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DEEP LEARNING BASED OPTIMIZATION ALGORITHMS FOR COVID-19 MEDICINE INDUSTRY SUPPLY CHAIN MANAGEMENT USING BACTERIAL FORAGING OPTIMIZATION

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Abstract
In this study, the concept of Deep learning is explained, and algorithms for optimizing bacterial foraging are optimized under Covid-19 medicine industry Supply chain management. By defining the basic phases and content of Deep learning, the relationship between AI and optimization is examined. Based on this study, a bacterial feed optimization algorithm was considered under Covid-19 medicine industry Supply chain management. Steps and operations of these artificial intelligence-based optimization algorithms, which were widely used in the literature, have been examined in detail. All algorithms discussed in this study are related to nature. Covid-19 medicine industry Supply chain management of medicine industry is one of medical issues that need special attention. One of the general problems in the production of medicine industry is the total number of requirements that do not correspond to the production volumes available in the medicine industry system. One of the limitations of the Covid-19 medicine industry supply chain problems is the Covid-19 medicine industry supply, where medicine industry is a perishable product using Bacterial Foraging Optimization and the Singular Value Decomposition method. This research models the distribution of the Covid-19 medicine industry supply chain so that the model can be used to minimize the operating costs of hospital vaccination availability due to the level of demand and type of medicine industry using Bacterial Foraging Optimization and Singular Value Decomposition Method.
Keywords:-Supply chain, warehouse, distribution center, Deep learning, Bacterial Foraging Optimization and Singular Value Decomposition Method

1. Introduction

The Covid-19 pandemic also stressed that although the virus or quarantine measures have not directly affected the factories in a particular area, it may still happen that the areas from which the raw material was found capture the area in Corona's grip. The crisis, which has taken over half of the world with its own power, is likely to affect the rest of the region due to the complex supply chain that exists in the world. This type of barrier is no longer an uncommon thing. A study by the McKinsey Global Institute has shown that companies now expect disruptions in their supply chains that last a month or more after every 3.7 years. The reasons behind this can be the growing natural disaster, pandemic, terrorism, cyber-attacks or insecurity related to trade policies - whatever. Due to the increasing risks in international trade, many decision makers place their emphasis on self-confidence in times of crisis. However, self-confidence is not in itself a guarantee of better security. Studies show that ending dependence on foreign products and raw materials directly means increased dependence on original products. But the risk of early crises on native products also remains. The fact is that international trade can act as a shield in the event of unforeseen events, because thereby the diversity of supply can be ensured. For example, if a factory stands still somewhere, companies can easily secure their supply from the factories elsewhere. With the help of international trade, the countries of the world can create many sources of demand and supply. International trade is also needed to promote new discoveries in the long run. The latest edition of the World Trade Report also says that open trade provides access to large markets, which motivates companies to take risks for new discoveries. Imports of capital and intermediate goods through international trade provide access to the latest technologies in developing countries. This gives them a chance to participate in the global value chain. Competition is also encouraged through trade. As a result, companies are always alert and encouraged to continue experimenting. Given the increasing risks in the company, it is imperative to develop the ability to do new experiments.In modern times, many people were given the opportunity to work from home due to digital measures to wind up work. 3D printing technology helped them find immediate solutions to a wide range of problems related to personal protective equipment, medical equipment and isolation wards. The Covid-19 epidemic has made it clear that the outbreak spread over an area of this interconnected world could reach other countries in a matter of days. No one is safe until everything is safe. At a time when all the countries of the world are starting to use life-saving medicine industrys, the need to promote international trade and cooperation is the highest today. Some member countries of the World Trade Organization have proposed an agreement under which the import duty on medical goods will be completely abolished. Along with this, proposals have also been made to implement the necessary reforms of international rules and systems during the crisis in trade in key commodities. The experience of Covid-19 has been the same throughout humanity. This can be a reason to start a continuous effort with each other, taking into account the future preparations for the countries of the world.The series of companies that ultimately make products and services available to consumers, including all the features that enable the production, delivery and recycling of materials, components, end products and services, is a Covid-19 medicine industry supply chain. The term Covid-19 medicine industry supply chain refers to the complex sequence of activities, information, and material flow involved in the production and

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distribution of a company's output. It consumes huge amounts of capital in the form of plant, equipment and inventories and is responsible for most of the company's costs for goods and operating expenses. It creates significant value and ultimately determines the company's ability to satisfy customer requirements. As a result, effective Covid-19 medicine industry supply chain management is an important strategic challenge for most companies. But formulating effective strategy requires a good understanding of what drives costs and service in a Covid-19 medicine industry supply chain. Covid-19 medicine industry supply chain management is the systematic, strategic coordination of the traditional business functions and tactics across these functions within a particular company and across companies within the Covid-19 medicine industry supply chain with the aim of improving the long-term results of individual companies and the Covid-19 medicine industry supply chain as a whole.

Today, companies can no longer compete solely as individual entities in the ever-changing business world. Market globalization and increased competition are forcing organizations to rely on efficient Covid-19 medicine industry supply chains to improve their overall performance. The Covid-19 medicine industry supply chain has become an important topic in management science and industry. When individual companies in the Covid-19 medicine industry supply chain make business decisions that ignore the interests of other chain members, this sub-optimization only transfers costs and additional latency along the Covid-19 medicine industry supply chain. Ultimately, this is primarily higher prices for end products, lower Covid-19 service levels in the supply chain medicine industry and thus lower demand for end customers. For this reason, the management of the Covid-19 medicine industry supply chain certainly needs extra attention from the managers. If Covid-19 Medicine industry Supply Chain Medicine industry inventory information is not shared or exchanged between different parties in the Covid-19 medicine industry supply chain, it may be in principle for the principles of weakly linked activities and decisions across the Covid-19 medicine industry supply chain. Today, timely sharing and coordination of information across Covid-19 medicine industry supply chains in addition to the new capabilities has changed the way Covid-19 medicine industry supply chains operate. The global visibility of medicine industry inventory profiles across the Covid-19 medicine industry supply chain principles for reduced costs and improved customer service.

In the Covid-19 medicine industry supply chain, many problems still need careful consideration in terms of solution procedure to support the respective systems. In addition, collaborative relationships that focus on reducing uncertainty in operating environments by using improved information systems and business processes will result in more efficient allocation of key resources, faster market response times and more reliable Covid-19 medicine industry supply chain performance. However, these co-operation schemes alone cannot compensate for fundamentally deficient and operationally inefficient production and distribution environments. Covid-19 medicine industry supply chain management deals with total process quality and represents a new

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way of managing the business and the relationship with other members of Covid-19 medicine industry supply chain. Supply chain management can be defined as: "Supply chain management is the coordination of production, storage, location and transport between players in the supply chain to achieve the best combination of responsiveness and efficiency for a given market. Many researchers in the inventory system have focused on a product that does not exceed deterioration.

However, there are a number of things whose significance does not remain the same over time. The deterioration of these substances plays an important role and cannot be stored for long {Yadav et al. (1-10) Deterioration of an object can be described as deterioration, evaporation, obsolescence and loss of use or restriction of an object, resulting in a lower stock consumption compared to natural conditions. When raw materials are placed in stock as a stock to meet future needs, there may be deterioration of objects in the arithmetic system that may occur for one or more reasons, etc. Storage conditions, weather or humidity. {Yadav, et al. (11-20)}.Inach generally claims that management owns a warehouse for storing purchased warehouse. However, for various reasons, management can buy or give more than it can store in the warehouse and name it OW, with an extra number in a rented warehouse called RW near OW or a little away from it {Yadav, a. al. (21-53)}. Inventory costs (including holding costs and depreciation costs) in RW are usually higher than OW costs due to additional costs of handling, equipment maintenance, etc. Reducing inventory costs will economically use RW products as quickly as possible. Actual customer service is provided only by OW, and to reduce costs, RW stocks are cleaned first. Such arithmetic examples are called two arithmetic examples in the store {Yadav and swami. (54-61)}. Managing the supply of electronic storage devices and integrating environmental and nervous networks {Yadav and Kumar (62)}. Analysis of seven supply chain management measures to improve inventory of electronic devices for storage by sending a financial burden using GA and PSO and analysis of supply chain management to improve inventory and equipment inventory using genetic calculation and model design and analysis of chain inventory from bi inventory and economic difficulty in the transport of goods by genetic calculation {Yadav, AS (63, 64, 65)}. Inventory policies for inventory and inventory needs and miscellaneous inventory costs under allowable payments and inventory delays An example of amortization of goods and services of various types and costs by keeping a business loan down and an inventory model with sensitive price needs, inventory costs as opposed to loans for business expenses under inflation { Swami, et. al. (66, 67, 68)}.

The objectives of Multiple Objective Genetic Algorithm and PSO, which include supply and deficit improvement, inflation and a calculation model based on a genetic calculation of scarcity and low inflation of PSO {Gupta, et. al. (69, 70,)}.An example with two stocks of depreciation on goods and inventory costs during particle upgrade and an example with two inventories of property damage and inventory costs in inflation and soft computer techniques {Singh, et. al. (71, 72)}. Delayed control of alcohol supply and refinement of particles and supply system for green cement and inflation by means of particle

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improvement and electronic inventory system and distribution center by means of genetic calculations {Kumar, et. al. (73, 74.75)}. Example of two-store depreciation and stock-based warehouses using a genetic stock and vehicle stock for demand and inflation stocks with two distribution centers using genetic stock {Chauhan and Yadav (76, 77)}. Marble Analysis Improving Industrial Reserves Based on Gene Technology and Improving Multiple Particles {Pandey, et. al. (78)}.White wine industry in supply chain management through nervous networks {Ahlawat, et. al. (79)}. Best policy to immediately import damaged goods and pay for conditional delays under the supervision of two warehouses {Singh, et. al. (80)}.

2. Process of Covid-19 medicine industry supply chain Management

Covid-19 medicine industry supply chain management is a process used by companies to ensure that their Covid-19 medicine industry supply chain is efficient and cost effective. A Covid-19 medicine industry supply chain is the collection of steps a company takes to turn raw materials into an end product. The five basic components of Covid-19 medicine industry supply chain management are discussed below: -

1. Plan: The initial phase of the Covid-19 medicine industry supply chain process is the planning phase. We need to develop a plan or strategy to address how the products and services will meet customer requirements and needs. In this step, the planning should primarily focus on designing a strategy that provides maximum profit. To manage all the resources required to design products and provide services, a strategy must be designed by the companies. Covid-19 medicine industry supply chain management focuses primarily on planning and developing a set of measurements.

2. Develop (source): After planning, the next step involves development or sourcing. In this phase, we concentrate primarily on building a strong relationship with suppliers of the raw materials required for production. This involves not only identifying reliable suppliers, but also determining various planning methods for shipping, delivery and payment of the product. Companies need to choose suppliers to provide the goods and services they need to develop their product. So in this step, the Covid-19 medicine industry supplier chain managers need to construct a set of pricing, delivery and payment processes with suppliers and also create measurements to control and improve the relationship. Finally, Covid-19 medicine industry supply chain managers can combine all of these processes to manage their Medicine industry Inventory goods and services. This handling includes receipt and examination of shipments, transfer to production facilities and approval of supplier payments.

Make: The third step in the Covid-19 process for managing the medicine industry supply chain is the manufacture or manufacture of products as required by the customer. In this step, the products are designed, produced, tested, packaged and synchronized for delivery. Here, the task of the Covid-19 medicine industry supply chain manager is to plan

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all the activities required for manufacturing, testing, packaging and preparation for delivery. This phase is considered the most metrically intensive unit in the Covid-19 medicine industry supply chain, where companies can measure quality levels, production output and worker productivity.

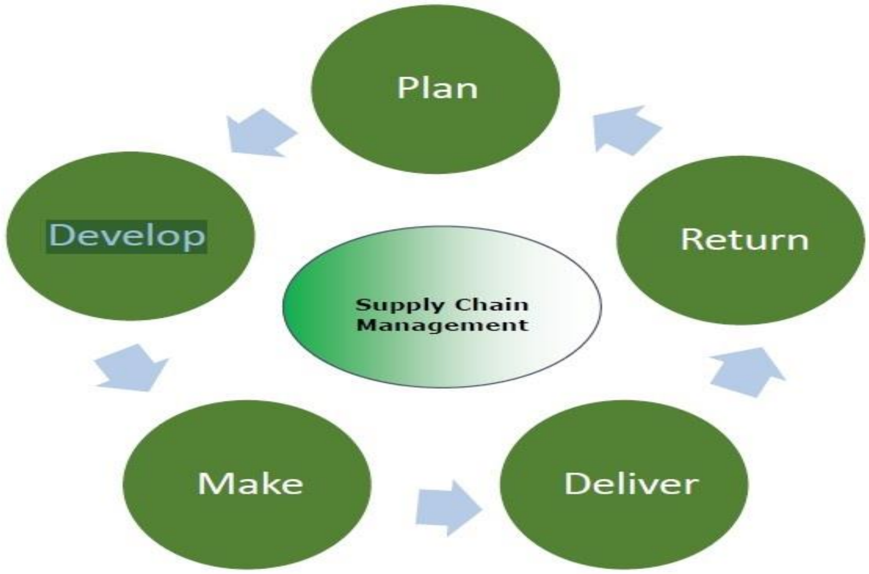

Fig. 1.:- Process of Covid-19 medicine industry supply chain Management

4. Deliver: The fourth phase is the delivery phase. Here, the products are delivered to the customer at the destination by the supplier. This phase is basically the logistics phase where customer orders are accepted and delivery of the goods is planned. The delivery phase is often referred to as logistics, where companies collaborate on receiving orders from customers, establish a network of warehouses, pick carriers to deliver products to customers and set up an invoicing system to receive payments.

5. Return: The last and final phase of Covid-19 medicine industry supply chain management is called the return. In the phase, defective or damaged goods are returned to the supplier by the customer. Here, companies need to process customer inquiries and respond to their complaints, etc. This phase is often a problematic part of the Covid-19 medicine industry supply chain for many companies. The planners of the Covid-19 medicine industry supply chain need to find a responsive and flexible network to accept damaged, defective and extra products back from their customers and facilitate the return process for customers who have problems with delivered products.

3. Deep Learning

Deep learning is based on the ability of a technology to learn from raw data. Word processing, voice or face recognition; There are a large number of applications.

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YannLeCun and Geoffrey Hinton are the two leading experts who use neural networks inspired by biological neurons in this area. If these neuronal neurons can be connected in various ways, the neural networks consist of overlapping layers in most cases. The neural network is trained to recognize the contents of an image. Depending on the results, the "link force" between each neuron is corrected. Thus, the neural network was perfected until further recognition error disappeared. Cigref's guide says "Deep Learning is very powerful but also very expensive". Olik It should be kept for the most important classes, and other Deep learning algorithms should be used at a lower cost, which can result in sufficient results. OlivThe AI machine is learning to learn and deep learning warns Olivier Ezratty in a new blog post. "There are a number of limitations: best AI solutions often combine together various techniques," he said, including other techniques including programming and rule engines and silenced them due to resonance in deep learning(Buchanan, 2005).

4. Step by Step Flow process of Covid-19 medicine industry supply chain Management:

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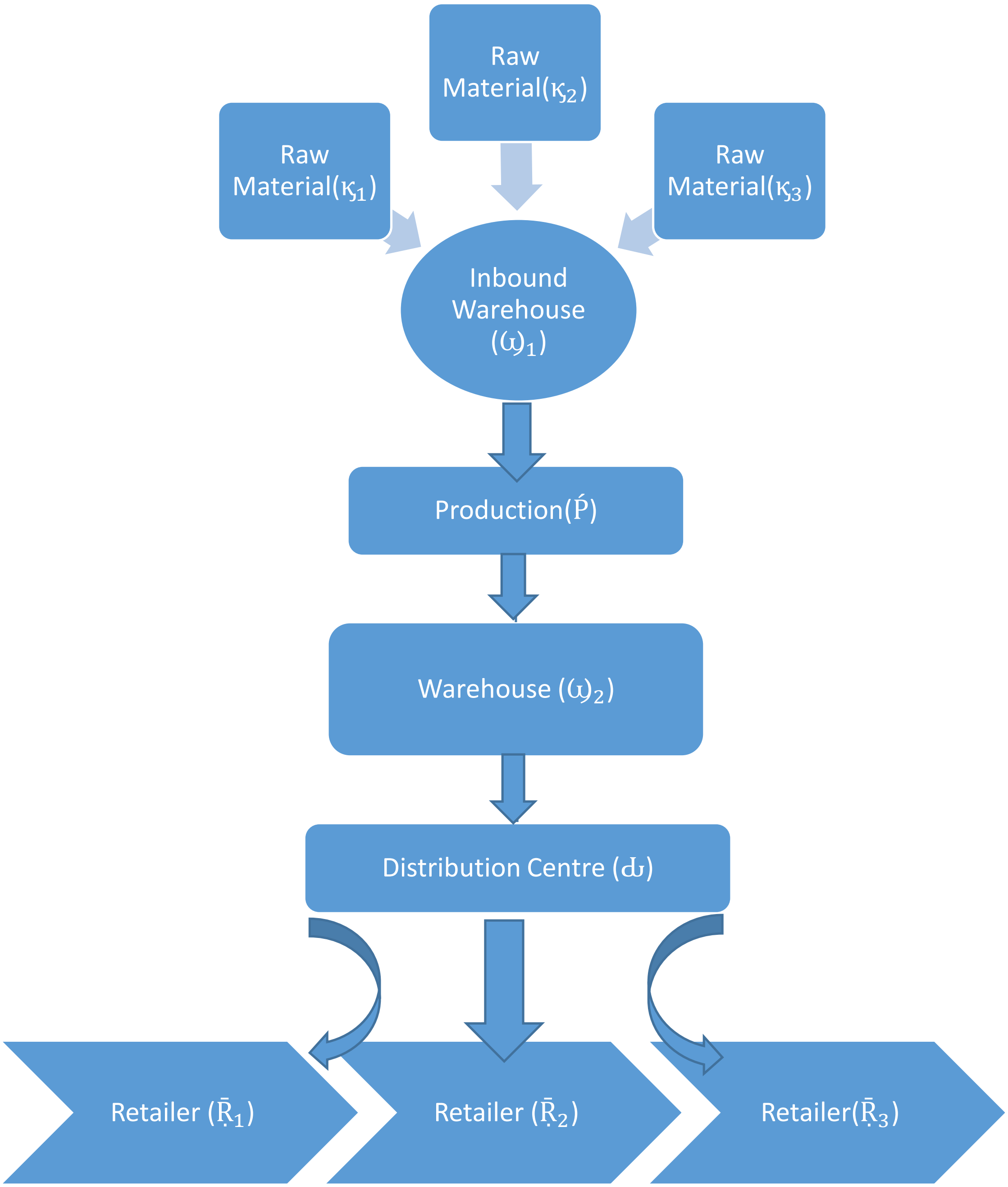

Fig.2.:Five-Step Flow process of Covid-19 medicine industry supply chain Management:

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5. Step by Step Explanation of the flow process:

5.1. Notations

The following assumptions have been made to develop the model:

$ƙ_1$ =Whole Virus.

$ƙ_2$ =Protein Subunit.

$ƙ_3$ =Nucleic Acid.

$$\underset{\wedge}{D}_{ƙ_1} = \text{Demand of raw material } (ƙ_1)$$

$$\underset{\wedge}{D}_{ƙ_2} = \text{Demand of raw material } (ƙ_2)$$

$$\underset{\wedge}{D}_{ƙ_3} = \text{Demand of raw material } (ƙ_3)$$

C_{θ_1} = Ordering cost for $ƙ_1$

$$C_{\theta_2} = \text{Ordering cost for } ƙ_2$$

$$C_{\theta_3} = \text{Ordering cost for } ƙ_3$$

$C_{T_{ƙ_1}}$ = Transportation cost of raw material ($ƙ_1$).

$C_{T_{ƙ_2}}$ = Transportation cost of raw material ($ƙ_2$).

$$C_{T_{ƙ_3}} = \text{Transportation cost of raw material } (ƙ_3)$$

$ɷ_1$ = Inbound Warehouse with highly containment facility (for raw materials)

$C_{H_{ƙ}}$ = Holding cost of raw materials in ($ɷ_1$)

$\acute{P}$ =Production Site.

$$C_{\acute{P}} = \text{Cost of production}$$

$ɷ_2$ =Warehouse with highly containment facility (After Production).

$C_{\tilde{T}_{ƙ}}$ =Transportation cost from $ɷ_1$ to $\acute{P}$.

$C_{\tilde{H}_{ƙ}}$ = Holding cost of finished goods.

ȡ =Indian Council of Medical Research (ICMR) (Distribution Centre).

$\underset{\wedge}{D}_{ƙ}$ =Demand of finished goods ($ƙ_1$,$ƙ_2$, $ƙ_3$).

$ᴆ_{ƙ_1}$ = Demand of retailer for finished goods ($ƙ_1$) .

$ᴆ_{ƙ_2}$ = Demand of retailer for finished goods ($ƙ_2$).

$ᴆ_{ƙ_3}$ = Demand of retailer for finished goods ($ƙ_3$).

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$C_{\overline{T_{ʞ}}}$ = Transportation cost from $ω_2$ to ȡ.

$C_{\overline{T_{ʞ_1}}}$ = Transportation cost from ȡ to retailer ($\bar{Ṛ}_1$).

$C_{\overline{T_{ʞ_2}}}$ = Transportation cost from ȡ to retailer ($\bar{Ṛ}_2$).

$C_{\overline{T_{ʞ_3}}}$ = Transportation cost from ȡ to retailer ($\bar{Ṛ}_3$).

$\bar{Ṛ}_1$ =Retailer which deals with Whole Virus.

$\bar{Ṛ}_2$ =Retailer which deals with Protein Subunit.

$\bar{Ṛ}_3$ =Retailer which deals with Nucleic acid.

Explanation of Model

Step-1: First, we order a raw material Whole Virus ($ʞ_1$) from Different Country via air cargo according their demand $Ḓ_{ʞ_1}$. Second, we order a raw material Protein Subunit ($ʞ_2$) from Different Country via air cargo according their demand ($Ḓ_{ʞ_2}$). Last, we order a raw material ($ʞ_3$) from Different Country via air cargo according their demand ($Ḓ_{ʞ_3}$). It includes a cost of ordering and transportation for raw materials ($ʞ_1$,$ʞ_2$,$ʞ_3$) i.e. ($C_{\Theta_1}, C_{\Theta_2}, C_{\Theta_3}$) and ($C_{T_{ʞ_1}}, C_{T_{ʞ_2}}, C_{T_{ʞ_3}}$) respectively. Here, our raw materials are medicine.

Step-2: We store the raw materials in an inbound warehouse ($ω_1$) with highly containment facility. For storing a raw materials, it includes a storage cost ($C_{H_{ʞ}}$).

Step-3: We shipped the raw materials from inbound warehouse ($ω_1$) to Production Site via container for production. In production area, they produce finished goods. It involves the cost of production ($C_{\acute{P}}$) and transportation($C_{\tilde{T}_{ʞ}}$).

Step-4: After getting finished goods, we stored the products in warehouse with highly containment facility ($ω_2$). For holding finished goods, it involves the cost of storage ($C_{\tilde{H}_{ʞ}}$).

Step-5: Following manufacturing, we ship all medicine to the drugs distribution centre (ȡ) via container based on demand ($Ḓ_{ʞ}$). It also includes cost of transportation($C_{\overline{T_{ʞ}}}$).

Step-6: Now, medicine flow from distribution centre (ȡ) to respective retailers via container based on the demand. It means, finished goods of $ʞ_1$ goes to the reatailer ($\bar{Ṛ}_1$) which deals with Whole Virus medicine based on demand ($Đ_{ʞ_1}$). Similarly, ($ʞ_2$, $ʞ_3$) finished goods flows to the retailer ($\bar{Ṛ}_2, \bar{Ṛ}_3$) which deals with the Protein Subunit and Nucleic Acid based on demand ($Đ_{ʞ_2}, Đ_{ʞ_3}$) repectively. Finished goods transport from ȡ to

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retailer($\bar{R}_1, \bar{R}_2, \bar{R}_3$) according to retailers deals with that medicine based on the demand ($Đ_{\kappa_1}, Đ_{\kappa_2}, Đ_{\kappa_3}$) include transportation cost i.e. ($C_{\overline{T_{\kappa_1}}}$, $C_{\overline{T_{\kappa_2}}}$, $C_{\overline{T_{\kappa_3}}}$) respectively.

6. Deep learning and Optimization

Deep learning on singular value decomposition

These methods are used in Deep learning on singular value decomposition In Deep learning, statistical and mathematical methods are used to learn from data sets. Dozens of different methods exist for this, whereby a general distinction can be made between two systems, namely symbolic approaches on the one hand and sub-symbolic approaches on the other. While symbolic systems are, for example, propositional systems in which the knowledge content, i.e. the induced rules and the examples are explicitly represented, sub-symbolic systems are artificial neuronal networks. These work on the principle of the human brain, whereby the knowledge contents are implicitly represented.

The singular value decomposition of a matrix A is the factorization of A in to the product of three matrices $A = UDV^T$ where the columns of U and V are orthonormal and the matrix D is diagonal with positive entries.

Where U and V are orthogonal matrices with orthonormal Eigen vectors chosen from AA^T and A^TA respectively D is a diagonal matrix with r elements equal to the root of positive Eigen Values of AA^T or A^TA (both matrices have the same positive Eigen values). The diagonal elements are composed of singular values

$$D = \begin{bmatrix} \sqrt{\lambda_1} & & & & \\ & \sqrt{\lambda_1} & & & \\ & & . & & \\ & & & . & \\ & & & & \sqrt{\lambda_r} \end{bmatrix} D = \begin{bmatrix} \sigma_1 & & & & \\ & \sigma_2 & & & \\ & & . & & \\ & & & . & \\ & & & & \sigma_r \end{bmatrix}$$

is if A is an m x n Matrix can be factorized as

$$[A]_{m\times n} = [A]_{m\times m}[D]_{m\times n}\left[A^T\right]_{n\times n}$$

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$$\begin{bmatrix} a_{11} & a_{11} & . & . & a_{1n} \\ a_{21} & a_{21} & . & . & a_{2n} \\ . & . & . & . & . \\ . & . & . & . & . \\ a_{m1} & a_{1m} & . & . & a_{mn} \end{bmatrix} = \begin{bmatrix} u_{11} & . & . & . & u_{m1} \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ u_{1m} & . & . & . & u_{mm} \end{bmatrix} \begin{bmatrix} \sigma_1 & 0 & 0 & . & 0 \\ 0 & \sigma_1 & . & . & 0 \\ 0 & 0 & \sigma_1 & . & 0 \\ . & . & . & . & . \\ 0 & 0 & . & . & a_{mn} \end{bmatrix} \begin{bmatrix} v_{11} & . & . & . & v_{1n} \\ . & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ v_{n1} & . & . & . & v_{nn} \end{bmatrix}$$

We can arrange Eigen vector in different orders to produce U and V to standardize the solution we order the Eigen vectors such come before these with smaller values $\sigma_1 \geq \sigma_2 \geq .... \geq \sigma_m$

7. Bacterial Foraging Optimization

To better understand the basics of BFO, it is worth mentioning briefly about the movements and life processes of the KoliBasili bacteria. Consequently, a coli bacterium may be present in different chemotaxis depending on the density of the medium (the substance) and its living conditions. KoliBasili bacteria carrying whips on them rotate their whips counter clockwise in environments suitable for food sources, movements based on swimming, tumbling and vice versa. By rotating these movements to include more rolling {Passino (82), Yang (83)}.During these processes, KoliBasili bacteria can be split in two or reproduced, or the presence of harmful sources in the environment or in accordance with the average life processes of these bacteria can end their lives. In addition, KoliBasili bacteria secrete a substance to attract the other coli bacteria in the appropriate environment, and the bacterial density of the environment is increased with this method of spread {Passino (82), Yang (83)}. BFOs also use a variety of solution processes, inspired by all of these processes and using the particles they accept as bacteria, in a flock-oriented manner in the solution space. In this context, chemo taxis includes a mixture of different phases such as rolling, swimming, reproduction and elimination - distribution. We can describe the algorithmic solution steps in BFO, which are designed in the context of the described functions and functions {Yang(83)}.Investigation of Artificial Intelligence Based Optimization Algorithms {Okula, el.al. (84)}

1-Step (installation phase): Randomly disposes of N pieces of bacterial particles (potential solution variables) in the solution space. Algorithm parameters (egNk: maximum number of chemotaxis, Nyus: number of swimming movements, Nude images: number of replicates, Ne: maximum elimination number, tensile and repulsive coefficients, oed: probability of elimination). Perform the necessary arrangements to resolve the issue.
2-Step: Calculate the objective function value (fitness) according to the location of the bacteria (potential solution variables).
3-Step: Perform the following steps, repeat until: (in conjunction with each objective function size)

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3-a-Step (chemotaxis phase): Perform the following steps for each bacterium up to the Nk value:
3-a-1-Step: Calculate the objective function value (suitability) according to the location of the next bacteria (potential solution variable).
3-a-2-Step: The objective function of the bacterium related to (fitness) cell to cell attractive effect of the update. Keep this value until the swimming phase.
3-a-13-Step: (Rolling phase): Generate random numbers up to the purpose function size in the range [-1, 1]. Run the scrolling process for the respective bacteria.
3-a-4-Step: Calculate the objective function value (suitability) according to the location of the bacteria (potential solution variable). The purpose of the relevant bacterium is to update the value of the functional function (fitness) from cell to cell with attractive effect.
3-a-4-Step (Swimming Phase): Perform the following steps for the related bacteria, up to the Nyush value.
3-a-5-1-Step: If the final objective function value (suitability) of the bacterium is better than stored before the swimming phase, keep this new value.
3-a-5-2-Step: Update the maintained objective function value (suitability) of the relevant bacteria according to the displacement value to be calculated.
3-a-6-Step : If not all bacteria have been treated yet, switch to the next bacterium and return to 3-a-1-step.
3-b-Step (Reproduction phase): Calculate the health status of each bacterium and sort them all from small to small according to these values.
3-c-Step: Remove the worst bacteria according to the set criteria. Let the bacteria grow in the best condition. New bacteria are in place of their parents.
3-d-Step: If the now value has not yet been reached, increase the counter for that value and go back to 3-a-step and continue with the next generation.
3-5-Step (Elimination - Distribution Phase): Transfer each bacterium to a new location according to the oed value.
4-Step: At the end of the processes, the value (s) obtained at the best global position are considered as the optimal value (s).

8. Implementation Results

We have implemented the analysis based on Bacterial Foraging Optimization and Singular Value Decomposition for optimal inventory management on the platform of

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MATLAB. As mentioned, we have the detailed information on excess and missing stock levels in each supply chain member, the most important times of product inventory levels to replenish each supply chain member as well as the main time of the commodity. The sample data with this information are given in Table 1.

Table 1: A sample data set along with its stock levels in each member of the supply chain

Bacterial Foraging Optimization										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3
T-1	3225	3472	3985	3485	3350	3267	3025	3072	3485	3050
T-2	3265	3442	3775	3475	3321	3269	3065	3042	3475	3021
T-3	3222	3462	3565	3465	3331	3262	3022	3062	3465	3031
T-4	3233	3443	3155	3455	3341	3265	3033	3043	3455	3041
Singular Value Decomposition										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3
T-1	3325	3272	3315	3385	3250	3467	3225	3472	3485	3350
T-2	3365	3242	3325	3375	3221	3469	3265	3442	3475	3321
T-3	3322	3262	3335	3365	3231	3462	3222	3462	3465	3331
T-4	3333	3243	3345	3355	3241	3465	3233	3443	3455	1341

Table 1 has the product ID, shipping ID, inventory levels that are in excess or missing at each supply chain member. Negative values represent lack of inventory levels, and positive values represent excess inventory levels. The transport ID mentioned in the form acts as an index for unpacking the main times for stocks and raw material chair. Table 2 shows the sample data, which has transport ID and the most important times for stocks. For the five-member supply chain, four main times can be achieved.

Table 2: Sample data from Database which is having principal times for stocks

Bacterial Foraging Optimization										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3

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T-1	3125	3172	3285	3185	3150	3167	3225	3472	3485	3350
T-2	3165	3142	3475	3175	3121	3169	3265	3442	3475	3321
T-3	3122	3162	3665	3165	3131	3162	3222	3462	3465	3331
T-4	3133	3143	3855	3155	3141	3165	3233	3443	3455	3341
Singular Value Decomposition										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3
T-1	3625	3672	3985	3685	3650	3667	3225	3472	3485	3350
T-2	3665	3642	3875	3675	3621	3669	3265	3442	3475	3321
T-3	3622	3662	3765	3665	3631	3662	3222	3462	3465	3331
T-4	3633	3643	3055	3655	3641	3665	3233	3443	3455	3341

Table 3: Initial random individuals

Bacterial Foraging Optimization										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3
T-1	3154	3142	3214	3234	3431	3354	3154	3142	3234	3431
T-2	3654	3653	3602	3612	3617	3541	3654	3653	3612	3617
Singular Value Decomposition										
T-I	RM-1	RM-2	RM-3	WH-1	M	WH-2	DC	R -1	R -2	R-3
T-1	3754	3742	3730	3734	3731	3754	3154	3142	3234	3431
T-2	3554	3553	3510	3512	3517	3540	3654	3653	3612	3617

To optimize bacterial foraging and analysis of singular value degradation, we need to generate random individuals with eight number of particles representing product ID and seven supply chain members. Table 3 describes two random individuals. Similarly, Table 4 represents random velocities corresponding to each particle of the individual.

Table 4: Initial Random velocities corresponding to each particle of the individual

		Bacterial Foraging Optimization								
T-I	RM-1	RM-2		WH-1	M	WH-2	DC-1	DC-2	DC-3	R
T-1	3354	3342	3339	3334	3331	3354	3154	3142	3234	3431

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T-2	3154	3153	3119	3112	3117	3141	3654	3653	3612	3617
		Singular Value Decomposition								
T-I	RM-1	RM-2		WH-1	M	WH-2	DC-1	DC-2	DC-3	R
T-1	3154	3142	3131	3134	3131	3154	3154	3142	3234	3431
T-2	3254	3253	3211	3212	3217	3241	3654	3653	3612	3617

9. Conclusions

Medicine industry inventory is an important component of Covid-19 medicine industry supply chain management. The members of the Covid-19 medicine industry supply chain are responsible for minimizing the cost of a Covid-19 medicine industry supply chain by managing the level of medicine industry inventory in a series of production and distribution operations associated with different chain steps. As lead time plays a crucial role in the increase in the cost of the Covid-19 medicine industry supply chain, the complexity of predicting optimal stock levels increases. We have proposed an innovative and efficient method using presented genetic algorithm aimed at reducing the overall Covid-19 medicine industry supply chain cost, as it undoubtedly established the most likely excess inventory level and shortage level along with the primary time involved in supply the multi-product stockpiles required for the optimization of medicine industry stocks in the Covid-19 medicine industry supply chain so that the total cost of the Covid-19 medicine industry supply chain is minimal. The proposed approach was implemented and its performance was evaluated using MATLAB 7.4. The performance of genetic algorithm was good as predicted. Following the proposed genetic algorithm-based approach to medicine industry stock management, we determined the products that the members of the Covid-19 medicine industry supply chain had additional cost of possession or lack of throughout the Covid-19 medicine industry supply chain. The proposed approach to medicine industry inventory management has achieved the objectives of minimizing overall Covid-19 medicine industry supply chain prices as well as lead time and determining the products that the respective Covid-19 medicine industry supply chain members endured either further cost or lack of cost of main time consideration, which is an important information for Covid-19 medicine industry supply chain Medicine industry Inventory optimization.

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