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# INNOVATIVE MANAGEMENT EVALUATION METHOD BASED ON KEY PERFORMANCE INDICATORS

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***Abstract:*** *This paper aims to identify an innovative performance management evaluation method in the field of Supply Chain Management by highlighting the most relevant key performance indicators in this area. Following the methodology of bibliographic study using various secondary sources, the supply chain management system is analysed and specific key performance indicators are selected in order to develop an innovative performance management evaluation method and contribute to the efficiency and effectiveness of the entire production and create a competitive advantage on the market.*
***Key words:*** *KPIs, supply chain management, performance management, innovation, production.*

## 1. INTRODUCTION

The supply chain management system as a whole derives from the interactions between all directly or indirectly parties involved in fulfilling customers' requests and needs. Practically this involves suppliers, manufacturers, specific intermediaries, transporters, warehouses, wholesalers, retailers, clients, but also functions such as new product development, finance, marketing, operations, distribution or customer service [1]. The purpose of supply chain management is to integrate independent activities, human and material resources from the point of origin to final destination [2].

This paper aims to identify specific key performance indicators in the field of Supply Chain Management in order to develop an innovative performance evaluation method, taking into consideration the specific subsystems of the Supply Chain Management.

The paper is structured as to present the methodology of research, the analysis of the supply chain management system and then present specific relevant key performance indicators which can be integrated with a performance management evaluation method presented in chapter 5.

## 2. METHODOLOGY OF RESEARCH

The work is elaborated by using the methodology of bibliographic study and qualitative research by various secondary sources from different authors.

Secondary research is based on the study of secondary data, data already known as information material. The secondary research facilitates the incorporation into the problem and is characterized by rapid data collection [3].

We distinguish internal and external data. External data are known to the public, such as the different information that can be obtained through various existent research, such as online surveys, publications or official statistics. Internal data are data that are not available to the public [4].

The qualitative research can be used whenever the progress of the research field is not so well developed. The qualitative research includes the collection, recording of motives, needs or images [5].

## 3. ANALYSIS OF THE SUPPLY CHAIN MANAGEMENT SYSTEM

The supply chain management system includes the whole evolution of any product

from raw material to finished product, taking into consideration all the successive transactions and transformations [6]. This links the supply with the transformation and demand, referring to procurement, production and distribution. (see Figure 1.1.)

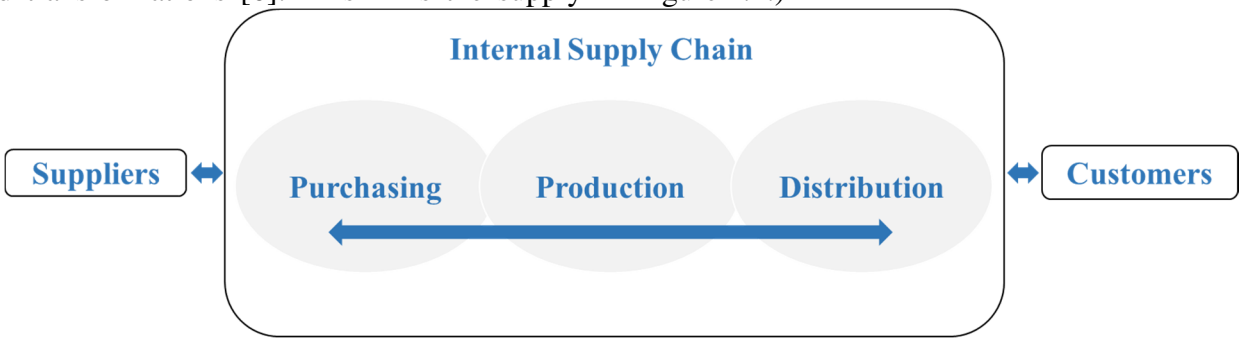


**Fig. 1** The company's supply chain [7]

Supply chain management aims to produce and distribute at the right time, in the right quantity and to the right locations, in order to reduce system wide costs while satisfying requirements, by taking into consideration every factor (from supplier, manufacturing facilities, warehouses, distribution, retailers, stores) that has an impact on cost and plays an important role in forming the good conform to customer specifications and requirements. In some cases, also the suppliers' suppliers and the customers' customers have to be taken into consideration having an influence on supply chain performance [8].

The supply chain management can improve the productivity and business function, can develop better customer relationship, improve service, create better delivery mechanism by reducing delays, minimize warehouse and transportation costs, direct and indirect costs, improve shipping conditions, enhance inventory management, assists companies in adapting to the economic challenges and changes, assist in minimizing wastes or achieving efficiencies throughout the supply chain process [9].

A supply chain integrates beside the purchasing, transformation and distribution of the material flows, the informational flows referring to electronic data exchange or website linkages and also the financial flow including the specific payments between company-suppliers- subcontractors for specific goods or services and between the customer and retailer for the final product [10].

Taking these aspects in consideration, the supply chain management can be represented and described in the following figure (see Figure 2).

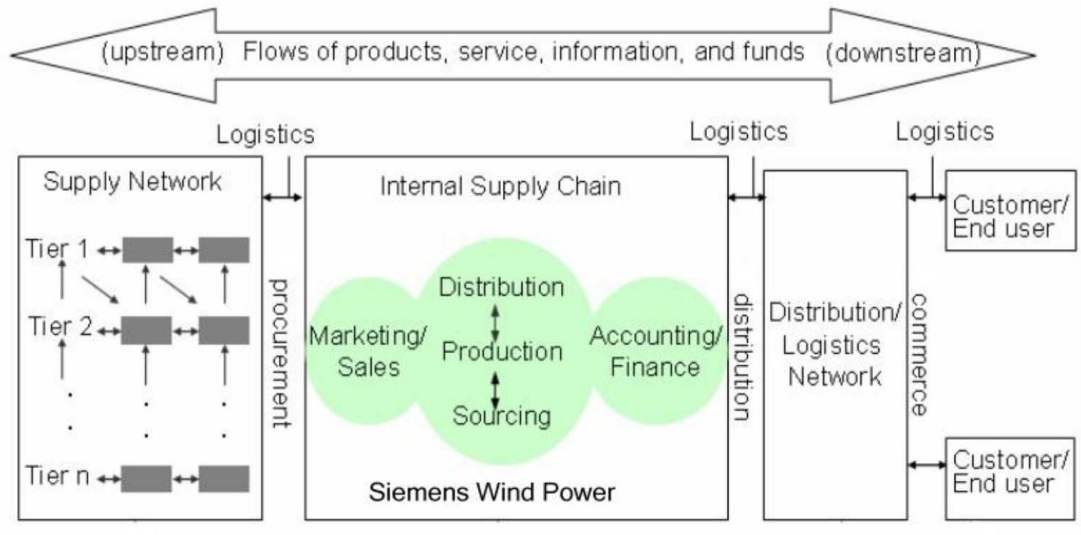


**Fig. 2** Analysis of a supply chain [12]

Moving materials inwards from supplier are described as upstream and those after the organization, from outwards to customers are called downstream [11].

Upstream activities are divided into tiers of suppliers. A supplier that sends materials directly to the operations is a first-tier supplier; one that sends materials to a first-tier supplier is a second-tier supplier and so on back to the original sources.

Each product has its own unique supply chain. The supply chains are in general very complex, spanning many suppliers, different types of operations, geographical locations, technology, types of customers and others. The supply chain describes the total journey of materials as they move from suppliers to end consumers.

Despite the normal flow direction from the supplier to the end consumer, the process flow can be directed also back up from consumer to producer for different reasons such as service, product returns, remanufacturing, refurbishing, disposal, recycling or reuse of materials [13].

The supply chain management can be influenced by the customer satisfaction, flexibility, material flow integration, information, risk management, suppliers, planning activity, production, delivery but also other factors [14]. Supply chain strategies have to be determined and aligned with specific goals of the organisation taking into consideration the development chain with the new product introduction. It is challenging to aim at a global optimization, by minimizing systemwide costs and maintaining systemwide service levels, especially when an entire system is being considered, risk and uncertainty being inherent in every supply chain, what machine and vehicles breakdowns, customer demand forecast, transportation time and condition and other external factors. In order to reduce this risk and costs recent trends such as outsourcing, offshoring or lean manufacturing have been followed [15].

## 4. KEY PERFORMANCE INDICATORS IN THE FIELD OF SUPPLY CHAIN MANAGEMENT

The Supply Chain Management represents the entire flow of goods from the supplier to the producer and to the end consumer, from raw material to finished product, taking into consideration all transformations.

This flow begins with the flow between several suppliers, the company being influences also by the suppliers' supplier, taking into consideration potential delays or quality issues. The entire process includes various functions, such as purchasing, R&D, quality, logistics, production, performance management, marketing, human resources, finance, IT, project management and ESH. In order to ensure a good functioning of the production, the relationship with suppliers, the transportation conditions, payment conditions, quality of goods, packaging, delivery terms and delivery time are some of the key aspects.

In the transformation process various subsystems are involved, such as demand management, supplier management, contract management, product development, purchasing, warehouse management, production management, distribution and sales management. Following these specific subsystems several KPIs have been highlighted as one of the most relevant when measuring demand management performance [16], [17], [18], [19], [20], [21], [23], [24], [25], [26], [27], [28]. These KPIs have to be considered in developing an efficient performance management evaluation method focusing on all subsystems and functions of the supply chain management system.

**KPI name: # Order fulfilment lead time**

KPI definition: A measure of an organisation's ability to quickly serve customer demands. This figure measures speed of service and indicates the average time from order placement to customer receipt.

KPI formula: # Order fulfilment lead time = Time of order fulfilment – Time of order receipt

**KPI name: # Order cycle, order entry to shipment**

KPI definition: Measures the time in calendar days from order release to manufacturing to customer shipment.

KPI formula: # Order cycle, order entry to shipment = Order shipment – Order manufacturing – Order released

**KPI name: # Order authorization to order receipt cycle**

KPI definition: Measures the time in calendar days from customer order authorization to order reception.

KPI formula: # Order authorization to order receipt cycle = Customer order authorization date – Order reception date

**KPI name: % Delivery performance**

KPI definition: Measures the percentage of orders delivered by the supplier, which are both complete and on time. To provide an indication of the service delivery performance, the level of operational excellence as a driver for organization's satisfaction in terms of quality, by referring to how often the organization receives the right amount at the right time of the right product as ordered.

KPI formula: % Delivery performance = Number of orders in full and on time / Total number of orders received * 100

**KPI name: € Supplier backlog**

KPI definition: Measures the value of the components and raw materials which were supposed to be already delivered to the organization. To indicate the supplier's performance in terms of delivering the orders to the organization on time and in full.

KPI formula: € Supplier backlog = Value of orders placed to the suppliers – Value of delivered orders to the organization

**KPI name: % Schedule lines delivered early / late**

KPI definition: Measures how many of the suppliers' purchase orders are delivered on time as agreed. To indicate the supplier's performance in terms of delivering the orders purchased on time.

KPI formula: % Schedule lines delivered early / late = Number of purchase order lines delivered on time / Total number of purchase order lines delivered * 100

**KPI name: % Changes to contract specifications**

KPI definition: Measures the percentage of the changes to contract specifications, from total changes to contract. To indicate the variations of changes and the ability of the contract parties to follow the pre-established specifications.

KPI formula: % Changes to contract specifications = Number of changes to contract specifications / Total number of contracts * 100

**KPI name: % Contract breaches due to non-compliance**

KPI definition: Measures the percentage of breaches of contracts due to non-compliance with agreements, from total contract breaches. To indicate the risk level generated by non-compliance with the contract. Breach of contract for sure exposes the erring party to liabilities penalties and of course to such tremendous amount of inconvenience.

KPI formula: % Contract breaches due to non-compliance = Number of contract breaches due to non-compliance / Total number of contract breaches * 100

**KPI name: # Contract complaints**

KPI definition: Measures the number of complaints or exceptions for the active contracts in a given period. To indicate the quality of contracts management as complaints indicate customer dissatisfaction.

KPI formula: # Contract complaints = (A1 + A2 + A3 + … + An) / n

Ai = Number of complaints for contract "i", where i=1 to n

n = Total number of active contracts in the given time period

**KPI name: # Time to market new products / services**

KPI definition: Measures the amount of time from product envisioning to its release on the market. To reflect the efficiency of innovation practice in terms of realizing concepts into actual products.

KPI formula: # Time to market new products / services = Duration of time from product concept to market availability

**KPI name: % Customer satisfaction with new products and services**

KPI definition: Measures the level of satisfaction among customers as percentage of satisfied clients with the new products and services resulted from innovation projects. To indicate the satisfaction level of the customers with the new launched innovations (products services) as this is an important indicator for the success of the organization.

KPI formula: % Customer satisfaction with new products and services = Number of satisfied customers with the new products and services / Total number of customers * 100

**KPI name: % Products meeting cost target**

KPI definition: Measures the percentage of new products that did not overrun their initial projected development cost from overall new products. To indicate the efficiency of the company in meeting their projected product development costs.

KPI formula: % Products meeting cost target = Number of newly developed products that met projected costs / Total number of newly developed products * 100

**KPI name: % Perfect purchase order rate**

KPI definition: Measures the purchase orders which are considered to be received on time, complete and without damages from suppliers, out of total purchase orders. To indicate the supplier's performance in delivering purchased orders according to the requirements.

KPI formula: % Perfect purchase order rate = Number of perfect purchase orders, received on time and without damages from suppliers / Total number of purchase orders * 100

**KPI name: # Average payment period for production materials**

KPI definition: Measures the average time from receipt of materials and payment for those materials. It is in a company's best interests to pay its suppliers slowly. The longer the average payment period the more efficient the business.

KPI formula: # Average payment period for production materials = (Value of materials payables / Total cost of materials) * Number of days in the defined period of time

**KPI name: % Supplier on-time delivery**

KPI definition: Measures the percentage of units or order value that arrives on or before the requested delivery date. The on time shipping rate is key to customer satisfaction. A high rate indicates an efficient supply chain.

KPI formula: % Supplier on-time delivery = Number of on-time units / Total number of units * 100

**KPI name: % Customer complaints due to poor service or product quality**

KPI definition: Measures the percentage of customer complaints registered by the organization as a result of poor quality of services or products offered out of the total number of complaints received. To assess the level of customer dissatisfaction due to poor quality of services and / or products.

KPI formula: % Customer complaints due to poor service or product quality = Number of customer complaints due to quality of services or products / Total number of customer complaints * 100

**KPI name: € Customer backlog**

KPI definition: Measures the value of the end products which were supposed to be already delivered to the customer. To reduce special transport costs to the customers and increase customer satisfaction.

KPI formula: € Customer backlog = Value of orders placed by the organization – Value of delivered orders to the organization

**KPI name: # Days sales outstanding**

KPI definition: A measure of how quickly revenue can be collected from customers. A low day's sales outstanding indicates a more efficient business.

KPI formula: # Days sales outstanding = (Number of receivables / Total number of sales) * Number of days in the defined period of time

**KPI name: # Stock level**

KPI definition: Measures the number of days in which, according to the future sales forecast, the locally held stock would be completely used up. To provide a time estimation when a reorder

must be made or when the stock falls to its calculated order point.

KPI formula: # Stock level = Number of days required to use / sale the existing stock

**KPI name: # Safety stock**

KPI definition: Measures the level of extra stock that is maintained below the cycle stock to buffer against stock-outs. Safety stock exists to counter uncertainties in supply and demand. To provide an indication of the optimum level of extra stock needed to protect the organization from stock-outs caused by inaccurate planning or poor schedule adherence by suppliers.

KPI formula: # Safety stock= E* √(A*B^2+ C^2* D^2 )

A = The average time between placing an order and receiving the demanded products (Lead time)

B = The standard deviation of the product demand

C = The average number of demands

D = The standard deviation of the lead time

**KPI name: % Stock to sales ratio**

KPI definition: Measures the percentage represented by the value of stock owned by the organization in the total value of sales generated, during a specific time period. To indicate the inventory conversion from stock to sales. It expresses the connection between the value of stock at the beginning of the time period and the value of sales.

KPI formula: % Stock to sales ratio = Value of stock at the beginning of the time period / Total value of sales during that time period * 100

**KPI name: # Average cycle time**

KPI definition: Measures the average time to produce a product with current resources and staffing. In more general terms, it is the total time taken to move a unit of work from the beginning to the end, or the time the product enters production until it is available for shipment. To provide an indication of the time for a complete production cycle which measures efficient equipment use and labour productivity.

KPI formula: # Average cycle time = Duration of production time / Number of products

**KPI name: € Unused production capacity costs**

KPI definition: Measures the difference of cost of actual production capacity and the cost of production capacity used. To provide an indication of financial efficiency within the production process due to not using the overall production capacity.

KPI formula: € Unused production capacity costs = (Total production capacity – Number of actual production realized) * Value of each product

**KPI name: € Production backlog**

KPI definition: Measures the value of the ordered end products against the produced end products, without changing the date of the release of the production orders. To provide a clear indication of the assembly's cost efficiency.

KPI formula: € Production backlog = Value of ordered end products at the assembly lines / Value of produced end products by the assembly lines * 100

**KPI name: € Damaged goods per shipment**

KPI definition: Measures the value of damaged goods on average per shipment. To indicate the quality of shipment and the cost level encountered with damaged goods during delivery.

KPI formula: € Damaged goods per shipment = Value of damaged goods / Number of shipments

**KPI name: % Cross-docking operations**

KPI definition: Measures the percentage of cross-docking operations from the distribution operations in flow. To indicate the usage of cross-docking as this can be a solution to improve distribution service to customers while reducing handling and storage costs.

KPI formula: % Cross-docking operations = Number of cross-dock operations / Number of logistics operations in flow * 100

**KPI name: # Loading time per vehicle**

KPI definition: Measures the loading time (in minutes or hours) on average per vehicle loaded used for logistics and distribution. To indicate

the efficiency and productivity in loading vehicles as part of the distribution process.

KPI formula: # Loading time per vehicle = (A1 + A2 + A3 + … + An) / n

Ai = Loading time per vehicle 'i' where i=1 to n

n = Number of vehicles loaded

Related KPI: # Unloading time per vehicle; which measures average unloading time per vehicle used in the logistics chain.

Related formula: # Unloading time per vehicle = (A1 + A2 + A3 + … + An) / n

Ai = Unloading time per vehicle 'i' where i=1 to n

n = Number of vehicles unloaded

## 5. PERFORMANCE MANAGEMENT EVALUATION METHOD

In order to ensure process improvement, products and services augmentation and to deliver superior performance and profits, managers need to choose the best tools and methods to evaluate performance and help them take better, wiser and more sustainable business decisions. There are several performance management evaluation methods, such as total quality management or supply chain management as a performance evaluation method that could be considered in order to ensure an efficient and effective supply chain management system.

### 5.1 Total Quality Management as a performance management method

A Total Quality Management (TQM) method is a systematic performance evaluation method aimed at quality improvement with a main focus on the product and customer specifications to increase performance. Therefore, TQM has a primary objective to deliver products accordingly, with zero defect and no customer reclamations [29].

By successfully implementing this performance evaluation method, organizations can increase profits, boost production and increase customer satisfaction.

**It is recommended** that managers should make following steps in order to implement a TQM method:

- Assess present data and predict future customer requirements and innovate products and services to surpass customer needs to achieve cost-efficiency;
- To ensure quality delivery, the main problem areas in the process should be identified and insisted upon increasing their performance until the process becomes close to zero-defects. Specific effective measures for process quality should be developed and implemented. Also, employees should be trained to properly used the new processes [30];
- Incentives can be provided to ensure that the quality objectives are reached and to promote a zero-defect philosophy. Management should lead by example, get involved, be close to the employees and ask for and implement received feedback to ensure continuous improvement.

### 5.2 Supply Chain Management as a performance management method

In order to meet customer's demands, all parties involved are synchronized by the supply chain management, these include suppliers, manufacturers, distributors, transporters, dealers and customers. This approach relies on new technologies to allow harmonious exchange of information and goods and services beyond organizational boundaries.

Following this method performance management results can be evaluated in a closer relationship among all parties involved in the value chain in order to ensure the delivery of the right product or service in the right time, at the right place and for the right cost.

**It is the author's opinion** that the primary goal should be to establish such strong bonds of trust and especially communication among all involved parties as to function effectively and efficiently as one fully aligned business process unit to achieve customer satisfaction.

**It is recommended** that a Supply Chain Management performance management evaluation method should be implemented as follows:

● Increase the trust and communication levels with key links in the supply chain. This results in a long-term commitment with selected partners. Managers should focus on a win-win philosophy;

● Increase the exchange levels of information and cross function processes. This creates a more accurate, long term and up-to-date database of present and future demand forecasts, stock levels, capacity utilization, production planning, delivery dates and other data that

help all involved supply chain partners improve their overall performance;

● Align the supply chain to function as one integrated process rather than separate independent business units. This leverages the core competencies of each involved party, creates a better information exchange, determines management processes change and incentive systems, unproductive activities are eliminated, long-term forecasting is improved, stock levels and cycle times are reduced and customers are involved in a higher level in the Supply Chain Management process.

## 6. CONCLUSIONS

By determining the functioning of the supply chain management system, various approaches of different authors regarding the elements and influence factors of the SCM system have been consulted. Every analysed approach captures only partially the entire flow of the SCM management system, so that in the author's point of view each model described above presents some gaps regarding its subsystems and processes described or regarding its influence factors.

With a purpose of capturing all the subsystems and influence factors involved in the supply chain management and to surprise the entire flow of goods from the supplier to the end consumer, all functions that influence this system have been identified, such as purchasing, R&D, quality, logistics, production, performance management, marketing, human resources, finance, IT, project management and ESH. Also, various subsystems are involved, such as demand management, supplier management, contract management, product development, purchasing, warehouse management, production management, distribution and sales management. Also, specific performance management evaluation methods have been identified.

After an intensive analysis based on bibliographic research but also on own experience, a KPI for each of the nine subsystems identified, namely demand management, supplier management, contract management, product development, procurement/ purchasing, warehouse/ inventory management, production management and distribution management has been identified.

In order to develop an efficient performance management evaluation method, it is strongly recommended to include all twenty-seven KPIs valid for every subsystem identified.

## 7. ACKNOWLEDGMENT

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## METODĂ INOVATIVĂ DE EVALUARE A MANAGEMENTULUI, BAZATĂ PE INDICATORI CHEIE DE PERFORMANȚĂ

***Rezumat:*** Lucrarea urmărește identificarea unei metode inovative de evaluare a managementului performanței în domeniul managementului lanțului de aprovizionare logistic prin evidențierea celor mai relevanți indicatori cheie de performanță în acest domeniu. Urmărind metodologia studiului bibliografic care utilizează diferite surse secundare, se analizează sistemul de management al lanțului de aprovizionare logistic și se selectează indicatori cheie de performanță specifici pentru a dezvolta o metodă inovativă de evaluare a managementului performanței și a aduce contribuții reale în ceea ce privește eficiența și eficacitatea întregii producții și a crea un avantaj competitiv pe piață.

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