

# INOVÁCIE VO ZVYŠOVANÍ FLEXIBILITY DODÁVATEĽSKÉHO REŤAZCA V SLOVESKÝCH VÝRBNÝCH PODNIKOKH

## INNOVATIONS IN INCREASE OF SUPPLY CHAIN FLEXIBILITY IN SLOVAK PRODUCTION ENTERPRISES

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### Abstract

*The purpose of this paper is to analyse the innovations of various measures and approaches designed to increase flexibility in supply chains. The main focus is on assessing the extent of such applications in large and medium sized enterprises located in Slovak republic. In order to achieve this goal we use data provided by Slovak enterprises via a survey, which was conducted in the period between May 2016 and September 2016. Structured questionnaire was used to obtain data from these enterprises from Slovak production enterprises. Our findings also provide a better understanding of development of supply chains in Slovak production enterprises through the lens of innovating the measures used to increase their flexibility.*

**Key words:** Flexibility, Innovations, Production enterprises, Supply chains.

### 1. Introduction

Supply chain management is a relatively newly developed field of study (Grover & Malhotra, 2003; Wiengarten et al., 2016; Shukla & Jharkharia, 2014; Choi & Messinger, 2016; Lin & Tseng, 2016; Hjaila et al., 2016; Wang et al., 2016; Bozorgmehr & Tavakoli, 2015). It is however highly necessary to focus on development of supply chains in current conditions. Given the ever-changing business environment, resources that have historically sustained an organization's competitive advantage in business may no longer be viable. In today's globalized world, competition has gone beyond the boundaries of single firms and extended across the full supply chain spectrum. According to Moon et al. (2012) it is therefore essential that supply chain members adjust and reconfigure themselves to achieve a balance between the responsiveness of their organizations and changes in the marketplace by increasing their flexibility in all operational activities. Supply chain flexibility involves the application of supply chain resources according to marketing dynamics, and requires firms to develop cross-functional and cross-company strategies that eliminate bottlenecks and create a level of performance that allows firms to strengthen their competitive advantage in an uncertain market.

From the view of supply chain management, a number of strategic measures can be utilized to increase performance and flexibility of supply chain (Nair et al., 2011; Lockström et al., 2010; Papke-Shields et al., 2006; Wang & Wei, 2007; Ishizaka, 2014; Závadský & Závadská, 2014; Závadský & Hladlovský, 2014). Although research on flexibility is considerable and its importance has been recognized for some time, much of the research has concentrated on intra organizational flexibility and has focus largely on manufacturing systems. Current literature in the field is vast, however it mainly focuses on modelling approaches. Flexibility studies from the supply chain perspective, however, have thus far been limited. Moreover, there are no studies that focus on innovations of applied measures. There

is a research gap which lies in the lack of more complex look into business reality on national level. We set out to explore how these measures are used in Slovak production enterprises.

## 2. Methodology

The main aim of this empirical research is to analyse the innovations of various measures and approaches designed to increase flexibility in supply chains in Slovak production enterprises. In order to achieve this goal we use data provided by Slovak enterprises via a survey, which was conducted in the period between May 2016 and September 2016. We took into account the criterion of company's size. We focused our research on medium-sized and large-sized enterprises, since we assume they have a higher extent of flexibility measures applications. The decisive criterion was set according to the European Standard No. 96/280/EC. Table 1 provides information about the structure of our sample file.

Table 1 Structure of sample file

| Size of enterprise represented by number of employees | No. of enterprises |
|-------------------------------------------------------|--------------------|
| 50 - 249                                              | 276                |
| 250 - 499                                             | 36                 |
| Total                                                 | 314                |

Source: Own elaboration.

During the research period, 326 questionnaires returned completed, out of which 12 were discarded due to inconsistent data. The final sample file used in this study consists of 314 enterprises. Our sample file consists of 276 medium sized enterprises (88.54 %) and of 36 large sized enterprises (11.46 %).

### Results and discussion

In this part of the paper, we present the results of a survey conducted in order to evaluate the current state of use of measures to increase flexibility of supply chains. We asked enterprises to select measures they apply to achieve flexibility. A list of 31 options was presented to them. We created this list of methods based on literature review. In order to properly evaluate their selections, we correlated these results with information provided about the number of company's suppliers and number of their customers. Our goal was to provide a detailed analysis of integration of flexibility measures into supply chain management.

The majority of enterprises in our sample file has between 76 to 100 customers. Interesting finding is that over 19.13 % enterprises that use flexible promotion have between 6 to 10 customers, which is the highest number of enterprises using the same measure within the same interval of customer's number. Another interesting finding is that the most commonly used measure by enterprises with over 501 customers is application of concepts of continuous improvement and learning organization (20.39 %). The most commonly used measure by enterprises with 5 and less customers is the selection of suppliers based on predefined criteria (13.41 %).

Table 2 provides information about the extent of methods use in practice. According to data provide by enterprises in sample file, we divide measures into three categories. The first category consists of most commonly used measures. These are the measures which are used by more than 20 % of enterprises in our file. The next category consists of measures used by at least one of the enterprises. We named this category "used measures". Lastly also we provide information about measures which are not used in Slovak business environment.

Furthermore we explored relations between applied measures and various factors. Correlation coefficient was used to evaluate these relations and to discover significant dependences between factors. Particular coefficients were calculated according to formula 1 (Maloney, Byard, 2013) and the results are presented in Table 3.

$$r = r_{xy} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}} \quad (2)$$

where:

$x_i, y_i$  – are defined as a value of  $i$ -element belonging to dataset  $\{x_1, \dots, x_n\}$ ,

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

- the sample mean and analogously for  $\bar{y}$ .

Table 2 Level of methods' utilization

| Most commonly used measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Used measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Unused measures                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>– flexible promotion</li> <li>– selection of suppliers based on predefined criteria</li> <li>– creation of stocks of finished products for special orders</li> <li>– possibilities for redeployment of human and material resources between process and / or facilities</li> <li>– implementation of quality system standards (ISO, TQM, etc.)</li> <li>– insurance against the risk of adverse events (natural disasters, changes in the political situation, changes on financial markets, etc.)</li> <li>– customer orientation as a main strategic concept of enterprise</li> <li>– continuous improvement, learning organization</li> </ul> | <ul style="list-style-type: none"> <li>– frequent product innovations</li> <li>– frequent adjustments in pricing policies</li> <li>– penalizations for failures to comply with the terms of supply of raw materials</li> <li>– pressure to reduce production time of product or service</li> <li>– creating partnerships</li> <li>– raising orders amounts for raw materials reserves</li> <li>– product standardization</li> <li>– creating plants closer to key customers</li> <li>– the use of multiple modes and types of transport raw materials and products</li> <li>– investments in research and development</li> <li>– implementation of risk analyses</li> <li>– utilization of flexible planning systems</li> <li>– corporate culture focused on change</li> <li>– use of external logistics organization</li> <li>– periodical analysis of market conditions and product life cycle</li> <li>– preparation of back-up plans and teams of crisis management</li> <li>– long-term capacity planning</li> </ul> | <ul style="list-style-type: none"> <li>– customers' expectations forecasts</li> <li>– effective flow of information in whole SC, sharing of information with partners</li> <li>– reverse logistics utilization</li> <li>– flexible supply contracts</li> <li>– mathematical programming utilization in SC management</li> <li>– application of game theory methods in parameters settings of production factors</li> </ul> |

Source: Own elaboration.

These results indicate that there is no significant dependence between any of examined measures and business sector in which enterprise operates. However, the size of enterprise proves to be different. There is a medium-strong direct dependence between size and application of measure concerning the selection of suppliers based on predefined criteria. This result indicates that larger Slovak enterprises are more likely to use this approach when selecting a new supply chain partner. Furthermore, according to the data provided there is a significant indirect dependence between enterprise's size and redeployment of human and

material resources between process and / or facilities. This means that smaller enterprises are more likely to adopt this approach. An interesting finding is the fact that implementation of quality system standards is not dependable neither with size of enterprise nor its business sector.

Table 3 Dependences between applied measures and enterprises' characterizations

| Correlation coefficients | No. of suppliers | No. of customers | Enterprise size | Business sector |
|--------------------------|------------------|------------------|-----------------|-----------------|
| FXP                      | 0.271            | 0.637            | 0.128           | 0.107           |
| SSC                      | 0.741            | 0.186            | 0.322           | - 0.151         |
| HMR                      | - 0.205          | - 0.091          | - 0.440         | 0.018           |
| IQS                      | 0.228            | 0.153            | 0.177           | - 0.196         |
| INR                      | 0.703            | 0.168            | 0.055           | 0.164           |
| COC                      | 0.348            | 0.696            | 0.206           | - 0.102         |
| ILO                      | 0.301            | 0.221            | 0.651           | - 0.024         |

Source: Own elaboration.

Based on these findings we can conclude that enterprise's business orientation does not have any correlation effects on applied measures to increase supply chain flexibility. However, the results are different when considering the size of enterprise. Based on correlation coefficients provided in Table 5, six significant relationships were discovered. R1 represents the positive correlation between selection of suppliers based on predefined criteria and number of enterprise's suppliers. Relationship R2 is between insurance against the risk of adverse events and number of enterprise's suppliers. The positive dependence between number of enterprise's customers and utilization of flexible promotion is marked as R3. Relationship R4 represents the dependence between customer orientation as a main strategic concept of enterprise and number of its customers. Dependence between enterprise's size and utilization of redeployment of human and material resources between process and / or facilities is marked R5. The last identified significant relationship R6 is between application of continuous improvement, learning organization and enterprise's size.

Furthermore, we explored the state of innovations of applied measures. Our findings include the fact that 55.73 % of production enterprises innovates flexibility measurers annually. However, the number of measures innovated varies. The chart 1 provides this data.

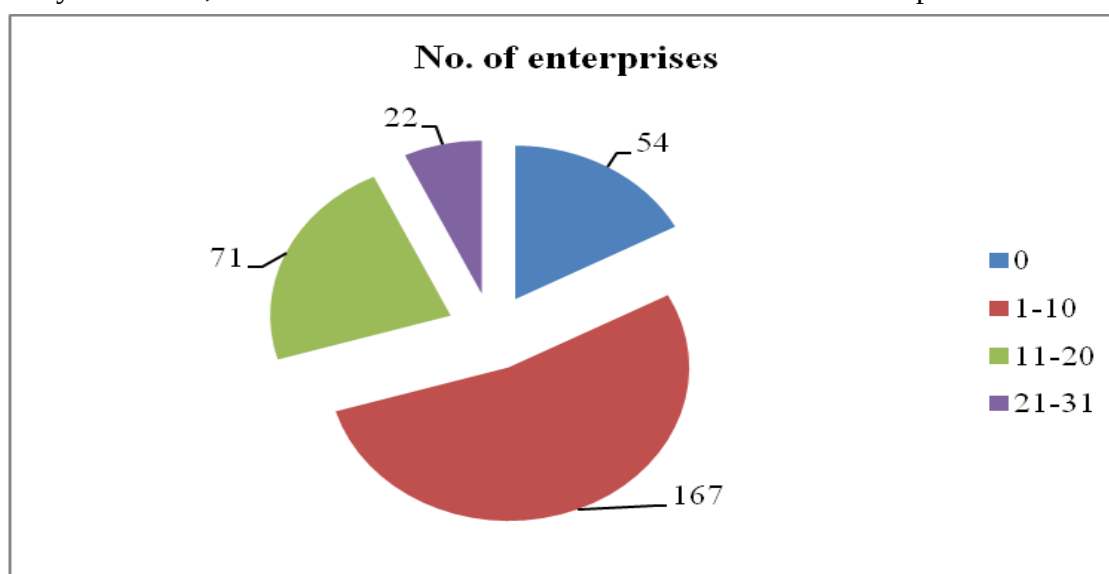


Chart 1 Number of measures innovated at least once a year

Source: Own elaboration.

## Conclusion

The main aim of this research was to analyse the state of innovations of various measures and approaches designed to increase flexibility in supply chains. Our main focus was on assessing the extent of such applications in large and medium sized production enterprises located in Slovak republic. The data was gathered by questionnaire. We provided 31 possible measures used in practice in order to increase flexibility of supply chains. Our findings describe how these measures are utilized in Slovak business practice. Our research also uncovered the measures which are currently not used.

## Literature

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