw materials, labor, and energy utilization values are indicated below.

Table 3 compares the numbers of finished products, the production times and labor times corresponding to one ton of production of the Spring 1 and Spring 2. Although the amounts of output are the same for these two springs in the assessments performed in Kg unit, it is seen that 5 pieces from Spring 1, and 113 pieces from Spring 2 could be produced for a production of 1 ton. Besides, there is approximately two-fold difference between the production times and the labor times.

Considering a leaf spring producer, which produces only these two products, in periods in which the spring 2 is produced intensively, the production will be reported as

**Table 1. Spring 1 - Multi-layered Conventional Spring**

Weight	:	210kg
Number in one operation	:	130pcs
Total Operation Time	:	103min.
Workmanship time	:	208man.min

Table 2. Spring 2 - Single-layered parabolic spring

Weight	:	9kg
Number in one operation	:	18pcs
Total Operation Time	:	8min.
Workmanship time	:	16man.min.

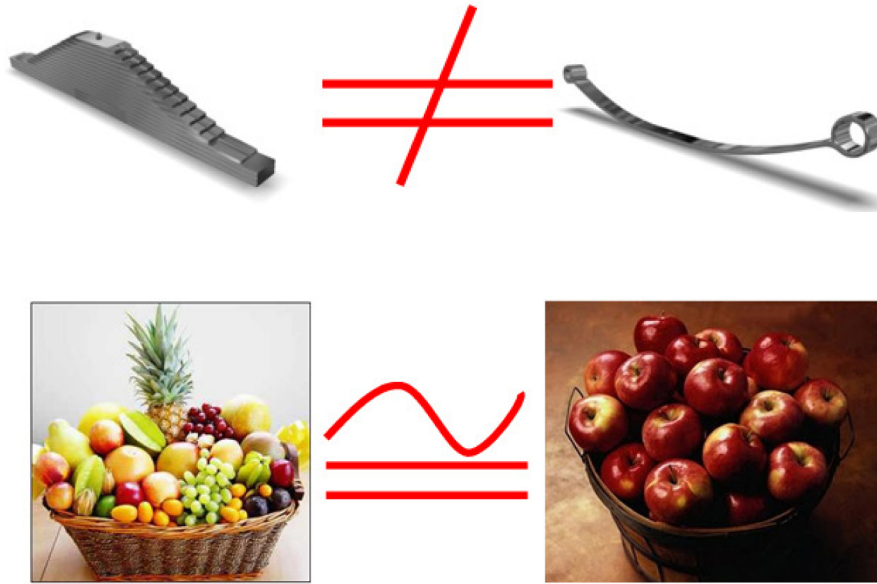
Table 3. Comparison

Parameters	Unit	Spring 1	Spring 2
Production Amount	kg	1.000	1.000
Production Amount	pcs.	5	113
Production Time	min.	491	902
Labor Time	man.min.	991	1.804

inefficient since these two products will be demanded in different combinations in every production period, and production will be realized in line with these demands. The actions taken after the periods that are not correctly reported will not be realistic, and wrong strategies will be determined for achieving the target.

Considering a period, in which 1 ton Spring 1 and 1 ton Spring 2 are produced, the total output is mentioned as 2 tons.

However, with a logic similar to the approach of opportunity cost of the machine resource employed for this period, when we focus on the subject of what the output will be when it is used for only one of these two products, the concept of equivalent product comes forth. Assessing the outputs with reference to an output is essential in productivity measurement according to the equivalent product. This is similar to assessing harvest times by assessing fruits of



various kinds in various quantities produced from a plantation with a kind of fruit.

In expressing the products in the kind of one another according the utilization of the machine resource, the total operation times of the products are expressed with the ratio of total operation time of a real product selected as the equivalent product, or of an imaginary product designed as a dummy. What is critical here is the fact that the product selected as the equivalent product has the quality of being a product conforming to the mean production specifications of the enterprise and having the power to represent the production portfolio.

The foundation of the logic of the equivalent product is based on standard times determined by the time studies for each product.

Besides the machine time, the equivalence coefficients are also different for labor times, and the standard times need to have been determined for each products for the workmanship as well. Besides, the equivalent product coefficients according to the machine time and labor time as determined for the product should go down to the operation. With a cumulative point of view, when stepping down the operations, the concept of equivalent product turns into the concept of equivalent operation. Besides the equivalence consideration as found according to the finished product as an output for a certain period, the examinations carried out on the bottleneck machine are critical. When going down to the equivalent operation, especially the analysis of the number of equivalent operations of the bottleneck machine is needed. Because the capacity determinant of the enterprise is the bottleneck machine.

CALCULATING THE EQUIVALENT CONSIDERATIONS

1.1. Selecting the Equivalent Product

The product to be selected as the equivalent needs to have the ability to represent the mean performance of the products produced in the enterprise.

There are two methods in selecting the equivalent product:

The first of these is to select as an equivalent product a real product currently produced. Preferably, this product is selected as the most demanded and produced product. Selecting the real product as the equivalent product offers a possibility to compare by determining missed or obtained opportunity. We can easily answer the question of what would be our production performance and profit if we produced the equivalent product from finished products instead of making production in a wide product portfolio. However, when we determine a real product as the equivalent, actuality of the analysis in the probability of ending the production of the product, which had been determined in time might have been lost, or the equivalence coefficients of the other products vary since the improvements or deteriorations in the operations of the equivalent product will change the total standard time. In addition, when going down to the equivalent operation analysis from the equivalent product, the equivalent operation coefficients cannot be calculated in some operations because of the probability that the route of the real product selected as the equivalent would not meet the route of all the other finished products.

Another method in selecting the equivalent product is to define a dummy-imaginary product. The dummy product