# The Influence Of ERP Systems On The Performance Indicators Of The Supply Chain Management

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**Abstract**. ERP producers claim that their products have been tested and established due to lots of experiences and this important issue makes them capable of offering extraordinary solutions for various parts of the industry and services. A lot of research is currently being done on the impact of ERP (Enterprise Resource Planning) systems on business performance. The results show that after implementation of the ERP system, many benefits in terms of performance were generally achieved, but also that some benefits previously associated with the ERP system were not fully achieved. In this context the aim of this of this study is to understand the benefit and challenges associated with the integration between ERP systems and supply chain management..
**Keywords:** ERP system, Supply chain management, performance indicators

## INTRODUCTION

The term Enterprise Resource Planning – ERP was first introduced by the Gartner Group of Stamford, Connecticut, in the early 1990s [1]. ERP systems are applied business process management software that manages and includes a company's financial, supply chain, manufacturing, distribution, transportation, reporting, human resources, and marketing activities. ERP systems help in collecting, storing, and managing data from different departments of the company to create a pertinent overview of it with real-time data. A modern ERP system offers flexible implementation options, improved security and privacy, durability, and low-code customization, being able to adapt to every process of a company. The fundament of a system architecture for company is constituted by ERP systems with WMS (Warehouse management system) and TMS (Transport management system) modules, figure 1.

- ERP - is the abbreviated from enterprise resource planning systems. The functions it performs are purchase, materials management and sales. Its main users are manufacturers and trading companies.
- WMS - is abbreviated from Warehouse Management Systems. Its main functions are as follows receipts put-away, bin management and order picking. Its main users are logistics service providers and wholesalers.
- TMS - is the abbreviated from Transportation Management Systems. Its main functions are the following transport booking, planning and monitoring. Its main users are forwarders and carriers [2].

The integration of the ERP system with WMS and TMS modules cannot only give full play to their respective advantages but also make the data of the ERP system timelier and more effective, work more efficiently, and promote the process of enterprise industry 4.0 construction [3].

Most enterprises do not realize the impact of ERP system on enterprise development. In Romania, many entrepreneurs consider that the implementation of an ERP system is just another operational cost, but, the use of an ERP generates added value on multiple levels, and the initial investment is amortized very quickly. Parametrization in Catia V5 is a technological approach involving the definition and utilization of parameters to control the geometric features and dimensions of a component. Essentially,

parametrization allows for the definition of variables, such as length, width, or height, in a flexible manner, providing the capability to easily adjust these values based on project requirements.



**Figure 1.** ERP system with WMS and TMS modules [2]

This perception is influenced by many factors, including:
- Initial costs – the initial implementation of an ERP system involves important investments in software, hardware, training, and consultancy. These costs are seen as a financial burden.
- The complexity of the implementation process – integration in the ERP system of an organization takes time and resources. This process is seen as difficult and energy consuming.
- The resistance to change –the employees and the management can be reserved in adopting the new system. The change can be seen as a perturbance of the daily routine and of the usual way of working.
- The need to prove benefits – the managers want to have a clear improvement of the performance after the implementation of an ERP. If these benefits are not obvious, they can consider that the investment is not needed.

A recent study made in Romania analysed the impact of implementing the ERP systems on the financial performance of companies. The results show that the impact is reduced, compared with the expectations of the managers [5].

However, it is important to recognize that implementing an ERP system can bring long-term benefits such as optimizing processes, increasing efficiency and improving service quality. ERP systems help companies achieve their business goals [6].

According to the study The Total Economic Impact™ of Microsoft Dynamics 365 Business Central conducted by Forrester, the average payback time of the investment in the implementation of an ERP system drops to 1 year. In this context, this article will analyze the influence of the implementation of an ERP system on the performance indicators of supply chain management. Are studies that have demonstrated an improved operational performance for companies that have implemented ERP systems. In addition, benefits have been found in terms of data accuracy and simplification of processes [7, 8].

## ERP AND SUPPLY CHAIN INDICATORS

### *The initial supply chain*

The supply chain management is based on the corelation and cooperation, exchange of information and common planning - in view of its efficiency and competitiveness. The initial supply chain is specific to an automotive company, and it's based on using Microsoft Excel following the next steps:
- Creation of the supply requisition - Microsoft Excel
- Conversion of the requisition into a supply order - Microsoft Excel
- Sending supply orders and confirming delivery terms - email
- Goods reception divided into the following stages:
  - Physical reception of goods:
    - ✓ Verification of whether the references and quantities received match those in the delivery documents.
    - ✓ Identification of the order number for which the parts were supplied.

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           ✓   Editing specific labels with references.
- - Computerized goods reception - recording received goods in an Excel file for consultation by the logistician who supplies the parts.

- Goods storage consists of storing them until they are released to production. Storage is done on the metal shelves in the warehouse (Figure 2), with parts stored according to project.
- Finally, the Excel table is checked to ensure that the received quantity matches the recorded quantity. Inventory is periodically checked by the logistician by reading the table.



**Figure 2.** Modul of products storage

Currently, the automotive components manufacturing enterprise has a list of 156 approved suppliers, among which 120 are significant suppliers of raw materials, packaging, spare parts for equipment, etc., and 36 are service providers (mold design and execution, transportation, metrological measurements and emissions, water, and gas suppliers, etc.).

Therefore, good supplier performance can bring multiple advantages in terms of efficiency, quality, and costs in the procurement process. It is important to establish and maintain strong relationships with suppliers and to constantly monitor their performance to identify improvement opportunities and ensure a beneficial partnership for both parties.

Monitoring the performance indicators of the supply process can be useful for addressing several challenges faced by supply chain management:

- Evaluating supplier importance: a high share indicates increased dependence on that supplier and possible vulnerability if the supplier cannot meet requirements or has operational issues. In this case, it may be necessary to find alternatives or develop strategies to diversify the supplier base.
- Negotiating contracts and conditions: suppliers with a significant share of total purchases can be approached differently in contract negotiations. A high share may provide a stronger position in obtaining better prices, more favourable payment terms, or more advantageous commercial conditions.
- Monitoring supplier performance: the share of total purchases can be used to monitor supplier performance over time. If a supplier has a high share, it is important to regularly monitor quality, timely delivery, and other key aspects to ensure that the supplier meets expectations and does not pose significant risks to the procurement process.
- Identifying opportunities for cost optimization: analysing the share of total purchases can reveal opportunities to streamline costs through negotiation and consolidation of purchases with high-share suppliers. This may include centralizing purchases, benefiting from economies of scale, or negotiating more favourable conditions due to higher purchasing volumes.

***SUPPLY chain indicators***

The KPIs are specific indicators used to evaluate the performance of an enterprise or a process. They are directly linked to strategic objectives, reflect the success in achieving them, allow managers to assess whether the objectives are met, and identify areas that require improvement. The study presented by [9] shows that a successful organization should have most of its activities be linked to key performance indicators (KPI). The KPIs help to monitor the progress made to reach the objectives and to identify deviations. These allow the managers to take corrective measures in useful time.

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In paper [10] defines a systematic process of structural performance improvement through the development of individual and group performance. KPIs are an important tool in communication between teams and hierarchical levels. They ensure that all employees understand priorities and their contribution to the organization's success. Managers are responsible for monitoring KPIs and taking necessary actions to achieve objectives.

The paper [11] investigated organizational performance management in the organization of third-party logistics service providers. The performance of the supply process is measured by monthly and biannual KPIs. The KPIs that were influenced by the implementation of the ERP system are defined in the following [12, 13].

Monthly:

1) *Stock Level = average monthly stock lever/ daily consumption.* This KPI represents the estimated time in which the available stocks can satisfy the average daily demand or consumption of a certain resource or product. This indicator is used in inventory and supply chain management to assess the efficiency and sustainability of inventory in the context of supply and provides insight into the ability of inventory to meet consumer demands within a given timeframe.

2) *Transit time in supply = Monthly raw material stock level/ daily purchasing quantity.* Is a measure used in supply chain management to assess the average time it takes for an order or batch of products to get from supplier to destination. This indicator provides information on the speed and efficiency of the transit process and can influence inventory planning and supply management. This indicator can be used to evaluate the performance of suppliers in meeting delivery deadlines and to identify potential problems or delays in the supply chain.

3) *Supply Breakdown Indicator = Quantity of missing raw material/ Quantity of needed raw material (monthly).* Also known as unavailability indicator or stock-out indicator, is an indicator used in inventory and supply chain management to assess the frequency and severity of situations where a particular product or resource is not available to be delivered or used at the time requested. A high supply disruption rate can have negative consequences, such as loss of customers or a reduction in customer satisfaction, financial losses, and damage to the company's reputation. On the other hand, a low supply disruption indicator shows a better performance in managing inventory and meeting customer demands. Monitoring and analyzing the supply disruption indicator is important for identifying supply chain issues, improving inventory planning, and scheduling, and taking corrective action to minimize product unavailability.

4) *Safety Stock Indicator = End of month raw material stock level/ Monthly consumption per family of products.* Represents a quantity of additional stock held in warehouse for risk management and insurance of supply in unforeseen situations or in case of fluctuations in demand and delivery. This additional stock is maintained to protect the organization against delays in delivery, quality defects, changes in demand or any unforeseen events which could affect stock availability. The safety stock in supply is calculated based on the level of risk accepted and the level of service desired. The higher the risk of breakdowns or delays, the higher the safety stock in supply will be. It can be expressed either as an absolute quantity (for example, the number of units of the product) or as a period (for example, the number of days of consumption). The role of safety stock in supply is to mitigate risks and ensure stock availability in critical situations.

Biannual:

1) *Supply Quality Indicator* = calculated for each family of products, is the ratio between the Quantity of Non-conforming raw material (or products) supplied and the total quantity of row material (or products) supplied (%). The Quality in Supply Indicator is a metric used to assess the level of quality of products or raw materials supplied within a supply chain. This indicator reflects the extent to which the products or raw materials meet the established quality specifications and requirements. The supply quality indicator - SQI is a measure used to assess the level of performance and compliance of suppliers or supply processes in terms of the quality of the products or services provided. This indicator aims to ensure that the raw materials, products, or services provided meet the specified quality standards and requirements.

2) *The supply service indicator* - IS refers to the measurement of the performance and efficiency of the supply process, especially in terms of meeting the demands of customers or internal beneficiaries. This

indicator is used to evaluate the capacity and quality of services provided by the supply department or the supply chain.

3) *Time of Delivery Indicator* = calculated for a specific family of products is measured by the number of days in which the supplier delivered the raw materials (products) – before or after the set term. Is the estimated or agreed period in which a supplier undertakes to deliver an order or a specific quantity of products or raw materials to an organization or customer. This indicator is used to evaluate the promptness and efficiency of the supplier in the supply of goods and materials. The supply lead time can be expressed in days, weeks, or any other time unit convenient for the industry or organization.

4) *Certified Suppliers Indicator* – in Sourcing is a KPI that measures the proportion of suppliers that have obtained relevant certifications or accreditations in the sourcing process of a company or organization. This indicator reflects the degree of commitment of the organization in selecting and collaborating with suppliers that comply with the specific standards and requirements of the industry or company.

All the KPIs are monitored in the dashboard – Scorecard, which provides an overview of the most important indicators at the organization level. Depending on the results obtained, for the KPI that do not reach the target, corrective action programs are drawn up to correct non-conformities with deadlines and responsible parties.

## *Implementation ERP vs supply chain indicators*

Implementing an ERP system with WMS and TMS modules involves integrating all processes within an enterprise, thus ensuring efficient management of the supply chain and logistic operations, figure 2. The WMS module integrates for efficient warehouse and supply chain management. Integrating a WMS module involves:

- efficient management of products as it automates reception, storage, picking, and shipping of goods.
- optimization of stocks by correlating data from ERP with actual warehouse stock.
- efficient inventory and tracking of product movement in the warehouse as it monitors merchandise movement in the warehouse using innovative technologies such as RFID, Pick by Light or Pick by Voice.
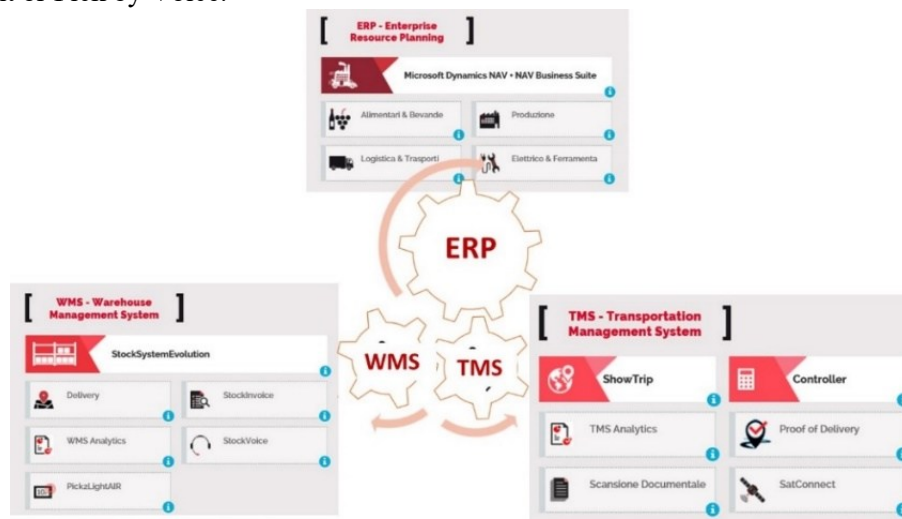


**Figure 3.** ERP system with WMS and TMS modules

The TMS module is implemented to streamline route planning, track shipments, and facilitate communication among all involved parties. Integrating these modules allows us to:

- Automation of transport processes - including route planning, shipment tracking, transport cost management, and issuance of necessary documents.
- Data synchronization - information such as shipment details, inventory, suppliers, and costs are updated in real-time.
- Route and associated cost optimization - provides functionalities to find optimal routes and minimize transport costs.

- Shipment tracking - enables monitoring the status of each delivery and identifying any potential issues or delays.
- Document Management - facilitates automatic generation of necessary transport documents, such as invoices, shipping manifests, and transport labels.

Integrating an ERP system with WMS and TMS modules provides operational efficiency by reducing manual effort and human errors. This leads to increased efficiency in supply chain management. Following the implementation of an ERP system with WMS and TMS modules or monitoring the supply chain indicators for a period of one year. The obtained results will be presented in the following. The objective of the Stock level indicator is to reach the 15-day target, that is, the value of the index tends to 0.8%.
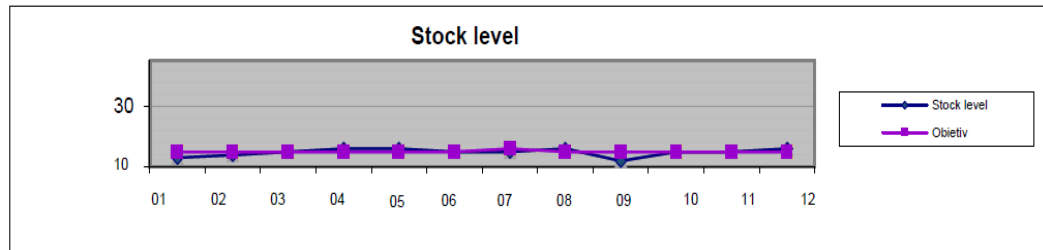


**Figure 4.** Stock level

This objective was reached throughout the analyzed period, in January and September it was even exceeded, reaching a stock level of 13 and 12 days, respectively.

The objective of the transit time in supply indicator is to reach the target of 14 days, and during the observed period the average was 13.83 days.
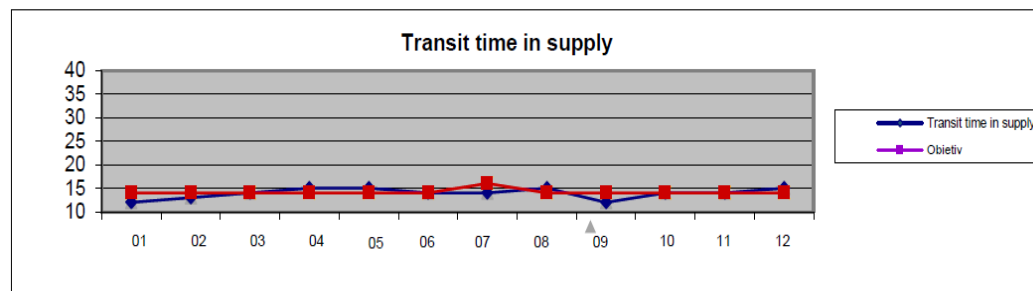


**Figure 5.** Transit time in supply

The objective of the Security Stock indicator is to reach the 10-day target, that is, the index value tends to 0.8%.
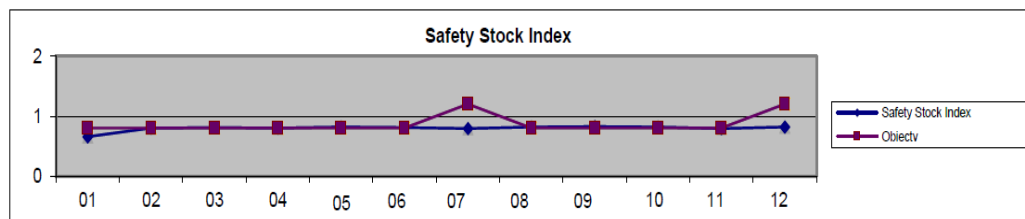


**Figure 6.** Safety stock

For the month of July, the indicator is 1.2% because the outputs are lower because of the overhaul period, and for the month of December the value is also 1.2% since the materials are supplied in advance for the start of production in January.

The indicator values measured biannually are presented in table 1 and the target of all was reached.

**Table 1.** Target indicators vs Obtained indicators

| Target indicators | Obtained indicators | 2019 | 2021 sem I | 2021 sem II | 2022 sem I | 2022 sem II |
|---|---|---|---|---|---|---|
| ICA = Supply Quality indicator **Target: 0%** | ICA = Supply Quality indicator **Obtained: 0%** | **3** | **1,1** | **0** | **0** | **0** |

| IS – Service in supply indicator. Target : 0 days | IS – service in supply indicator Obtained: 0 days | 1,2 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|
| ITL = Time of Delivery indicator Target : 0 days | ITL = Time of Delivery indicator Obtained: 0 days | 5 | 2 | 1 | 0,5 | 0,5 |
| IFC = Certified Suppliers indicator Target: 100% | IFC = Certified Suppliers indicator Obtained: 100% | 0 | 100% | 100% | 100% | 100% |
| IRA = Supply Breakdown Indicator Target: 0 | IRA = Supply Breakdown Indicator Obtained: 0 | 2,8 | 0 | 0 | 0 | 0 |

The KPIs were measured twice a year before the implementation of the ERP modules WMS and TMS (year 2019) and continued in years 2021 and 2022.

For the Supply Quality indicator, the enterprise targeted a value of 0%. Without an ERP system, it achieved a value of 3%, and only after the second semester of 2021 was it able to reach the targeted value of 0%. The targeted value for the Service in Supply and Time of Delivery indicators was 0 days. The implementation of the ERP system had immediate effects on the Service in Supply indicator, reaching the value of 0 days in the first semester of 2021. The Time of Delivery indicator decreased from 5 days in 2019 to 2 days in the first semester of 2021, reaching a value of 0.5 days in 2022. For the Certified Suppliers indicator, the effects of implementing the ERP system were immediate, reaching the targeted value of 100% from the first semester of 2021. The last indicator measured for the supply chain is the Breakdown Indicator, where the effects of ERP system implementation were immediate, reaching the targeted value of 0 breakdowns in the supply chain from the first year.

## CONCLUSIONS

Therefore, the implementation of ERP systems helps to increase performance in the supply chain and can bring multiple advantages in terms of efficiency, quality, and costs in the supply process. Implementing these systems helps maintain strong relationships with suppliers and allows us to constantly monitor their performance to identify opportunities for improvement and ensure a mutually beneficial partnership.

In this study, over the course of two years, the supply chain performance indicators were monitored for an automotive component manufacturing enterprise that implemented an ERP system with WMS and TMS modules. It was observed that following the implementation of the ERP system, the targeted values for almost all monitored indicators could be achieved, except for the Time of Delivery indicator, whose value decreased from 5 days to 0.5 days.

ERP systems help the enterprise address challenges stemming from many goods receipts, insufficient or incomplete reporting, and unsatisfactory inventory management due to lack of visibility into occupied space and part locations. The implementation of the ERP system along with WMS and TMS modules led to a significant reduction in reception, storage, and picking times for parts, as well as in data transmission times between different departments, with information being automatically transferred from the system. Additionally, costs associated with replenishing damaged parts during storage were also reduced, as evidenced by the achievement of a 0% Supply Quality indicator.

Following the system implementation, the number of human errors significantly decreased due to the automation of processes within the supply chain. The conclusion drawn from monitoring the effects of ERP system implementation is that it brings the enterprise a new horizon of information and better control over the processes carried out in the supply chain.

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