MEASURING THE PERFORMANCE OF AGILE SUPPLY CHAIN BY USING THE THEORY OF CONSTRAINTS

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Abstract The aim of the paper is to represent the importance of analyzing performances and its improvement. In the paper, it is emphasized the importance of using different performance measurement systems to enhancement performances. Following these agile supply chains are observed. Definition of performance, indicators and key performance indicators are given in the first section after introduction. The second section refers to the definition and importance of agility, agile supply chain and key performance indicators of this type of supply chain. The theory of constraints (TOC) as a performance measurement system and its overview is represented in the third section. The fourth section is based on the example of use theory of constraints for measuring and improving performances of agile supply chain. The conclusion represents the fifth section.

Keywords: Key performance indicators; agility; agile supply chain; theory of constraints.

1. INTRODUCTION

Performance can represent the achievement of a group, individual or organization. The results of measuring performance processes are indicators. Indicators represent the level of performance achievement. Except for results, performances can also be related to the way a job is done.

The paper has largely observed the performance of agile supply chains. Performances generally can be the subject of analysis in various fields. In the paper performances of the agile supply chain are observed. The agile supply chain was selected as the object of observation because of the comprehensiveness it entails. It considers processes that are performed until a product or service is delivered to the end customer, with focus on flexibility and adaptability. It also represents the theory of constraint implementation on agile supply chain improvement.

It is analyzed how the theory of constraints can be implemented on an agile supply chain to enhancement performances. There are five elementary steps when the theory of constraints is implementing. The focus is on every step implementation. Analyzing constraints as well as the way of eliminating it to improve key performance indicators over a certain period are analyzed. The key performance indicator that was chosen is flexibility. Furthermore, the selected constraint was a deficiency of distribution capacity. If there is a need, use italic for emphasizing a word or phrase. Use boldface typing only for section headings and subheadings.

2. KEY PERFORMANCE INDICATORS

Performance refers to the results that have been achieved over a certain period [1]. Performance can be defined as the way of the job execution and its results [2]. Outputs that are obtained as a result of processing some inputs can also be defined as performance [1].

An organization needs to be efficient and effective. This involves defining the performance values to be achieved for each activity performed in the organization [3]. The entire cycle from defining, through performing activities to corrective action, must be under the control of management. Management decisions should be performance-based. Collective effort in an organization is required to reach performance targets. If performance targets are achieved then the mission of the particular organization will also be achieved [4]. Except for mission, the realization of goals in one organization also depends on performance [5].Performance targets are defined based on common goals [6].

By using indicators it can be estimated or measured the level of particular goal achievement. The level of goal achievement can be measured directly or indirectly. Also, indicators show if goals are achieved by the deadline. Indicators can be quantitative or qualitative. Qualitative indicators are based on experience, while the basic characteristic of quantitative indicators is possibility of numerical expression [7]. Essentially, indicators are a measure of the success of performing a particular activity following the set goals [8].

Key performance indicators represent a narrower term than indicators. Key performance indicators refer only to those indicators that have been selected as the most representative and most appropriate to reflect the business of the organization as a whole. Key performance indicators can be set to reflect also the business of an organizational unit. Key performance indicators are selected in a way that their realization implies the realization of an organizational strategy. On the other hand, the realization of key performance indicators influences the strategy. Strategy can be aligned with the chances and threats expressed through the realization of the key performance indicators.

If the key performance indicators are defined at all levels of the organization, then different objectives of the individual business areas are necessary to be integrated. On the other hand, if key performance indicators are defined at levels of organizational units, it should be incorporated into key performance indicators at higher levels of the organization. In conclusion, it is necessary to align individual key performance indicators with the set goals of the whole organization. Key performance indicators should not exist individually or disrupt the concept of the whole. Therefore, this contributes to aligning the goals of different parts of an organization and directing them to consistent action that delivers results across the organization. If the key performance indicators are not defined well, their use will not make sense. Key performance indicators reflect the critical success factors of an organization. If the key performance indicators are inadequate, the entire organization can fail.

Key performance indicators are a measure of how an organization operates. Also, key performance indicators show an orientation towards the same goals by individual members of the organization [9]. Every individual and the whole collective must strive to achieve the goals that have been set. Goals should be set in such a way to inspire, but also to be achievable.

There are different views of the authors on the optimal number of key indicators, some of them are:

1) five [10],

2) between fifteen and twenty, but not more than twenty [11],

3) not more than ten [12],

4) there need not be clearly indicated limits to the optimal number of key indicators [13].

3. AGILE SUPPLY CHAIN

Supply chain is an organizational system that has a distinct organizational structure that allows the product or service to be delivered to the customer. The supply chain is the link between the company and the supplier and involves the production and distribution of the products to the end customer. Supply chain includes different entities, resources, information, activities, and people. In the general, the supply chain includes all transfers necessary for the valuation of goods or services in the market.

When defining key performance indicators of the supply chain, financial indicators are decreasingly used. Traditional indicators such as costs that are realized within the supply chain in contemporary business are out of focus. Key performances indicators are considered within the individual business processes of the supply chain. Key performances indicators also can be defining depend on the type of supply chain. Key performance indicators are different between lean and agile supply chains.

Agility as a term means the use of market knowledge to take advantage and use opportunities. Today market is very turbulent. Leanness means developing a value stream to eliminate waste [14]. It is about "zero inventory" and "just in time" approach [15]. A lean supply chain is focused on long term relationships and primary selection criteria in the lean supply chain are performances [16]. Lean supply chain does not respond to specific customer needs. The primary goal of the lean supply chain is total cost reduction. On the other hand, the main characteristic of the agile supply chain is flexibility. The agile supply chain must be flexible because of frequent market changes. The agile supply chain must be capable to meet violet demand. In other cases, sales will be lost [17].

An Agile Supply Chain (ASC) is considered to be the best alternative for serving difficult markets with uncertain demand, immature and innovative products, constantly changing and increasing customer expectations, etc. Therefore, continuous performance appraisal is required to ensure competitive advantage and sustainability of the business. The main limitation of the agile supply chain is time pressure.

The agile supply chain tends to be very adaptable to respond to unforeseen external economic and technology changes and changes in customer demand. The risk associated with the long and slow movement in the supply chain now is unsustainable. Traditional supply chains must be changed in a way to become more *agile*.

Employees and their knowledge have a very important place in the agile supply chain. Also, communication between participants is necessary. Products are mostly innovative. As products are regard to innovation, a premium price is set. Performances are defined following the need for the

rapid market response due to its dynamics, specificity, flexibility, growth and customer orientation. Key performance indicators reflect the degree of performance realization. Key performance indicators of the agile supply chain are often delivery speed and flexibility in time.

4. THEORY OF CONSTRAINTS (TOC)

In order to achieve sustainable performance in an organization, it is essential that processes are managed. Process management, on the other hand, requires continuous performance measurement. In order for processes to be geared toward organizational goals, performance measurement should also be linked to organizational goals. Performance measurement also involves evaluating the people involved in the processes. Financial indicators meant using traditional methods to measure them. The decision on the success of the organization was made earlier based solely on financial indicators. In period of nineteenth century for the first time was recognized need for measuring other performances. Specially, there was a need for new indicators that would reflect the organization's operations. The scope of defining performance has been expanded.

The theory of constraint (TOC) is a performance measurement system that has been significantly changed through history, especially over the last two decades. Earlier, TOC was a method to identify major obstacle to earn more profit for organization owners. Now, the theory of constraint is oriented on changes [18]. The theory of constraint is towards a constant increase in productivity, through continuous improvements.
Goldratt (1984) was the first to introduce the notion of the theory of constraint.

When TOC is used as performance measurement system, an organization is observed as a whole. The idea is to identify constraints that prevent a better business results. Constraints are searched globally, not locally. Performance improvement will be achieved with constraint enhance. The principle is that every chain is strong as its weakest link. When the weakest link is detected activities that will further enable optimization should be defined.

Key performance indicators that are usually observed in the theory of constraint are separated on financial and operational. Financial indicators are net profit, return on investments (ROI) and cash flow. On the other hand, operational indicators are inventories, operating expense and throughput [19].

There are five steps in TOC [20]:

 1)   identify the constraint,
 2)   exploit the constraint,
 3)   subordinate and synchronize to the constraint,
 4)   elevate the performance of the constraint,
 5)   repeat the process.

On figure 1 steps of theory of constraint are shown.

This performance measurement system is simple and applicable to many business segments. The theory of constraints is considerable implements in analyzing and improving supply chain indicators. The theory of constraint can be used in improving the performances of the agile supply chain.
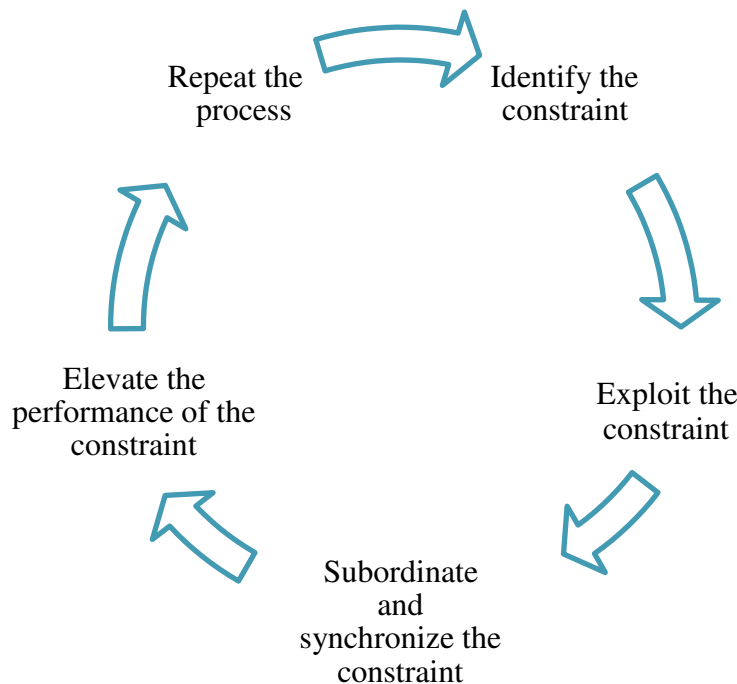
Figure 1. Theory of constraint – five focusing steps.

5. RESEARCH

There is at least one constraint in the agile supply chain. Otherwise, infinite profit can be generating [21]. Constraints in the agile supply chain can be internal or external. Also, constraints can be physical or not. Examples of physical constraints are limited resources, deficiency of distribution capacity or raw materials. In another case, examples of constraints are legacy rules, complex procedures or operational policies.

In many cases, the constraints identified in the supply chain exist because of local rules in a particular supply chain segment. One of the most important features of the agile supply chain is flexibility. When theory of constraints is used as a performance measurement system of agile supply chain, then the first constraint that can be solved is one which impact flexibility.

For example, in agile supply chain problems can be defined in distribution. If there is a deficiency of distribution capacity that can significantly affect the flexibility of agile supply chain. When the constraint is defined managers must tend to resolve it. In many cases, the identified constraint operates because of local rules in a particular segment. If this is the case, managers must seek to remove the same by changing business policy.

The second step refers to the exploitation of constraint. It is necessary to arrive at a decision on how a particular constraint will be used. This implies that capacity constraints should occur at the existing limit. In this step, decisions should be based on the way of constraint use. In accordance with previously defined constraints, the decision should be made depending on existing distribution capacities. A decision can refer to the distribution of dependent products, minimal value products to satisfied customers need or some other possibility. Proper planning and control are very important.

The third step involves subordinating everything to the identified constraint. Constraints should also be synchronized. This specifically implies the application of rules and measures that allow better exploitation of constraint. Constraint in this step should be eliminating. Following the previous example, if there is a certain influx of funds that can be used in a targeted manner, the distribution capacity will be expanded first. This leads to performance enhancement. If this problem is not initially resolved then the improvement of another segment in the supply chain will not make sense.

The fourth step refers to raise the constraint to a higher level. This means that not only expanded distribution capacity should be enough for performance enhancement. After the initial solution, orientation can be on product design advancement, new distribution technology or distribution schedule optimization.

The last step refers to continuous improvement. If a limitation defined in the first step is resolved and more, set up to a higher level, it means that there is now constraint in another part of the agile supply chain. Elimination of this constraint will contribute to agile supply chain flexibility improvement.

6. CONCLUSION

Performances of the supply chain are defined based on the tendency to integrate processes both inside and outside the organization. It is necessary for each organization to implement an adequate performance measurement system. The performance measurement system will be selected on the basis of the performance itself, the business processes being observed, the overall orientation of the organization, as well as the actual application capabilities of the specific organization. Considering the issues that include the inability to completely adapt the performance measurement system to an organization, it is necessary to make constant adjustments to specific situations as well as to update data and information. A performance measurement system that has been observed in the work and applied to measurement agile supply chain performance is a theory of constraints.

However, in general it can be noticed that not only internal decisions but also external factors can influence the performance of an agile supply chain. For example, continuous changes in demand significantly influence the agile supply chain. Changes in customer needs can contribute to an inability to utilize existing distribution capacity. In that case, new and appropriate distribution capacity should be purchase.

The theory of constraint contributes to the possibility of spotting constraints in supply chain and its solving. Based on the foregoing, as well as from the theoretical point of view, it is possible to implement the theory of constraint on agile supply chain performance improvement. This leads to better performance realization. Five defined steps in the theory of constraint should be repeated. When one constraint is resolved the other one should be identified. What is important in implementing such a performance measurement system is that participants in the supply chain must modify inappropriate business rules. Furthermore, supply chain actors need to focus on established constraints as well as on improvement initiatives.

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