JOURNAL OF APPLIED INTELLIGENT SYSTEMS & INFORMATION SCIENCES
VOL. 3, ISSUE 2, PP. 1-12, DECEMBER 2022.
Available at: **www.journal.research.fanap.com**
DOI: https://doi.org/10.22034/JAISIS.2022.371007.1052

SUPPLY CHAIN PROCESSES ROBUSTNESS: A DATA ANALYTICS VIEWPOINT

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ABSTRACT

The administration of a network of business processes involved in the creation and delivery of production and service packages to final consumers can be summed up as supply chain management. Naturally, it is required to first identify key processes according to appropriate indicators to optimize them based on efficiency to enhance supply chain performance. The purpose of proposing a model is to classify the various supply chain operations into standard, repetitive, and non-repetitive processes in this article. The important processes are then identified using variance components analysis, and then the way these processes may be improved to raise the supply chain robustness performance indicators is decided. It's obvious that by strengthening the major supply chain operations, it is possible to reduce supply chain variability while enhancing performance in terms of cost, time, and quality and raising customer satisfaction throughout the chain as well. The outcomes of the study conducted on a supply chain show how well the model works.

KEYWORDS: Supply chain, Robustness, Standard processes, Variance component analysis, Repetitive processes.

1. INTRODUCTION

The typical perspective in the supply chain was task-oriented up until recently. From this perspective, the supply chain was separated into various segments depending on the task. Suppliers, producers, internal and external logistics, distributors, wholesalers and retailers, and customers were among these components (Min et al., 2019). Additionally, the function and accountability of each component were described, and the overall relationship between these components was explained. However, when concerns about the quality and advancement of organizations grew, this frame of view evolved into one that was process-oriented. A supply chain is a group of interconnected processes. Making this process better is the purpose of quality management. There hasn't been much study about the classification of supply chain processes up to this point. The supply chain association has identified eight crucial procedures that must be executed. (Cooper et al., 1997):

1- Demand management
2- Return management

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RECEIVED: 20 NOVEMBER, 2022; ACCEPTED: 24 DECEMBER, 2022; PUBLISHED ONLINE: 25 DECEMBER, 2022

3- Customer relationship management
4- Customer service management
5- Demand completion
6- Production flow management
7- Product commercialization and development
8- Procurement (suppliers relation management)

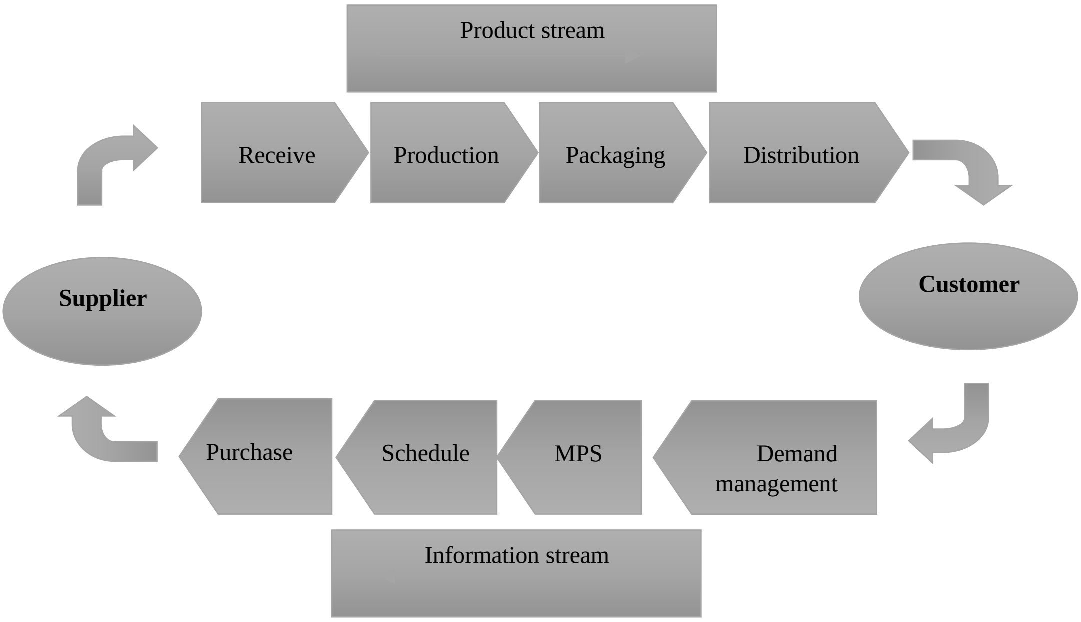

Fig. 1. Supply chain processes and interconnections (Lambert & Cooper, 1998)

Today, the supply chain is an integral part of every business. Whether a manufacturing company or a service company, the supply chain plays an important role in providing efficient information flow, creating added value for all stakeholders, and delivering products and services to customers on time and with quality (Christopher, 1992). According to Fig. 1, the supply chain consists of several separate organizations that are connected through physical flows or material flow, information flow, and any financial flows.

According to Laudon & Laudon (2002), supply chain management emphasizes the integration of supply chain activities, as well as the information flow related to them through the improvement of the relationships, to achieve a reliable and sustainable competitive advantage. Therefore, supply chain management is the process of integrating supply chain activities and related information flows through the improvement and coordination of activities in the supply chain of the product. In the following, the concept of processes will be discussed, and after that, the methods for identifying key and critical processes are investigated. In this research, with the help of Crystal Ball software, the variance components analysis of the process performance indices is determined. In this method, the percentage contribution of the variance of the performance index of each of the processes in the total variance of the system performance index is calculated, and by calculating the system evaluation indices, the most key processes are identified with the help of sensitivity analysis. Finally, to perform additional analysis, the type of these processes will be examined. In this research, a new category of processes including standard processes, repetitive processes, and non-repetitive processes is mentioned, and the improvement strategy will be determined according to the type of these processes.

Manrodt & Vitasek (2004) investigate the challenges of critical process standardization in the international market compared to the domestic market. This study explains how one company standardized its procedures around the world using a case study. Also included is a framework for managing and standardizing important multinational processes. Steinfield et al. (2011) investigate an automotive sector case study encompassing the standardization of data and processes as well as a shared, cloud-based architecture to address information transparency issues in the supply chain. They claimed that the hub-type information technology architectures that are shared by all businesses involved in an industrial field and not just the participants in a single manufacturer's supply chain are needed to supplement standards.

In Stajniak & Koliński (2016) study, the authors concentrate on the effectiveness of the transportation processes and show how the supply chain's effectiveness is significantly impacted by the standardization processes. By using BPMN notation, they have created standard processes that have been deemed necessary for the standardization of the business practice.

A supply chain's robustness is its capacity to withstand external and internal perturbations. The formal definition and theoretical framework of supply chain robustness are presented by Durach et al. (2015). The primary hazards associated with supply chain operations are outlined in Monostori (2018), along with some basic risk reduction techniques. A framework for assessing the robustness, complexity, and efficiency as well as metrics for measuring the structural and operational robustness of supply chains are also addressed.

Generally, as we go from the lower layers of the supply chain (issuance of customer orders) to higher layers, the variability increases, which is called the bullwhip effect. Many articles have been written about the impressions of this phenomenon and its control methods. In this article, an approach has been tried to control this variability. This means that by calculating the allowed tolerance of the variability of each process and trying to perform the process in that time range, the bullwhip effect can be greatly reduced. First, we make a new definition of the process and determine what types of processes can be controlled more. Then, using simulation and variance component analysis, we determine the processes based on which pattern and with what significance they have variability.

The rest of the structure of the article is as follows. First, a definition of the processes is provided. Then the types of processes are expressed according to their repeatability. In the next section, variance component analysis is introduced as an analytical approach. A case example of the supply chain is provided to examine the approach. In the end, the results of the research are discussed.

2. THE PROBLEM DEFINITION

2.1. Processes and their types

In this part, the definition of the process and its types in the organization is discussed, and in the following, a new classification of the types of processes and definitions related to them are discussed.

Fig. 2. Overview of a process

According to ISO/TC 176/SC 2/N 544R of the International Standard Organization (ISO), as depicted in Fig. 2, a "process" includes a set of interrelated activities, which transform inputs into outputs. It is worth mentioning that firstly, the inputs of a process are generally the outputs of other processes (Fig. 3), and secondly, the processes are generally planned and controlled to create added value.

Fig. 3. Sequences of processes

Besterfield (2014) also introduces a process as a converter consisting of activities and methods that transform a set of inputs into outputs expected by the customer. The process can be considered a value chain that adds value to the previous stage. Sometimes they call the transformation process a black box because some or all of it may be unknown to humans. Based on Porter's classification, processes in the organization are divided into the following categories (Porter, 1980):

1) The main processes that are executed centrally in the organization include direct activities from suppliers to customers.

2) Support processes that do not create value directly but are needed for the implementation of the main processes, such as financial management and human affairs management.

3) Management processes that are not implemented centrally in the organization but are responsible for guiding and leading the human force in achieving the goals of the organization, such as planning and resource allocation processes.

4) Development processes, which are carried out to increase the efficiency of the value chain, such as product development and supplier development.

Lillerank (2011) believes that the process is a three-step sequence (AAA) consisting of assessment, algorithm, and action as explained in Fig. 4:

1) Assessment stage: It will have the authority of a receiver who receives and evaluates the entries. As a result, it confirms the required entries and rejects the irrelevant ones.

2) Algorithm stage: It is a set of communications, algorithms, and existing and innovative methods that produce the required control information based on the status of inputs and available resources.

3) Action stage: which takes the necessary actions to realize the desired output by the information of the previous stage.

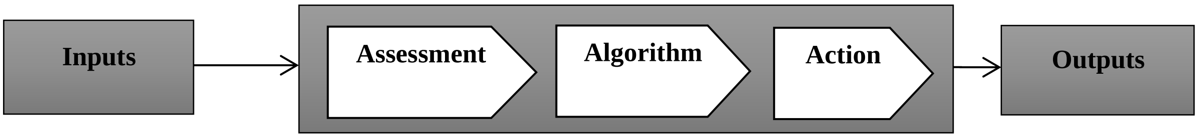

Fig. 4. Process Steps

Perrow (1967) classified organizations and their technology based on exceptions and the number of unexpected events that occur in that organization and the extent to which these exceptions can be analyzed in that organization or whether there is a specific solution for them or not. An organization with a small number of such events and problems is called repetitive. Often, service or production companies at the mass level and with repetitive and standard activities include this category of (repetitive) processes. On the other hand, in non-repetitive organizations, many exceptions cannot be analyzed due to the lack of predetermined plans.

There is evidence that quality management techniques and models such as ISO and EFQM, as well as standards such as PMBOK, have worked more successfully on repetitive processes or in non-repetitive organizations that have repetitive sub-processes. Most of the quality management methods deal with processes with the same repeatability and do not have the efficiency when faced with non-repetitive organizations and processes due to their numerous exceptions. Now we will examine the types of processes in this research:

- **Standard Process**

Processes that are performed constantly and repetitively have the following features:

1- The input of these processes is completely clear and identifiable. In the first phase (Assessment), the inputs of the process are tested and if they are related to the goal of the process (output), they are accepted. So, the decision in the Assessment phase is based on the logic of rejection and acceptance.
2- The algorithm in this process has been precisely defined and compiled based on a strong theory, which is the best way to do the work.
3- For the process, a certain output has been determined, and all its features and specifications have been completely defined in advance. In the standard process, a specific value is defined as a "goal" for the output, and the process will be terminated if the goal is met according to the acceptance limits (Fig. 5).

These types of processes, if they are repeated a lot, have no difference in terms of the form and content of the execution, and the only difference between these repetitions is in the details and dimensions of the components of this process. Each repetition fluctuates compared to the other repetition.

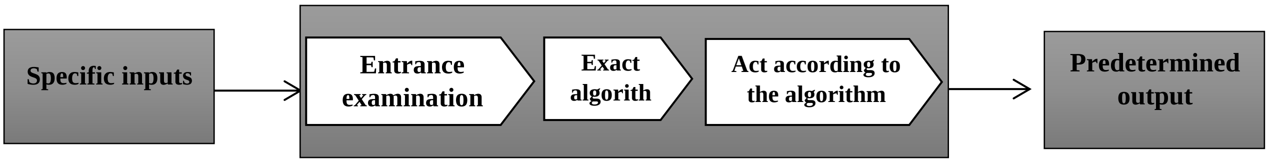

Fig. 5. A standard process

In this process, the management tries to adjust the variations in the system by controlling the inputs and resources used in the process. It should be mentioned that the statistical process control theory can only be applied to standard processes.

- **Repetitive process**

This category of processes is repeated many times in the systems and has the following features:

1- They contain two or more recognizable and specific inputs. These inputs are examined in the assessment phase, and if approved, the algorithm related to that input is determined. So, the assessment phase does not only deal with rejecting or accepting the input but in case the input is accepted, a decision is also made about which implementation method is included. Therefore, the assessment phase categorizes the inputs based on fuzzy logic.
2- For each of the outputs, there is a fully specified and defined algorithm, and in the second phase of these processes, the algorithm and related implementation methods are selected and determined to work on each group of inputs.
3- They contain two or more specific outputs, of course, and the specifications and features of each output are completely clear and well-defined. Failure to achieve a proper output can be due to two reasons. Firstly, the appropriate algorithm is not selected for the desired input, and secondly, the algorithm is correctly selected but performed improperly.

A repetitive process includes a set of standard processes, each of these processes is the same in terms of content and task, but they differ from each other in terms of the form of process execution.

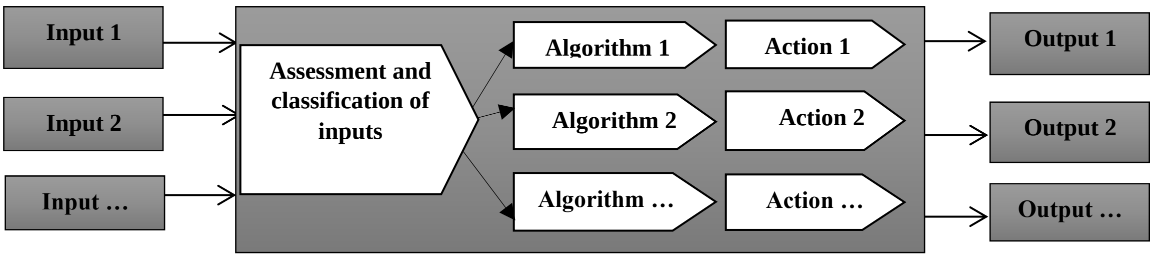

Fig. 6. A repetitive process

- **Non-repetitive process**

This category of processes has a vague and non-repetitive nature, which has the following characteristics:

1- The inputs of these processes are very numerous and can be completely vague and unknown, and they cannot be determined and defined in advance. Therefore, in the assessment phase, entries that do not match the existing definitions are not rejected, and they are analyzed and interpreted in this phase to gain a better understanding of them.
2- It is obvious that in this type of process, there are no predetermined methods and algorithms for these vague and unknown inputs, therefore, depending on the knowledge and abilities of the organization, and by conducting appropriate research, new algorithms or methods are invented and defined.
3- Outputs in non-repetitive processes completely depend on the needs raised by the customer and the main goal of these processes is to satisfy these needs.

The difference between standard, repetitive and non-repetitive processes is completely relative. This difference depends on the conditions of inputs and capabilities of the organization in the three stages (assessment, algorithm, and action) of the process. As the processes go from non-repetitive to repetitive and from repetitive to standard, their uncertainty and variations are reduced. Standardization processes mean the reduction of errors or process variations. Over time and with the improvement of the experience and level of knowledge and learning of the organization and the people involved in the process, non-repetitive processes become repetitive and repetitive processes become standard processes.

2.2. Process type in a supply chain

In this section, process types are discussed by providing an example in the production field, so that the necessity of identifying them in practice and determining the priority of improvement in the supply chain is illustrated.

Suppose we want to choose a product for production first and then plan the supply chain related to this factory according to this product. The supply chain in an industrial structure needs proper planning. At the programming level, most processes are repetitive or non-repetitive. For example, the process of choosing the type of product is non-repetitive because we are not able to identify all the inputs, limitations, resources, etc. at the beginning. The number of inputs in this area is very large and it is difficult to choose a type of product that has a specific output. To solve this problem, one solution is to convert this non-repetitive activity into several repetitive processes as much as possible. For example, we choose the industrial field of the product as chemical and limit the required resources to several suppliers. This action causes several options to be formed, which are repetitive processes, and now that they have become repetitive, they can be analyzed and selected. Also, the process of market analysis and market contribution acquisition, as it is a forecast-based process, includes a set of repetitive activities. Then, other activities such as determining the budget, the net profit and payback period, and the amount of manpower and equipment, as it is based on a specific method and model, make a standard process.

But in the operational phase, presenting a new product in the planning phase is not a non-repetitive process, but due to the increase of our knowledge and the feasibility study of the production according to the available resources, this process is repetitive. Evolution and innovation in the product are the same.

All three types of processes can be seen in the maintenance and repairs section. For example, if only one monthly or yearly inspection of the device is carried out, this process becomes standard, and the procedure becomes clear and documented. But if a machine suffers an unpredictable and sudden breakdown, if the cause of this breakdown can be identified by inspecting the device, this is a repetitive process. But if the cause of the failure is not clear, this process is non-repetitive. The processes of storage, transportation, and distribution are repetitive because there are limited options to choose from.

2.3. The concept of variation against variety

In general, any deviation from a certain predetermined value is called variation or variability. However, the number of possible states that can be displayed in a system, the number of distinct input and output items, or the number of product options that are similar in terms of performance, is called variety. In business, a set of choices among design options, colors, etc. is called variety. Although the terms "variation" and "variety" are sometimes used interchangeably, they are fundamentally different. Variation is a measurable deviation from a certain target value, such as the deviation of the items of an assembly part that deviate from the predetermined target value during the machining process, and this term is related to quantitative statistical analysis. But on the other hand, the presence of differences in sets that are functionally similar, such as different colors on a piece, leads to variety.

According to Deming (1994), all works are created from a set of processes, and all processes show variations and changeability, and quality science is based on dealing with these variations. According to the above topics, it is necessary to determine the types of processes to reduce the variations in the supply chain, and then, according to the importance of each process, the focus of activities for improvement should be determined. According to the definitions given about the processes, the variety in non-repetitive processes is more than the repetitive processes and there is no variety in standard processes. On the other hand, there are variations in all three types of processes. One of the ways to reduce variations in non-repetitive and repetitive processes is to increase our knowledge and awareness of this type of process so that over time we can convert these types of processes into standard processes. Non-repetitive and repetitive processes are both related to the variety and in contrast to standard processes which deal with variations. In fact, in repetitive processes, we are faced with several options, which are the same variety in choice, and non-repetitive processes, which deal with a very large and indeterminable variety. So, to control variations in these types of processes, non-repetitive processes must change into repetitive ones and repetitive processes into standard ones, and this is achieved by increasing our knowledge and awareness of the processes and repeating those processes in the same way. But in the discussion of standard processes, due to facing variations and tolerances, statistical and quantitative methods can be used to control them.

3. Research Method: Analysis of variance components

To reduce the variation and changeability of processes, one should pay attention to three things: the scope of the variation or changeability, the causes of the variation, and the contribution of each cause to the total variation. A tool like a histogram can provide useful information about variability. Statistical control charts can also detect the existence of variations due to unusual causes. However, to evaluate the contribution of each factor in creating the total variability, the variance components analysis can be used. In this method, we need an equation to relate the output of the process with the inputs. As we know, the input variables of the process influence the output of the process. If we call the time between the issuing of the goods ordered by the customer and the delivery of the goods to the customer in the supply chain delivery time (y), this time refers to the sum of the times of several sub-processes (x_i). Therefore, $y = \sum_i^n x_i$. Variations in each of these processes will lead to variations in the delivery time of the final product. The variance components analysis evaluates the contribution or the degree of influence of the changeability of the input variables of the process on the changeability of the process output. We know that if the sub-sections of a process are independent, the total variance of the output of a process can be calculated based on the sum of the variance of the output of each sub-section of the process as follows (Fig. 7):

$$\sigma_{Total}^2 = \sigma_1^2 + \sigma_2^2 + \cdots + \sigma_n^2$$

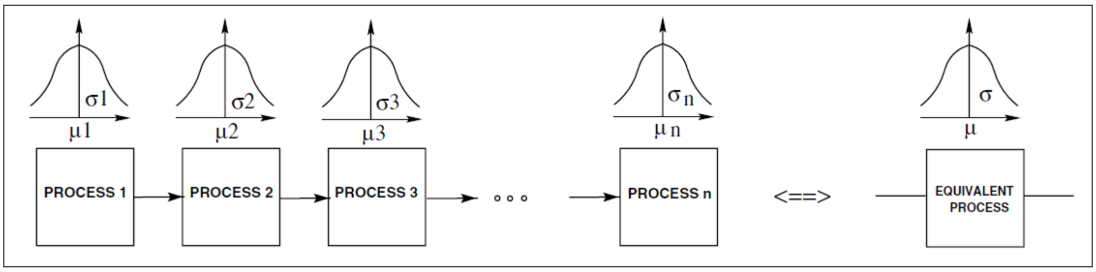

Fig. 7. An overview of the supply chain and the variations of each of its processes

Based on this method, the variance contribution of each sub-process in the variance or changeability of the whole process will be determined. In this case, the variance components analysis will help to identify the variations in each sub-process and identify the sub-process that leads to more variations in the output, so that improvement activities can be focused on to improve this group of sub-processes. By using simulation, it is possible to identify the most critical sub-processes from the point of view of creating variations in the output of the main process and focus improvement measures on these processes in a targeted manner.

4. RESULT: A SAMPLE CASE

Take a look at a four-stage supply chain to help better comprehend and express this approach. Each of these stages encompasses several related operations, including procurement, production, assembly, transportation, and distribution of the product. The supply chain's delivery performance encompasses each step from placing the order for the items to giving them to the consumer. The customer specifies a goal delivery time of 45 days and a tolerance of 6 days (between 42 and 48 days). Each of its steps and sub-processes is listed in Table 1. These procedures are carried out sequentially and in the following order to deliver the goods to the consumer. Each of these processes' timings has been measured numerous times. Then, using Crystal Ball software, the distribution corresponding to each of these times is calculated. The usage of crystal ball software facilitates statistical analysis, optimization, and modeling of uncertainty and variation. This program runs simulations using Monte Carlo methods (Oracle Crystal Ball). The parameters and time distribution for each of these processes are displayed in the table below.

Table 1. Distribution and parameters of supply chain processes

Stage	Process	Distribution	Parameters
Procurement	Issuing an Order for The Supplier	Normal Log	Location= 0, M=2.1 , Σ=0.8
	Production Waiting Time at the Supplier	Exponential	Λ=0.8
	Transporting Raw Materials from the Supplier to the Producer	Gamma	Location=4 , Scale=0.3 , Shape=3
	Quality Control of Raw Materials	Weibull	Location=0 , Scale=1, Shape=2
Production	Production and Machining	Normal	M=14 , Σ=0.2
	Dyeing Parts	Exponential	Λ=1.1
	Quality Control	Weibull	Location=0 , Scale=1 , Shape=9
	Semi-Finished Product Warehouse	Beta	MIN=0 , Max=5 , A=30 , B=2
Assembly	Final Assembly	Logistics	M=10 , Scale=0.3
	Packaging	Exponential	Λ=3
Distribution	Carrying Goods to Sales Warehouses	Normal	M=3 , Σ=0.8
	Delivery of Goods at the Seller's Place	Weibull	Location=0.5 , Scale=1.5, Shape=5

The simulation model of this supply chain is now constructed with the use of crystal ball software. Having created the aforementioned distribution for each process at this point, the simulation can now determine the model's statistical characteristics, such as mean, variance, process capability indicators, etc., by generating random numbers that fit the distribution. These statistics are shown in Table 2.

Table 2. Predicted statistics of the supply chain model by simulation

Statistics	No. Run of simulations	Mean	Var	Coeff. of Variability	Min	Max	Cp	Cp_k	Cp_m	Sigma level
Predicted values	5,000	44.93	4.97	0.0496	38.64	55.25	0.425	0.368	0.448	0.920

To investigate the time variation of the processes of this supply chain, it is first necessary to determine the causes of variability and the contribution of each cause or process to the total variability using the method of variance components. In this supply chain, each stage includes several sub-processes, which in turn contribute to the variance of that stage. If we call the variance i of the sub-processes from the supply chain σ_i^2, the total variance of the delivery function is equal to $\sigma^2 = \sum_i \sigma_i^2$. That is, the time variance of each of the sub-processes of each stage contributes to the total time variance of a stage, and the time variance of each stage also contributes to the total time variance of the delivery function. Analysis of variance can be used to calculate the effect of variance components on the total variance. In Table 3, after performing the calculations related to the variance analysis, the contribution of the variance of each step in the variance of the entire delivery process has been determined.

Table 3. Variance component analysis

Stage	Procurement				Production				Assembly		Distribution	
Process	The process of issuing an order to the supplier	Production waiting time at the supplier	Transporting raw materials from the supplier to the producer	Quality control of raw materials	Production and machining	Dyeing parts	Quality control	Semi-finished product warehouse	Final assembly	Packaging	Carrying goods to sales warehouses	Delivery of goods at the seller's place
Percentage contribution of variance of each process	13.7	28.9	7.5	5.7	0.9	14.5	0.4	0.6	6.7	1.8	15.5	3.8
Percentage contribution of variance of each stage	55.8				16.4				8.5		19.3	

Table 3 shows that the volatility in the procurement stage accounts for roughly 56% of the overall variance in delivery performance. This indicates that this stage should get the majority of improvement efforts. It should be emphasized that because the supply chain's stages are interdependent, it may be claimed that some variations in the production stage are connected to variations in the earlier stage or procurement. The Pareto variance diagram for each process is displayed in Fig. 8. This graphic makes it easy to determine the most important processes in terms of variance reduction and the priority of improvement actions. As can be seen, the process of waiting time for production in the supplier has the highest amount of variation effect.

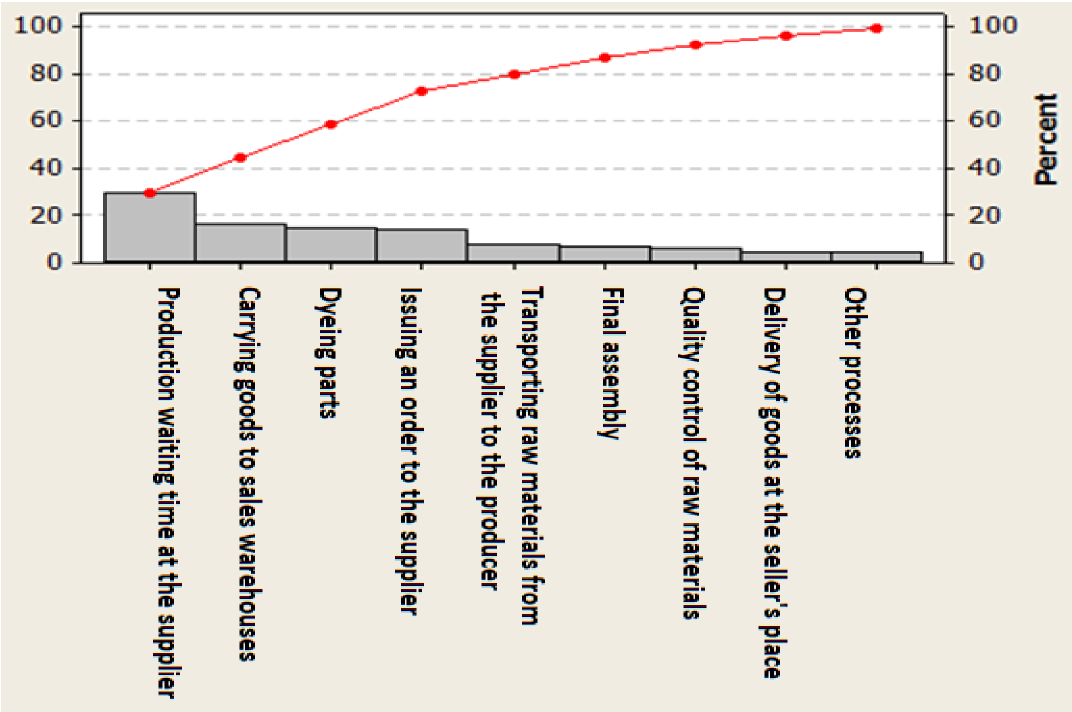

Fig. 8. Pareto diagram for the percentage contribution of the variance of each of the processes in the total variation

Now the sensitivity of each step is carried out. According to the sensitivity analysis, the two stages of transportation and logistics are more important. So, by changing the parameters of the processes of these two stages, we examine the evaluated criteria, which are the process capability indicators here. According to Table 4, the more the variance of the procurement and transportation stage decreases, the higher the improvements shown by system indicators. Table 4 has examined process capability indicators in different modes. In the first column, the current status of the indicators is displayed. In the second column, the average approaches the target specified by the customer and in the third column, the variance is reduced by 90% and 50%. According to the sensitivity analysis, the variance of all stages should be below one to increase the level of system capability indicators. Also, the closer the mean process time is to the predetermined target value determined by the customer, the better the values shown by the indicators.

Table 4. Sensitivity analysis and recognition of improvement points

	Status	**If the mean is on target**	**Variance reduction**	
			50%	90%
The mean performance time of delivery	44.93	45	45	45
The variance of the supplier production waiting time process	1.56	1.56	0.78	1.404
The variance of transporting goods to sales warehouses process	0.64	0.64	0.32	0.576
The variance of the dyeing process of parts	0.83	0.83	0.415	0.747
The variance of the final assembly process	0.30	0.30	0.15	0.27
Total variance	4.97	4.97	3.86	3.10
The percentage of non-conforming items	0.1591	0.4664	0.3990	0.2892
C_{pk}	0.3688	0.3920	0.8543	1.015
C_{pm}	0.4484	0.5578	0.8928	1.236

Now that the focus and amount of improvement activities have been determined, it is necessary to investigate the sub-processes in each of the stages in the cycle of issuing the goods ordered by the customer until it is delivered. As mentioned earlier, the processes are divided into three categories repetitive and non-repetitive, and standards. In this point of view, one should first identify the inputs, outputs, and execution patterns of the processes and then determine the type of the process. Repetitive and non-repetitive processes, in addition to variations, also have variety. This means that they have different outputs and execution methods. In the supply chain, efforts should be made to convert these types of processes into standard processes. The best way to reduce the variety of repetitive and non-repetitive processes is to raise our level of knowledge and awareness of this type of process. If these processes can be implemented with a lot of repetition and in the same way, then it is possible to calculate their variance with statistical process control methods and then improve it with a suitable strategy. The priority for controlling variations should be given to non-repetitive and repetitive processes, and because these processes are executed in a completely different way every time they are repeated, they have a lot of variation and variety, which should be controlled by standardization.

The noteworthy point is that the reason for the high variance in the procurement stage may be the existence of non-repetitive processes in this stage, in which case it is possible to reduce the number of variations in this type of processes by reducing the variety of processes in this stage and standardizing the processes. In Table 5, a strategy is considered for each process according to its type. For repetitive and non-repetitive processes, it is possible to use standardization, high repetition, documentation, and increasing knowledge of the process. For standard processes, statistical process control methods can be used to control variations.

Table 5. Supply chain and its stages

Stage	Process	Process type	Strategy
procurement	Issuing an order for the supplier	Standard	Statistical process control
	Production waiting time at the supplier	non-repetitive	Increasing knowledge about suppliers' processes
	Transporting raw materials from the supplier to the producer	Repetitive	Analysis of transportation methods
	Quality control of raw materials	Standard	Statistical process control
Production	Production and machining	Standard	Statistical process control
	Dyeing parts	Repetitive	Analysis of suitable color for parts
	Quality control	Standard	Statistical process control
	Semi-finished product warehouse	Repetitive	Choosing the right place for parts
Assembly	Final assembly	Standard	Statistical process control
	Packaging	Standard	Statistical process control
Distribution	Carrying goods to sales warehouses	Repetitive	Analysis of transportation methods
	Delivery of goods at the seller's place	Standard	Statistical process control

5. Conclusion

Here, the necessity of a process-oriented approach in the supply chain was investigated. In fact, with the right understanding of the processes, it is possible to identify the most crucial processes in the supply chain, and depending on the nature of these processes, an appropriate strategy can be put into place to enhance their performance. The supply chain, as was previously stated, is a network of different processes that are linked to one another through both informational and physical flows. Every process has variations, according to statistics, and because chain processes depend on one another, each variation in one process has an impact on the other, resulting in a cumulative variation in the entire supply chain. The contribution of each process's variation to the overall supply chain may be evaluated with the aid of a variance components analysis, and the most crucial processes can then be identified for improvement using a sensitivity analysis. A new taxonomy of supply chain processes was presented in this study including standardized procedures with defined input, execution strategy, and output. Repetitive processes need to be chosen from a variety of execution strategies, inputs, and outputs. Additionally, non-repetitive processes have several inputs, outputs, and execution strategies. We can make greater use of statistical process control tools, reduce the variability of these processes, and turn non-repetitive processes into repetitive processes and the repetitive processes into standard processes.

The two ideas of variation and variety were also brought up, and it was discovered that there is no variation in standard processes while there is more variation in non-repetitive processes. However, each of these three categories of processes varies. To reduce variability in repetitive and non-repetitive processes, it is possible to gain more knowledge and experience and repeat the process more often. Statistical process control techniques can also be utilized for conventional processes.

The introduced approach can be used in any field such as production, services, construction, medicine, etc. There is a set of interdependent processes in every field, where the beginning of one process is dependent on the end of another process. As a result, it will be possible to expand variability in those processes. Processes should be classified according to their types and standardized as much as possible.

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