Xinfeng Yan[1], Shakhrukh Madjidov[2], Habiba Halepoto[3,4], Lihong Chen[5]
[1] ICES of Donghua University, No. 1882, West Yan'an Road, Shanghai 200051, China
[2] Changshu Institute of Technology, 99 South Third Ring Road, Suzhou, Jiangsu 215500, China
[3] Donghua University, University, Engineering Research Center of Digitized Textile and Fashion Technology, Shanghai 201620, China
[4] Donghua University, College of Information Science and Technology, Shanghai 201620, China
[5] Donghua University, Shanghai International Fashion Innovation Center, 200051, China

Optimisation in the Logistics and Management of Supply Chains in Production by Textile Enterprises

Optimizacija v logistiki in upravljanju dobavnih verig proizvodnje v tekstilnih podjetjih

Original Scientific Article/*Izvirni znanstveni članek*
Received/*Prispelo* 6-2020 • *Accepted*/Sprejeto 3-2021

Corresponding author/*Korespondenčni avtor*:
Lihong Chen
E-mail: lchkxyy@163.com

Abstract

This article is devoted to questions regarding the analysis of the implementation of logistics and supply chain management conditions in textile production. Based on delivery optimisation, the authors offer a model of multimodal transportation of textile products produced in Uzbekistan. The importance of optimising the supply chain of the logistics business processes in order to decrease costs is demonstrated in this article. A mathematical model of optimisation for placement textile enterprises to stimulate the reduction of supply chain costs is recommended. However, this research would be beneficial for the textile and fashion industries. The approach might be further extended to other similar industries.
Keywords: logistics, transportation management, multimodal transportation, optimisation, supply chain management

Izvleček

V članku so obravnavana vprašanja, povezana z analizo pogojev izvedbe logistike in upravljanja dobavne verige v tekstilni proizvodnji. Na podlagi optimizacije dostave avtorji predlagajo kombinirane prevoze tekstilnih izdelkov, izdelanih v Uzbekistanu. V članku je dokazan pomen optimizacije dobavne verige logističnih poslovnih procesov za zmanjšanje stroškov. Priporočen matematični model optimizacije plasiranja tekstilnih podjetij spodbuja zmanjšanje stroškov dobavne verige. Raziskava se nanaša na tekstilno in modno industrijo, vendar je pristop mogoče razširiti na druge podobne industrije.
Ključne besede: logistika, upravljanje prevoza, kombinirani prevozi, optimizacija, upravljanje dobavne verige

1 Introduction

The globalisation of the world economy, the development of information technologies, means and ways of delivering products, the outsourcing of business processes, and services have a considerable impact on the way administrative decisions are adopted in all components of the business processes of production, marketing, commerce and logistics [1]. Adopting optimal administrative solutions in difficult economic situations has always been a constant in the practical activities of textile sectors throughout the world [2]. Moreover, their role has increased considerably recently as the dynamism of the external and internal environment has increased. The period required to make decisions has been reduced. The development of science and technologies has resulted in the emergence of many alternative options and interdependence. Different administrative decisions and their consequences have been amplified. The labour input required to adopt and implement challenging and multi-criteria decisions has increased significantly [3]. In these conditions, establishing rational and optimal solutions is the main focus of developing textile enterprises' logistics and organisations' business processes at the strategic and operational levels to improve supply chain management and logistics methods [4, 5]. The need for the high-quality growth of Uzbekistan's economy assumes that textile enterprise managers make better use of the entire range of methods and models of adopting optimal solutions in the supply, production and distribution of goods and services in the logistics and supply chain.

A diagnostic analysis of the administrative decisions made by the managers of textile enterprises and supply chain participants allowed us to establish that adopting logistic decisions used in practice is characterised by utility and subjectivity, and a lack of modern computer technologies (software products). The conducted research can be deemed the further development of the theory and methodical bases of supply chain management, and an opportunity for the broader application of mathematical models and methods for adopting optimal logistic solutions in the performance of management functions and the business processes of production, distribution, transportation and consumption of intermediate and readymade products [6−10].

Despite the extensive and practical application of logistics and supply chain management in the organisation of the transportation and production of goods, it is still not fully implemented in Uzbekistan. There is a lack of exhaustive scientific research successfully carried out in these areas. The importance of optimising logistics business processes to cut costs is demonstrated in this article using a mathematical model. Though different models have been proposed for other industries, the textile and fashion industry has not considered them. We have developed a method for optimising the business process of distribution and sales (supply) of a textile enterprise's finished products based on an economic and mathematical model for optimising the sales structure. Thus, this research practically presents a practical solution for both the textile and fashion industries.

2 Methods

2.1 Analysis of conditions in the textile industry in Uzbekistan

Uzbekistan is one of the largest global cotton-fibre suppliers, while it also pays a great deal of attention to the deep processing of raw cotton [11]. For instance, the current coefficient of processing is 40%. The adopted modernisation programme of the textile industry is expected to bring the processing volume to 70% by 2020 [5]. In the modern world, the textile industry possesses a high rating among the other exports. It has the broadest range of exported goods' nomenclature, from yarn to readymade goods (apparel and knitted products; see Figure 1).

The textile industry is an essential, versatile and innovatively attractive sector of the economy of Uzbekistan. Its role is a macroeconomic complex that can be assessed from the following data: the textile industry accounts for 2.7% of Uzbekistan's GDP, 26.2% of industrial output in terms of volume, and more than 34% of the production of non-food consumer goods. Four hundred textile companies equipped with modern conditions are included in the UZTEX Group. Of those, 130 are joint ventures created with the participation of foreign partners from the world's leading countries. The group records annual increases in production and exports of more than 18% and 10%, respectively. The annual combined output of group companies is around 480 thousand tonnes of yarn, 290 million square meters of cotton fabrics, 101 thousand tonnes of knitted cloth, 275 million pairs of stitched-knitted products, 53.1 million pairs of socks and hosiery, and 2.1 thousand tonnes of raw silk threads. Group companies also make products for medical use, nonwoven fabrics, batting products, uniforms and fashion apparel, and eiderdown products. Companies operate continuously using modern and efficient equipment. More than 1.6 million spinning spindles and 100 thousand cabinets are commissioned for operation, accounting for 89.3% of existing technological equipment. Products produced by the textile industry are exported to more

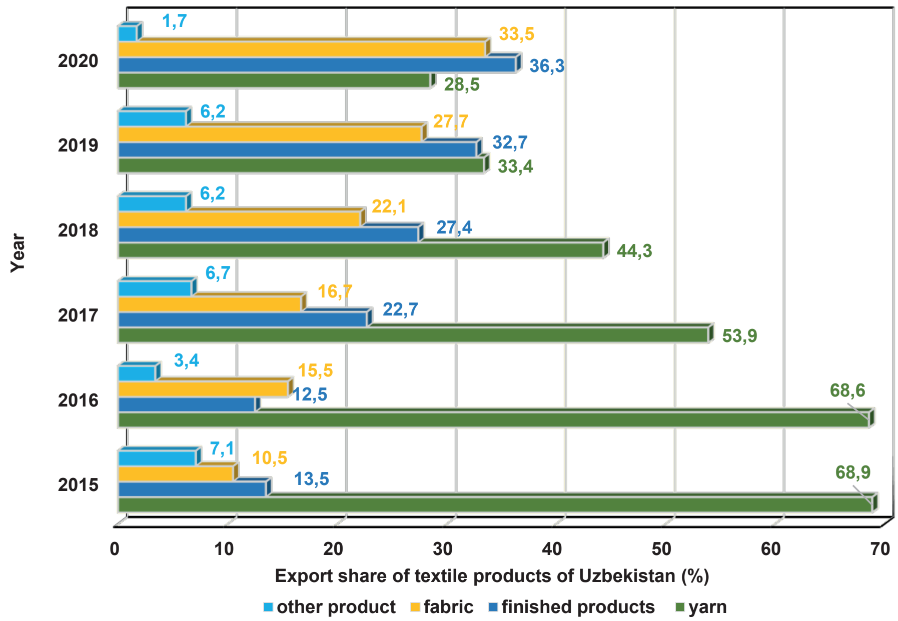

Figure 1: Structure of exports of textile products of Uzbekistan

than 50 countries, including European countries, China, the Commonwealth of Independent States, Latin America, the Republic of Korea, Singapore, Israel, Iran, the USA and others. In this regard, textile enterprises' supply chain management issues are crucial today.

The formation of textile supply chains has some sophisticated and distinctive influencing factors. They include the need for technological associativity based on a material stream that defines the contractors' choice, providing the delivery of and ability to render additional services. They also include the physical characteristics of a material stream that define a means of transportation and storage conditions, with the choice of the transport scheme and the warehousing method, respectively (refer, Figure 2).

One of the primary operating conditions of a textile enterprise's supply chain management is its interconnected system, which streams of goods and services and the labour force, and moves within the

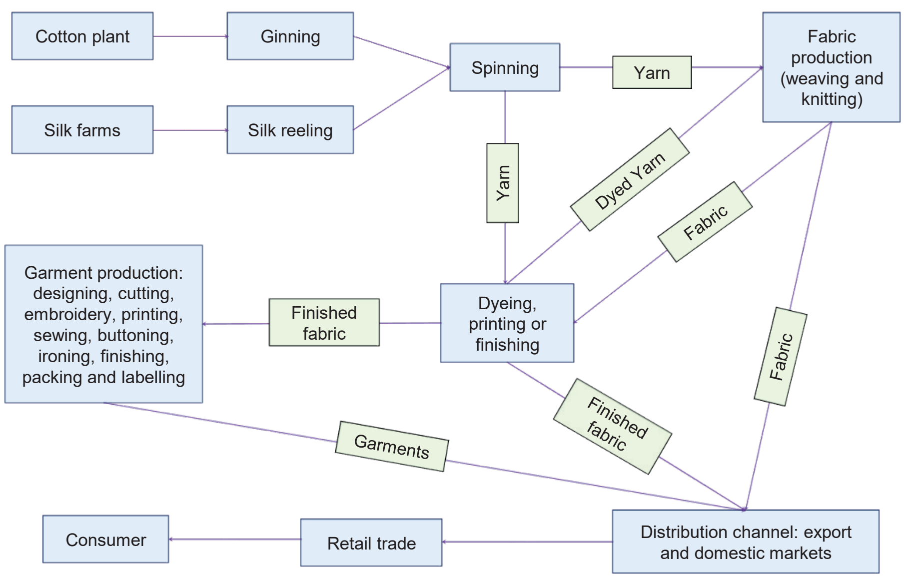

Figure 2: Formation of supply chains in a textile complex

market system under the influence of market stimulus [12–17].

2.2 Model formulation

An analysis of scientific literature over the last ten years regarding developments and the functioning of supply chains allowed us to formulate the following basic principles for carrying out the optimisation of supply chains and logistics business processes [18]:

I. The purposes of optimisation must be measurable and correspond to the optimality criteria of the actual logistic decision. This must be reflected in the statement of the corresponding task (the administrative decision). The following optimality criteria can be sued to create the general economic-mathematical model of optimisation of the sales of a manufacturer's finished goods: to maximise sales and profit, while minimising used resources and costs. Thus, various statements of problems of optimisation and the implementation of the associated economic-mathematical models can be developed. Thus, if the global purpose of business management lies in the hierarchy, then its purpose is about maximising overall profit, while the optimisation of supply is carried out for commodity groups of finished goods. To that end, the economic regulations of the sales dynamics of finished goods in natural units of measurement (O), proceeds from the sales of finished goods (R) and the dependence of price on sales of finished goods are used (C) in the implementation of these tasks. The graphs of these dependencies are shown in Figure 3.

$$C = a - b \times O \ \rightarrow O \times C = a \times O - b \times O^2 \quad (1)$$

$$O \times C = R \rightarrow R = a \times O - b \times O^2 \quad (2)$$

Consequently, a textile enterprise's profit as the difference between revenue and total costs (I) takes the form of a second-degree polynomial (P), which should be reflected in the profit maximisation problem statement.

Therefore, the profit of a textile enterprise, as a variety of procedures and general costs, has the aspect of a second-degree polynomial that must be reflected in a problem statement of maximising profit. The development of an economic-mathematical model for optimising the delivery of finished goods to commodity groups is based on the textile UZTEX Group. Optimality criteria result in the statement and solution of optimising the sales structure and delivery of finished goods to maximise a textile company's profit. Thus, the regression dependence of the profit of in one thousand US dollars from sales of t-shirts in one thousand pieces has the following aspect:

$$f(x) = 612.5x - 12.25x^2 \quad (3)$$

The regression dependence of the profit of in one thousand US dollars from sales of sportswear in one thousand pieces has the following aspect:

$$\varphi(x) = 82.2x - 1.1x^2 \quad (4)$$

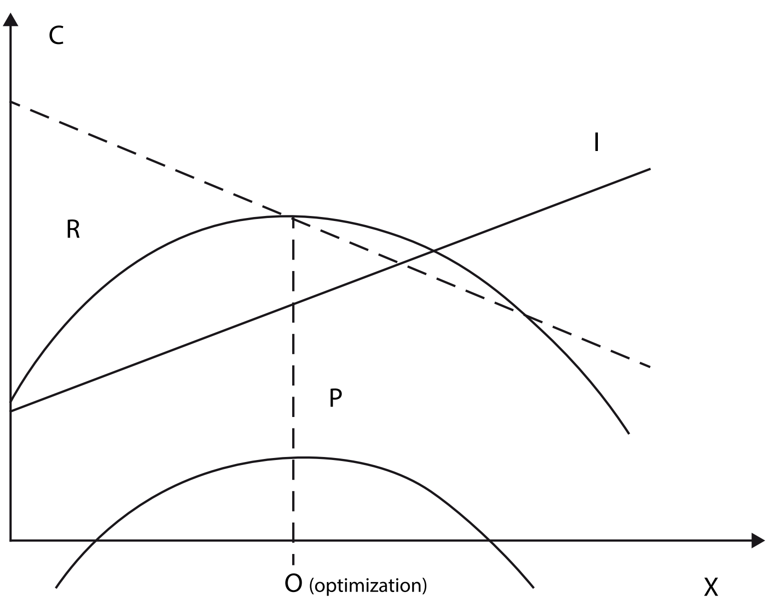

Figure 3: Dependence of the profit of a textile enterprise on product sales

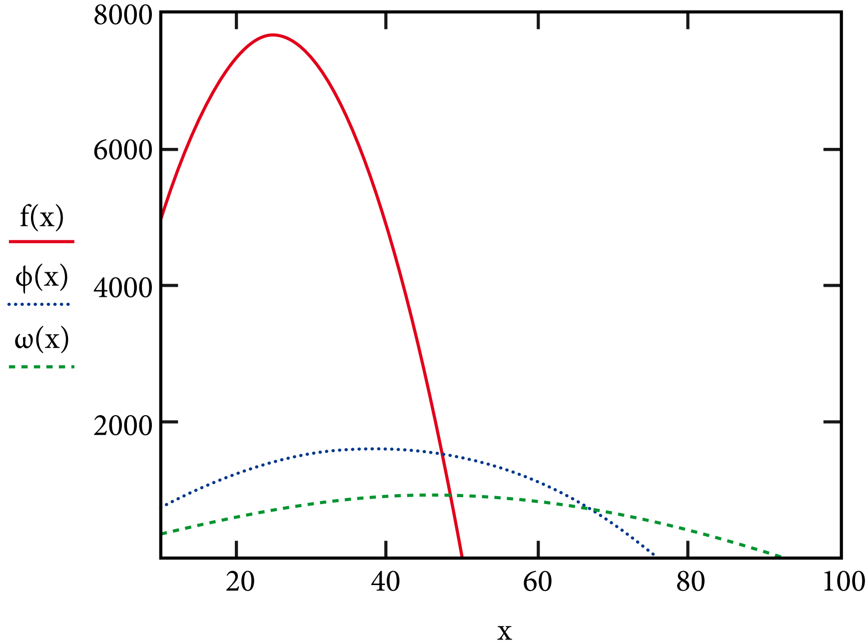

Figure 4: Regression dependences of profit from sales of finished products

The regression dependence of the profit of in one thousand US dollars from sales of hosiery in one thousand pieces has the following aspect:

$$\omega(x) = 38.9x - 0.42x^2 \quad (5)$$

The graphs of these regression dependences of profit from sales are shown in Figure 4. Graphical modelling allows us to conclude that there are maximum profit values at the optimal sales of the indicated types of finished products of a textile company. It is possible to optimize the structure of its sales and supply. The economic-mathematical modelling of the sales structure of finished goods of three main types consists of the formation additive function, which maximises the general profit from sales of t-shirts, sportswear and hosiery. The statement and solution of the optimising task are given below:

$$F = (x_1, x_2, x_3) = 612.5x_1 - 12.25x_1^2 + 84.2x_2 - 1.1x_2^2 + 38.9x_3 - 0.42x_3^2 \quad (6)$$

$$x_1 = 1;\ x_2 = 1;\ x_3 = 1 \quad (7)$$

Given $x_1 > 24\ x_2 > 32\ x_3 > 35$

$$Maximize(F, x_1, x_2, x_3) = \begin{bmatrix} 25 \\ 38 \\ 46 \end{bmatrix} \quad (8)$$

$$F(25, 38, 46) = 10170 \quad (9)$$

Thus, an optimal volume of the sale and supply of t-shirts to consumers is 25 thousand pieces, while that figure is 38 thousand pieces for sportswear and 46 thousand piecesfor hosiery. The UZTEX Group's overall maximum profit will be equal to $10.17 million.

II. Models of optimisation must be adequate, and accurately illustrate the logistics business processes and functions of supply chain management. Economic-mathematical optimisation models must be designed using concrete figures for logistics business processes and contain quantitatively measurable conditions for their implementation. They must be expressed in a system of restrictions of the model in terms of the size of used resources and reasonable assumptions on the scope of variation. In these terms, the research of operations applied in optimising logistics business processes should be supplemented with mathematic-statistical characteristics that take into account the probability of realisation under the established law of parameter distribution of these processes as random sizes.

III. The external conditions and parameters of the internal environment of supply chains and logistics business processes vary. While carrying out the optimisation, it is necessary to consider possible changes in the external conditions and parameters of logistic decisions. Similar changes are made periodically or in the process of detection to the developed economic-mathematical models of optimisation. Previous practice with optimising models shows that they can be applied in an imitating form [19]. This assumes the automatic recalculation of optimisation results when there is a change of factorial signs and system parameters of the restrictions imposed on the used resources in supply chains.

IV. Data regarding the parameters of supply chains must be exact, timely and quick. This requirement is due to the use of that data in optimisation models, whose results significantly vary depending on the values of factorial signs and system of restrictions. Testing the results of the optimisation parameters of supply chains is obligatory. Such testing is carried out by verifying developed models and the results obtained via other economic-mathematical processing. The large number of records regarding supply chain parameters requires the preliminary analysis of those records, in a subsequence of integration and the use of new software products for optimisation by the chosen optimality criteria.

V. Optimising calculations of supply chain parameters must be presented in a form convenient for use. The form of representing results of optimisation must facilitate the adoption and implementation of administrative decisions by managers. The development and application of unique decision-making algorithms are needed where applied supply chain optimisation parameters are one of the key factors [20]. Though it is still an essential element, the algorithm used to develop the optimal solution in supply chains must be flexible, adaptable and confirmable. This will facilitate the implementation of management decisions regarding supply chains.

VI. Optimisation requires the qualified professionals of companies to search for the best logistics decision [21]. This principle and requirement provide scientific and almost reasonable optimisation objectives, including intentional function, optimality criteria, a system of restrictions of the economic-mathematical model of the logistics decision, and modern software. It is not necessary to assume the correct objective definition of optimisation and the effective use of computer programs. This is particularly true for workers who do not posses the necessary knowledge in this area or experience in optimising calculations.

VII. Monitoring supply chains and logistics business processes subject to optimisation. The business processes for which optimisation is carried out must be supported according to goals and developed algorithms. However, this does not exclude their continuous improvement by managing changes and the emergence of more effective software products.

3 Results and discussion

The monitoring of optimised supply chains is supplemented with an assessment and analysis of optimisation costs. The maintenance of and changes to initial optimised parameters, as the improvement of supply chains, demand considerable technology and personnel costs. Also necessary are the assessment of the total costs of optimisation and the comparison of a previous decision with control alternatives. The definition of the impact of the optimisation of technology on the economic indicators of an organisation requires benchmarking. This might relate to crucial indicators of efficiency before technological implementation, the comparison of optimisation results with control indicators and the performance of regular audits of optimised business processes.

A critical place in supply chain management is taken by the optimisation of the arrangements of a warehouse chain in the territory served. The optimisation of a logistics chain includes analysing data and logistics strategy elements for the definition of quantity and delivery volumes, and the arrangement of distribution centres to achieve an optimum balance between the level of service and logistics costs. The optimisation of a chain allows us to increase service quality and achieve significant efficiency in terms of the maintenance costs of a warehouse, the transportation of goods and investment. Growing interest in the optimisation of chains among professional logistics providers has caused significant growth in the software market for optimisation over the last five years. However, many companies mistakenly carrying out optimisation based only on the analysis of data. By paying too much attention to economic-mathematical modelling, companies miss the strategic and practical contexts of optimisation, which may lead to a severe reduction in their client base. The characteristics of the shipment of goods through optimisation software may consider these critical, but less operational factors.

The optimisation possibilities of software have improved considerably over the last five years and now allow us to carry out complex factorial analysis [22]. However, logistics specialists must rely not only on the

modelling instruments of decision-making support, but also on the defining factors of creating a distributive chain. The best approach consists of the optimum combination of these tools that facilitate the economic-mathematical modelling of a distributive chain. This includes practical questions regarding a logistic chain's arrangement and objective statements, and the development of the corresponding strategy.
Initially, it is necessary to consider the shortcomings of the specific optimisation of a chain. It is then possible to offer a modern approach to carrying out similar optimisation. This considers the strategic and practical questions regarding the placement of a logistic chain and their integration with optimisation results. Companies wishing to optimise logistics networks spend most of the time collecting and developing accurate operational estimates of costs to satisfy data software package requirements. Considerable efforts are necessary for processing, analysing and verifying data to accurately understand their general corporate strategy with regard to their impact on the supply chain. Meetings with clients to plan future service parameters of the chain using data serve as secondary sources for analysis. A company can afford or delay optimising a chain or consider potential supply chain harmonisation without optimising the needs of its supply chain participants due to the high probability of the need to purchase assets for the development and optimisation of the chain. This is not less important than the practical strategic objective of achieving logistics chain optimisation.
Support for the adoption of the logistics decision to optimise a network is provided using modern software [18], which gives significant assistance for assessing collected data regarding the quantitative and qualitative parameters of a network and the productive parameters obtained from economic-mathematical modelling.

3.1 Application and implication of the model

In the integrated supply chain management world, the textile companies seek to optimise supply chains and the functional area of logistics, and the business processes of transportation, warehousing and distribution to achieve the maximum results while optimising current costs and resources [23]. In order to optimise economic streams at companies and in supply chains, the managers of foreign textile companies use well-known methods and ways that might include six sigma, economical production, integrated quality control, complicated computer modelling instruments, and the planning of deliveries, the use of modern technologies of management, and other numerous optimisation methods [24].
In the broadest terms, optimisation means balancing several factors to achieve the best overall result. In planning, for example, optimisation means balancing the use of transport and operational costs, i.e. the reserve rate, including customer service. The prices of finished goods and raw materials, outputs or a combination of business processes are balanced to achieve cooperation. In the processing mode, transaction optimisation means using modern software to choose the best alternative processes, such as the routing of shipment or distribution of production [25].
We must, however, take into account the best possible decision that provides the maximum result in each specific situation. This is impractical as its achievement requires high implementation costs. For example, textile companies develop an optimal distributive chain variant. Computer modelling can build an optimum chain of similar distribution on several markets and place the distributor's primary distribution centre on several markets. From a practical point of view, however, a better approach is to implement a decision on only one market. In other words, instead of looking for the ideal decision, it is better to choose the practical decision for each specific situation.
We can add to the central questions of optimising logistics business processes and supply chain management the definition of its purpose, optimality criteria, and the corresponding restrictions regarding time and resources. In strict economic-mathematical terms, optimisation represents the process of searching for parameters, such as economic streams, logistics business processes and supply chain management. By using them, the extreme (minimum or maximum) value of the indicator (vector) chosen by the optimality criteria is achieved [18].
Companies took a huge step forward in data processing automation, deliveries connected with a particular chain and logistics operations. While these innovations reduced costs due to decreased labour skills, their most significant impact is expected in the future. The automation of data processing is an essential subsystem of optimising the supply chain, and allows most textile companies to reduce their costs and increase efficiency significantly. There is an opportunity to reduce costs by 10 to 40% through more effective logistics decisions for many supply chains.

4 Conclusion

Findings

This research suggests that optimising and managing the supply chains of textile producers requires the optimisation of other costs and transport expenses, including optimal placement when establishing new textile enterprises. Thus, the satisfaction of the need for the effective control and management of all logistic chains, i.e., supply, production, transportation and textile production will lead to positive results when penetrating the organisational structure of a new business that is technologically adjacent to an existing production and marketing chain. It was also highlighted that optimisation models must be adequate and correctly illustrate the logistics business processes and functions of supply chain management.

Limitations

This research focused on only one country, i.e., Uzbekistan, and thus might not apply to some other countries. This research deals with well-established models and lacks the latest statistical or mathematical models. More care should be taken to ensure that data regarding logistics, supply chains and business processes are exact, timely and quick due to their use in optimisation models, which results in a significant variation depending on the values of factorial signs and system of restrictions.

Future suggestions

The purposes of optimisation must to be measurable and correspond to the optimality criteria of the actual logistic decision that it has to be reflected in the statement of the related task. For example, the economic-mathematical model of sales optimisation of finished goods can be carried out using the optimality criteria to maximise sales and profit, while minimising used resources and costs. The use of artificial neural networks and artificial intelligence might be applied in the future.

Funding

This research was funded by Humanities and Social Science Pre-research Project of Donghua University (218-10-0108019).

References

1. COHEN, S., ROUSSEL, J. *Strategic supply chain management: the five core disciplines for top performance*. 2nd ed. New York : McGraw-Hill Education, 2013, 321 p.
2. KHOSO, A.N., MEMON, H., HUSSAIN, M., SANBHAL, A.N., ABRO, A.Z. Production and characterization of wool and hair fibers in highlands of Baluchistan, an economic and sustainable approach for Pakistan. *Key Engineering Materials*, 2015, **671,** 473–482, doi: 10.4028/www.scientific.net/KEM.671.473.
3. BAKHSH, N., KHAN, M.Q., AHMAD, A., HASSAN, T. Recent advancements in cotton spinning. In *Cotton Science and Processing Technology*. Edited by H. Wang and H. Memon. (Textile Science and Clothing Technology). Singapore : Springer, 2020, 143−164, doi: 10.1007/978-981-15-9169-3_8.
4. CHRISTOPHER, Martin, TOWILL, Denis R. Supply chain migration from lean and functional to agile and customised. *Supply Chain Management*, 2020, **5**(4), 206–213, doi: 10.1108/13598540010347334.
5. MADJIDOV, S., KHAKIMOV, B. Viewpoints about potential stimulation and possibilities of investments on textile industry Uzbekistan. *European Journal of Business and Economics*, 2012, **6**, 22–24, doi: 10.12955/ejbe.v6i0.138.
6. BHATEJA, Ashish Kumar, BABBAR, Rajesh, SINGH, Sarbjit, SACHDEVA, Anish. Study of green supply chain management in the Indian manufacturing industries: a literature review cum an analytical approach for the measurement of performance. *IJCEM International Journal of Computational Engineering & Management*, 2011, **13**, 84−99.
7. BEAMON, B.M. Supply chain design and analysis: models and methods. *International Journal of Production Economics*, 1998, **55**(3), 281–294, doi: 10.1016/S0925-5273(98)00079-6.
8. FERNIE, J., SPARKS, L. *Logistics and retail management: insights into current practice and trends from leading experts*. Boca Raton : CRC Press, 1999, 214 p.
9. FISHER, M.L. What is the right supply chain for your product. In *Operations management*. Edited by Michael. A Lewis and Nigel Slack. (Critical perspectives on business and management). London: Routledge, 2003, 73–88.

10. LOWSON, B., KING, R., HUNTER, A. *Quick response: managing the supply chain to meet consumer demand*. West Sussex : John Wiley & Sons, 1999, 304 p.
11. KHANKHADJAEVA, N.R. Role of cotton fiber in knitting industry. In *Cotton science and processing technology*. Edited by Hua Wang and Memon Hafeezullah.. (Textile Science and Clothing Technology). Singapore : Springer, 2020, 247–303.
12. CHEN, Ming-Kuen, LIN, Yen-Ling, FANG, Chun-Pin, CHEN, Kuo-Hsuan. Supply chain strategic structure in the taiwan textile industry. *International Journal of Electronic Business Management*, 2013, **11**(2), 73–87.
13. KRITCHANCHAI, D., WASUSRI, T. Implementing supply chain management in Thailand textile industry. *International Journal of Information Systems for Logistics and Management*, 2007, **2**(2), 107–116.
14. KAYA, Ö., ÖZTÜRK, F.A. Research on the applications of supply chain in textile-clothing industry. *International Journal of Innovation, Management and Technology*, 2014, **5**(5), 334–338.
15. SØNDERGÅRD, B., HANSEN, O.E., HOLM, J. Ecological modernisation and institutional transformations in the Danish textile industry. *Journal of Cleaner Production*, 2004, **12**(4), 337–352, doi: 10.1016/S0959-6526(03)00049-0.
16. GIRI, S., RAI, S.S. Dynamics of garment supply chain. *International Journal of Managing Value and Supply Chains*, 2013, **4**(4), 29–42, doi: 10.5121/ijmvsc.2013.4403.
17. VANATHI, R., SWAMYNATHAN, R. Competitive advantage through supply chain collaboration – an empirical study of the Indian textile industry. *Fibres & Textiles in Eastern Europe*, 2014, **4**(106), 8–13.
18. HUI P.C.L., TSE K., CHOI TM., LIU N. Enterprise resource planning systems for the textiles and clothing industry. In *Innovative quick response programs in logistics and supply chain management*. Edited by Cheng T. and Choi T.M. Berlin, Heidelberg : Springer, 2010, 279–295, doi: 10.1007/978-3-642-04313-0_14.
19. CANIATO, F., CARIDI, M., CRIPPA, L., MORETTO, A. Environmental sustainability in fashion supply chains: an exploratory case based research. *International Journal of Production Economics*, 2012, **135**(2), 659–670, doi: 10.1016/j.ijpe.2011.06.001.
20. WANG, H., MEMON, H., SHAH, S.H.H., SHAKHRUKH, M. Development of a quantitative model for the analysis of the functioning of integrated textile supply chains. *Mathematics*, 2019, **7**(10), 1–14, doi: 10.3390/math7100929.
21. HERBERT, I.P., ROTHWELL, A.T., GLOVER, J.L., LAMBERT, S.A. Graduate employability, employment prospects and work-readiness in the changing field of professional work. *The International Journal of Management Education*, 2020, **18**(2), 1–13, doi: 10.1016/j.ijme.2020.100378.
22. GUNASEKARAN, A., NGAI, E.W.T. Information systems in supply chain integration and management. *European Journal of Operational Research*, 2004, **159**(2), 269–295, doi: 10.1016/j.ejor.2003.08.016.
23. DUTTA, P., MISHRA, A., KHANDELWAL, S., KATTHAWALA, I. A multiobjective optimization model for sustainable reverse logistics in Indian E-commerce market. *Journal of Cleaner Production*, 2020, **249**, 1–13, doi: 10.1016/j.jclepro.2019.119348.
24. STAMATIS, D.H. *Six sigma fundamentals: a complete introduction to the system, methods, and tools*. Boca Raton : CRC Press, 2019.
25. GAYIALIS, S.P., TATSIOPOULOS, I.P. Design of an IT-driven decision support system for vehicle routing and scheduling. *European Journal of Operational Research*, 2004, **152**(2), 382–398, doi: 10.1016/S0377-2217(03)00031-6.