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Evaluation of Batch Production Processes Based on Seven Criterions

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Abstract

To answer growing demand on products adapted to clients' individual needs, it is required to develop new ways of measurement and rating for batch production processes. The researchers developed method which allows synthetic and complex evaluation, as well as improvement of these processes. Case study with participating observation, non-participating observation, interviews, and the analysis of historical data was conducted in order to analyse a production company. Researchers developed concept of a multi-criteria evaluation method, with rating based on the following criterions: market, economical, ecological, social, technological, planning and general development – each including individual indicators.

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Keywords: multi-criteria rating; batch process; production measurement; technological rating; process evaluation

1. Introduction

The measurement of production processes has evolved along with expansion and development of these processes and entire production systems. Over time simple measurement methods that evaluate each aspect related to realization of production process became insufficient. Creation of new, more complex measurement methods have been undertaken, which were combined into multi-criterion rating later on. It allowed to measure processes under specific aspects, and results of these more complex measurements proved useful in elaboration of improvement plans. Additionally, difference in characteristics of basic production types, which are batch, line, and stationary production [1, 5] require individual approach. Some measurement methods, which are perfectly fit for line production, provide

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unreliable results in case of being used for another type of production. In view of this dilemma, the researchers decided to develop multi-criterion measurement method adapted strictly to batch production. The concept of seven-criterion rating method includes: technological, economical, ecological, social, market, planning and general development criterions. Each criterion has individual partial measurement factors assigned to it, which allows complex rating of each aspect.

2. Designation of multi-criterion process rating measurement

Rating of production process can be performed using various available measurers, as well as multi-criterion measure, if such has been developed. If there is lack of specific measurement method for the type of process performed in company, it must be developed individually. While developing multi-criterion measurement three stages of procedure should be followed [4, 9, 12], as in scheme presented in the Fig. 1.

The first stage is associated with choice of proper measurers. Proper measurer is defined as one that allows complex evaluation of process, which means it allows the evaluation of the process in many aspects, which are corresponding with companies' main resources. For example measurement combined with machine work, personnel work and customers' rating or financial expenses. Choice of measurers must be decided by manager, with support of most experienced workers.

The second stage is associated with determination of normalization function for all measurers. Since it is possible to acquire data distinguished by variety of units and scales, it is necessary to unify collected data to dimensionless unified scale, in order to compare specific processes. The normalization function allows the transformation of the measurement value presented in its unit into normalized state corresponding to established range of values (usually values ranges from 0 to 10). Applied to all measurement, it brings all values to a common denominator. This way many incomparable otherwise measurements can be formed into multi-criterion rating measure. It is crucial to develop exactly one function for each measure in such way, that the normalized result would represent state of process corresponding to this measurement. Value of 0 is assumed to correspond with inacceptable state, while the value of 10 corresponds with perfect state and 5 corresponds with the average state. It is also possible to adopt different mathematical functions in order to normalize the results. Normalization function can be designed based on historical data regarding specific measurer from companies which share common field (comparison method) or based on experts' opinion. Both methods can be adapted simultaneously as well.

The last, third stage is assigning weights to each measurer. Correct weight assignment relies on assigning higher values to key aspects of process rating. It is assumed that sum of all weights should be equal to 1 (which corresponds to 100%). This value is not necessary, but it simplifies the calculation of synthetic measurer value. Just as in case of measurer selection or function creation, it is recommended to entrust this task to experts, in order to increase reliability of the results based on appointed weights.

Fig. 1 presents procedure of multi-criterion production process rating measurer application, along with questions used in developing measurer. The presented stages allow to personally developing measurement that would allow for complex production process rating.

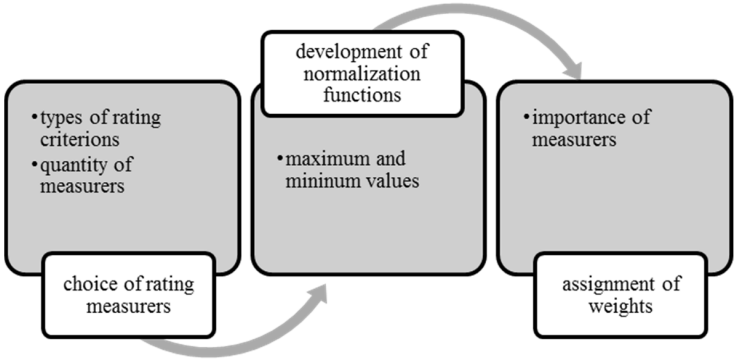

Fig. 1. Multi-criterion measurement rating development steps.