
EMPIRICAL STUDY OF SHOP FLOOR CONTROL IN BULGARIAN SMALL AND MEDIUM ENTERPRISES

■ **Abstract:**

In the current work are discussed the shop floor control problems in the Bulgarian small and average enterprises in the context of the Supply Chain Management. The researched small and average enterprises are units in the European Supply Chains which implement strategies for mass customization. The empirical research aims to evaluate the degree of effectiveness of the shop floor control systems in terms of parameters like: operational planning, dispatching, operational quality control, production system status monitoring etc. Objects of research are the small and average enterprises of lighting and furniture industries.

■ **Keywords:**

Mass customization, Shop Floor Control, Supply Chain Management

■ **INTRODUCTION**

Currently, the most significant changes in the industrial management are caused by the fact that the different industrial enterprises do not operate like autonomous entities, but they are units in various logistic chains. The logistics and the supply chain management (SCM) are becoming ever more powerful instruments for achievement of sustainable competitive advantage for the business organizations.

Over the last ten years more and more Bulgarian industrial enterprises are integrated as units in different international supply chains (SC). The business organizations are facing many problems caused by the emergence of new cooperation methods within the supply chains (SC).

In order to cooperate for successful competition under the new circumstances, the industrial enterprises should have significant capability of adaptation, mostly through various dynamic interactions. These interactions should be implemented with the participation of all the units in the supply chain (SC).

That kind of adaptation is achieved not only on physical (hardware) level. By increasing the degree of the various systems for management (integration of systems for resource management - ERP and manufacturing execution systems - MES, any change in the physical infrastructure of the enterprise leads to significant changes in the system for Shop Floor Control. The situation can be coped with through considerable efforts of the managers responsible for the operations management in the organization.

When the industrial enterprises take part in various collaborative networks (like virtual enterprises for example) they should exceed the limits of the ordinary production management (Shop Floor Control) so that they can ensure the management of different joint processes.

The dynamics of the systems for Shop Floor Control is evaluated according to the capability of the manufacturing systems of adapting to different type of changes.[1] Under these circumstances, by using relevant characteristics of the Shop Floor Control systems, the production systems should manufacture the

products for a very short time even without intervention of highly-qualified managing personnel.

The purpose of the present work is to evaluate the degree of effectiveness of the shop floor control systems with respect to parameters like: operational planning, dispatching, operational quality control, production system status monitoring etc. The objects of research are Bulgarian small and average enterprises of the lightening and furniture industries, which are integrated as units in different international supply chains.

The degree of effectiveness of the shop floor control systems in the explored enterprises is assessed in four aspects:

- Operative planning of the manufacturing
- Dispatching of the manufacturing
- Operative quality management
- Monitoring of the manufacturing system

The exploration of the Shop Floor Control condition in these four directions will allow improving the adaptation of the industrial enterprises to the requirements of the contemporary supply chains.

Basing on literature research, the author has developed a system of 26 measures for evaluation of the effectiveness degree in these four directions.

REQUIREMENTS FOR THE CONTEMPORARY MANUFACTURING SYSTEMS

Under the pressure of the contemporary business environment, considerable changes are taking place in the business organizations. These changes create new requirements for the manufacturing systems of the organizations. A significant part of the requirements is connected with the shop floor control.

The final purpose of the industrial enterprises integration is to achieve business integration within the supply chain. Finally, inter enterprise operations should be fulfilled.

For the achievement of business integration, first, it should be achieved physical integrity as well as easy and fast adaptation of the different units in the supply chain. At the present moment the problem of the physical integration is to a large extent resolved.

The main characteristics which a contemporary manufacturing system should possess are as follows: [2]

Integration of all the systems in the enterprise

- Integration of the manufacturing system with the systems of the organization's contractors (suppliers, customers, partners, etc.)
- Distributing architecture of the manufacturing system. There should be possibility for territorial distribution of the organization's production activity (operations, processes, functions, etc.)
- Heterogeneity of the elements of the production system. The contemporary manufacturing systems are composed of heterogeneous hardware and software components, incompatible with each other. Therefore, there should be suitable system for Shop Floor Control, which allows integration.
- Integration of human resources to the production system. There should be a possibility many employees with different qualification and knowledge to interact easily with the hardware and software components of the production system
- Cooperation in real time of the production system with the systems of the organization contractors (suppliers, customers, partners, etc.);
- Open and dynamic structure of the system. The production system should be open and should integrate with different new systems (or resources) in the organization. It should also be capable of removing existing systems at any time, without interrupting its own activity.
- Adaptability to dynamic organization structure of the enterprise. The production system should be able to adapt to different changes, which always occur in the organization structure as reactions to the changing environment;
- Resistance to disturbances. The production system should react adequately and timely to different disturbances and to recover fast and easy from them.

In order to come up with these requirements, there should be implemented significant improvements of the production systems of the industrial enterprises and more specifically, of the existing Shop Floor Control systems.

FACTORS FOR INCREASING THE EFFECTIVENESS OF THE SHOP FLOOR CONTROL SYSTEMS

For achieving effectiveness of a Shop Floor Control system, improvements should be made

simultaneously in the already mentioned four directions: operative planning of the manufacturing; dispatching of the manufacturing; operative quality management; monitoring of the manufacturing system.

For improvement of the operation planning, the products created by the industrial enterprises must be grouped in product families, according to similarity of the manufacturing routes.

Pull manufacturing systems must be applied in order to minimize the delays of the manufacturing systems and the quantity of work in progress. The effect of this kind of systems depends on the capability of the managers' team to control the manufacturing through cards of "Kanban" type.

The preservation of the manufacturing systems capacity as well as the minimization of the delays in case of disturbances in the resource supply and problems with different customers and partners can be achieved through transposition of customers' orders. Other options are to reach agreements with logistic contractors inside the organization in order to overcome bottle necks in the manufacturing process and to vary the size of the production lots.

The capacity of the manufacturing system in critical situations can be increased significantly by applying outsourcing.

Another meaningful factor for meeting the orders deadline is the ability of using alternative manufacturing routes for manufacturing the products.

The main factor for the dispatching improvement is the availability of detailed description of all operations implemented by the manufacturing system. Secondly, assessments should be made whether the described operations are really implemented in the required manner and whether the operation's description is expedient in practice.

In order to cope with different disturbances in real time, the important thing is how much can be shortened the lead time at the expense of speeding up of the different operations, scheduling of the operations consequence, compromise increase of the work in progress. Minimizing the setup time for transition from manufacturing of one product to other (lots, customer's order), is of immense importance.

The ability of managing the loading level of the production equipment is essential for increasing

the effectiveness of the manufacturing system. In this respect, meaningful factor is the ability of the manufacturing system operators to work on more than one working centers.

The perfection of the operative quality management allows to the industrial enterprises to plan the results of the production activity much more precisely so that the ordered products can be manufactured in the required quantities and agreed deadlines. The ability to apply statistic methods for quality management is essential for the achievement of high effectiveness of the operative quality management system. On the basis of these methods, there must be implemented different measurements, trials and tests in the production process. The results of these measurements, trials and tests must be generalized relevantly in different reports with statistic data for the quality.

The main factor for evaluation of the effectiveness of the operative quality management is the level of product reworks in the process of their manufacturing.

The maintenance of high effectiveness of the Shop Floor Control system is based also on the effectiveness of the production system monitoring.

The potential of the monitoring system depends on factors as: availability of norms and limits for resource consumption and production system loading; monitoring the ratio between consumed resources and manufactured products; monitoring the labor costs; monitoring the deviations for launch of the production lots in the manufacturing schedule; monitoring of the levels of inventories in warehouse of different resources and completed products; monitoring levels of work in progress; application of the principles of the Total productive maintenance (TPM); application of the principles for continuous improvement (KAIZEN).

Significant advantages for increasing of the monitoring effectiveness can be achieved through the application of the principles of the Total Productive Maintenance – TPM and continuous improvement (KAIZEN).

■ METHODS OF THE RESEARCH

As it was already mentioned, based on literature research, a 26-measure system was developed. On this system it can be evaluated the

effectiveness degree of Shop Floor Control systems in four directions.

The state of the operative planning of manufacturing will be assessed through the measures:

- degree of using of pull manufacturing system
- level of skills for using the "Kanban" system
- capability of rescheduling customer orders in case of disturbances
- degree of interaction with logistic contractors (suppliers) inside and outside the organization
- capability of changing the size of the production lots
- capability of applying outsourcing
- availability of alternative manufacturing routes

The state of the production dispatching will be evaluated through the measures:

- description fullness of manufacturing operations
- capability of deviation control throughout the production cycle
- capability for rescheduling operations in case of disturbances
- capability for minimization of the setup times
- capability for control of the loading level of the equipment
- capability for rotation of the working places of the operators

The state of the operative quality management will be evaluated through the measures:

- degree of applicability of the statistic methods for quality management
- implementations of measuring, trials and tests throughout the manufacturing process
- preparation of reports based on statistic processing of production data
- application of report analyses and problem identification
- remanufacturing of the production throughout the manufacturing process

The monitoring of the production system capabilities will be evaluated through the measures:

- availability of standards or limits about resource consumption and equipment load in the production system
- monitoring of the ratio between consumed resources and manufactured products quantity

- monitoring of the labor costs
- monitoring the deviations of launching production lots in the calendar schedule
- monitoring of the level of warehouse inventories (resources and products)
- monitoring of the work in progress share
- application of the principles of Total productive maintenance – TPM
- application of the principles of continuous improvement (KAIZEN).

The condition of the systems for operative management of the manufacturing in the selected enterprises will be assessed on the basis of benchmarking with leading European practices.

The benchmarking will be accomplished by experts in the sphere of industrial management selected by the author. These are managers from the average and large industrial enterprises who manage the logistics, manufacturing, procurement etc. The selected experts have more than 15 years of experience in the area where they work and observations of the best practices of European enterprises with which they cooperate.

A group of four experts was elected. They will be given the results of the author's research of the selected Bulgarian industrial enterprises. Each of the experts will be given a copy of the author's report of the explored enterprises.

Before making the benchmarking, the author has held profound observations of the Shop Floor Control systems in 10 average Bulgarian enterprises which are units in European supply chains. Four of the enterprises are from the sphere of the lightening technology and six from the furniture industry. The results of the observations are documented in a report where the author has classified his findings and conclusions enterprise by enterprise. Photo material of different objects has been attached, concerning various findings and conclusions.

On the basis of this report have been identified six enterprises which, in the author's opinion have shown the best results. The data for these enterprises is put in separate report for the experts. The experts are expected to assess the condition of the Shop Floor Control according to the European practices they are familiar with. In this special report the data is grouped in separate chapters, corresponding to the enterprises. Each chapter includes sections with

findings and conclusions in the following directions:

- condition of the operative planning of the manufacturing
- condition of the manufacturing dispatching
- condition of the operative quality management
- condition of the monitoring of the production system

The author has distributed copies of the special report among the experts in order to make them familiar with the data. Afterwards, the author held detailed discussions during which he clarified various questions concerning his findings and conclusions.

It is required that each expert gets acquainted with the author's report and afterwards gives assessment on five-grade scale. The measures on this scale characterize the condition of the Shop Floor Control in every explored enterprise.

The grades from 1 to 5 are formed as follows:

- 5 – condition which is significantly better than the average European level
- 4 – condition better than the average European level
- 3 – condition at the average European level
- 2 – condition worse than the average European level
- 1 – condition much worse than the average European level

The grades are filled in special questionnaires. They are filled in table where in the rows are arranged measures for assessment of the Shop Floor Control in four directions: condition of the operative planning of the manufacturing, condition of the manufacturing dispatching, condition of the operative quality management, and condition of the monitoring of the production system. In the columns the experts fill in the values of the measures for each of the six enterprises.

After collecting the filled questionnaires the author has processed the data. For each enterprise and for each of the 26 measures are formed average values of estimates of the four experts.

RESULTS OF THE RESEARCH

The condition of the operative planning of the manufacturing is evaluated through 7 indicators: degree of using of pull manufacturing system, level of skills for using

the "Kanban" system, capability of rescheduling customer orders in case of disturbances, degree of interaction with logistic contractors (suppliers) inside and outside the organization, capability of changing the size of the production lots, capability of applying outsourcing of activities, availability of alternative manufacturing routes for the products.

The research results show that generally, the condition of the operative planning of the manufacturing in the six enterprises is almost on the average European level. However, it is a little bit lower (2,81). Higher than the average level are the results of the capability of rescheduling customer orders in case of disturbances (3,7) and the capability of changing the size of the production lots (3,2). Very low is the level of capability of applying outsourcing (1,85) and the level of skills for using the "Kanban" system (2,55).

The condition of the production dispatching is evaluated through six measures: description fullness of manufacturing operations; capability of deviation control throughout the production cycle; capability for rescheduling operations in case of disturbances; capability for minimization of the setup times; capability for control of the loading level of the equipment; capability for rotation of the working places of the operators.

The research results show that, in terms of production dispatching, the Bulgarian industrial enterprises are almost on the average European level (2, 92). Better than the European results are the capability for rotation of the working places of the operators (3, 65) and the capabilities for rescheduling operations in case of disturbances (3, 25). Considerably lower than the European are the capabilities for minimization of the setup times (1, 75). The rest of the indicators are almost on the average European level.

The condition of the operative quality management is evaluated through five measures: degree of applicability of the statistic methods for quality management, implementations of measuring, trials and tests throughout the manufacturing process, preparation of reports based on statistic processing of production data, application of report analyses and problem identification, reworking of the production throughout the manufacturing process.

In this direction the results lag significantly behind the European practices (2, 26). Most

significant is the lag in relation to the application of report analyses and problem identification (1, 5). Almost on the European level are the capabilities for implementation of measuring, trials and tests throughout the manufacturing process (2,75) and the level of reworking of the production throughout the manufacturing process (2,6).

The possibilities of monitoring of the production system are evaluated through eight measures: availability of standards or limits about resource consumption and equipment load in the production system; monitoring of the ratio between consumed resources and manufactured products quantity; monitoring of the labor costs; monitoring the deviations of launching production lots in the calendar schedule; monitoring of the level of warehouse inventories (resources and products); monitoring of the work in progress share; application of the principles of Total productive maintenance – TPM; Application of the principles of continuous improvement (KAIZEN). The research results are at the lowest level here. The lag behind the European practices is the biggest (2, 13). Drastically lower levels are achieved for: monitoring of the labor costs (1, 5), monitoring of the work in progress share (1, 65), Application of the principles of continuous improvement (1, 8). In this direction the only measure which is almost on the average European level is the monitoring the deviations of launching production lots in the calendar schedule (2, 85). Almost on the European level is also monitoring of the ratio between consumed resources and manufactured products quantity (2,7) and the availability of standards or limits about resource consumption and equipment load in the production system (2,6).

CONCLUSION

The research results of the effectiveness level of the Shop Floor Control systems in the Bulgarian industrial enterprises which are units in European supply chains can be generalized with the following conclusions:

- As a whole, the condition of the Shop Floor Control systems in the Bulgarian industrial enterprises is almost on the average European level (2, 53). The existing lag can be overcome and the Bulgarian industrial

enterprises can operate successfully as units in different European supply chains

- The results for the operative planning and the dispatching of the manufacturing (respectively 2, 81 and 2, 92) are much better than the results of the operative quality management and the monitoring of the production system (respectively 2, 26 and 2, 13). This can be explained with the higher competence of the production managers and dispatchers in the Bulgarian industrial enterprises, in comparison to the competence of the quality and maintenance managers. Therefore, in order to reach the average European level, efforts should be made for improvement of the qualification of these managers and introducing contemporary European practices in the area of operative quality management and monitoring of the production systems.
- An important factor for the lag in the directions operative quality management and monitoring of the production system is the low level of application of contemporary technical devices for automatic data acquire like: Barcode systems, Radio Frequency Identification – RFID, computer terminals at the working places, etc. Insufficient attention is still paid to the feedback in the operative quality management and the maintenance of the production system;
- Rather unsatisfactory are the results, related to application of modern strategies for maintenance of the production system. Only at an initial stage is the application of the systems Total Productive Maintenance – TPM and continuous improvement (KAIZEN).
- It deserves to be noted that there are measures of the Shop Floor Control systems, on which the condition of the Bulgarian industrial enterprises is better than the average European level. These are the capability of rescheduling customer orders in case of disturbances (3, 7) and the capability for rotation of the working places of the operators (3, 65). These are crucial factors which affect the adaptability of the Bulgarian industrial enterprises to the requirements of the European supply chains and they should be the main source of competitive advantages.

The present work is part of the author's research of the adaptability of the Bulgarian industrial

enterprises, which are units in the European supply chains. It concerns only one of the adaptability aspects. The approach of collective expert estimates of the Shop Floor Control is intentionally chosen. The purpose is to eliminate the impact of the author's subjective opinion. The conclusions of the present work can not be considered representative for the Bulgarian industry. The purpose of the present research is mainly to probate the methods for assessment of the Shop Floor Control. In future the author plans a major research of the Shop Floor Control systems on national and supranational level. It will be carried out through participation in European projects.

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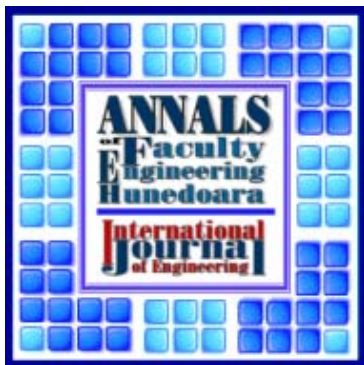
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