GLOBAL JOURNAL OF ENGINEERING, DESIGN & TECHNOLOGY
(Published By: Global Institute for Research & Education)
www.gifre.org

Optimum Supply Chain Cost by Numerical Method

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Abstract

Supply chain management (SCM) is the term used to describe the management of the flow of materials, information, and funds across the entire supply chain, from suppliers to component producers to final assemblers to distribution (warehouses and retailers), and ultimately to the consumer. A case on the supply chain cost has been presented and the optimum cost is found out using numerical method. 16.35% efficiency increment observed after applying supply chain systems.

Keywords: *Numerical Method, Runge Kutta, SCM, SCC, Case Study.*

1. Introduction

SCM is the integrated planning, implementation, coordination and control of all business processes and activities necessary to produce and deliver, as efficiently as possible, products those satisfy market requirements. In the definition of SCM, a 'business process' can be seen as a structured, measured set of activities designed to produce a specified output for a particular customer or market. Next to the logistical processes in the supply chain, which include activities such as operations, inventory management and distribution, we distinguish business processes such as those associated with new product development, marketing, finance, and customer relationship management. Supply chain management (SCM) is the term used to describe the management of the flow of materials, information, and funds across the entire supply chain, from suppliers to component producers to final assemblers to distribution (warehouses and retailers), and ultimately to the consumer. In fact, it often includes after-sales service and returns or recycling. In contrast to multi-selection inventory management, this coordinates inventories at multiple locations [1-2].

Corso and Paolucci [3] investigated the relation between different approaches to knowledge transfer and pattern of adoption of information and communication technology (ICT) application.
They also described the economic implications of these alternative approaches. No relation between ICT investments and a firm's growth was found. Tah and Carr [4] carried out a study for developing a sharable knowledge-driven approach to risk management. This defined generic risk and remedial action descriptive terms, which can be stored in catalogues. Wu [5] addressed the problem of coordination among multiagent systems. Several multi-agent systems for knowledge management were summarized. The issue of coordination problems in supply chain was presented and how to design multi-agent systems to improve information and knowledge sharing was highlighted.

Raisinghani and Meade [6] investigated the links between supply chain, firm's agility and knowledge management. Their focus was on the strategic decision making perspective. They provided a decision model that supports in determining the best knowledge management construct for an agile supply chain. Douligeris and Tilipakis [7] carried out a study on the new opportunities provided by the semantic web. They focused their attention on the introduction of web technologies on supply chain management. The use of the semantic web for improving knowledge management and the benefits of supply chain management sector were highlighted. In particular the use of ontologies in improving knowledge management applications was described. Huang and Lin [8] addressed the problem of managing knowledge heterogeneity in the context of interoperability among multi-entities in a supply chain. They proposed a solution for sharing knowledge using semantic web, while other studies pointed out the use of Web for sharing only information and data. Their solution was based on a semi-structured knowledge model to represent knowledge not only in an explicit and sharable, but also a meaningful format, an agent-based annotation process to resolve issues associated with the heterogeneity of knowledge documents, and an articulation mechanism to improve the effectiveness of interoperability between two heterogeneous ontologies.

Olivier Lavastre [9] worked on an empirical study of 142 general managers and logistics and supply chain managers in 50 different French companies. They demonstrates that for organizations to be effective, SCRM must be a management function that is inter organizational in nature and closely related to strategic and operational realities of the activity in question. Moreover, the findings of empirical study suggest that effective SCRM is based on collaboration (collaborative meetings, timely and relevant information exchanges) and the establishment of joint and common transverse processes with industrial partners.

Jianxi Fu [10] told that cost collaborative management of supply chain is a new topic which integrates three fields: cost management, intelligent application, supply chain management, and develops one of the most important tools on how to apply multi-agents and case-based reasoning to the improvement of cost collaborative management. Their research has two objectives: one is to develop the multi-agents system for CCM; the other is to construct a novel framework model of cost collaborative management in supply chain based on the application of case-based reasoning. Hai Quoc Le [11] suggested that association rule hiding is an efficient solution that helps enterprises avoid the risk caused by sensitive knowledge leakage when sharing data in their collaborations. They examined how data sharing has the potential to create risk for enterprises in retail supply chain collaboration and proposes a new algorithm to remove sensitive knowledge from the released database based on the intersection lattice of frequent item sets. The proposed algorithm specifies the victim item such that the modification of this item causes the least impact on frequent item sets and the non-sensitive association rule. In the experiment described in this research, this algorithm is used in risk avoidance for a retailer sharing data in retail supply chain collaboration. Emilie Chardine-Baumann [12] introduced of the concept of sustainable development in supply chain management, which has been identified not only as a constraint but also as a way to improve performance, impacting the competitiveness of a company and of its supply chain organization. To evaluate and analyze the potential relationships between traditional supply chain management practices and their impact on performance, we propose a framework for sustainable performance characterization and an analytical model for sustainable performance assessment. The framework is used to characterize a company's sustainable performance in the economic, environmental and social fields.

2. Decision Phases In A Supply Chain

2.1 Supply Chain Strategy or Design: During this phase, given the marketing and pricing plans for a product, a company decides how to structure the supply chain over the next several years. It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform.

Strategic decisions made by companies include whether to outsource or perform a supply chain function in-house, the location and capacities of production and warehousing facilities, the products to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs, and the type of information system to be utilized.

2.2. Supply Chain Planning: The goal of planning is to maximize the supply chain surplus that can be generated over the planning horizon given the constraints established during the strategic or design phase. Planning includes making decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing and price promotions. Planning establishes parameters within which a supply chain will function over a specified period of time.

2.3. Supply Chain Operation: The time horizon here is weekly or daily, and during this phase companies make decisions regarding individual customer orders. The goal of supply chain operations is to handle incoming customer orders in the best possible manner.

During this phase, firms allocate inventory or production to individual orders, set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery schedules of trucks, and place replenishment orders. Because operational decisions are being made in the short term (minutes, hours, or days), there is less uncertainty about demand information [13].

3. Drivers of Supply Chain Performance

To improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical and cross-functional drivers of supply chain performance: facilities, inventory, transportation, information, sourcing, and pricing.

These drivers interact with each other to determine the supply chain's performance in terms of responsiveness and efficiency. As a result, the structure of these drivers determines if and how strategic fit is achieved across the supply chain.

3.1. Facilities: are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated. The two major types of facilities are production sites and storage sites. Decisions regarding the role location capacity and flexibility of facilities have a significant impact on supply chain's performance

3.2. Inventory: encompasses all raw materials, work in process, and finished good within a supply chain. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness.

3.3. Transportation: entails moving inventory from point to point in the chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on supply chain responsiveness and efficiency.

3.4. Information: consists of data and analysis concerning facilities, inventors, transportation, costs, prices, and customers throughout the supply chain.

Information is potentially the biggest driver of performance in the supply chain because it directly affects each of the other drivers. Information presents management with the opportunity to make supply chains more responsive and more efficient.

3.5. Sourcing: is the choice of who will perform a particular supply chain activity such as production, storage, transportation, or the management of information. Al the strategic level, these decisions determines what functions a firm performs and what functions the firms outsource. Sourcing decisions affect both the responsiveness and efficiency of a supply chain.

3.6. Pricing: determines how much a firm will charge for goods and services that it makes available in the supply chain. Pricing affects the behavior of the buyer of the good or service, thus affecting supply chain performance.

4. Case Study and Analysis

Here the industry selected for the SCM is Chetak Pressure Cooker Pvt. Ltd. (Karnal). The following steps were followed for supply chain.

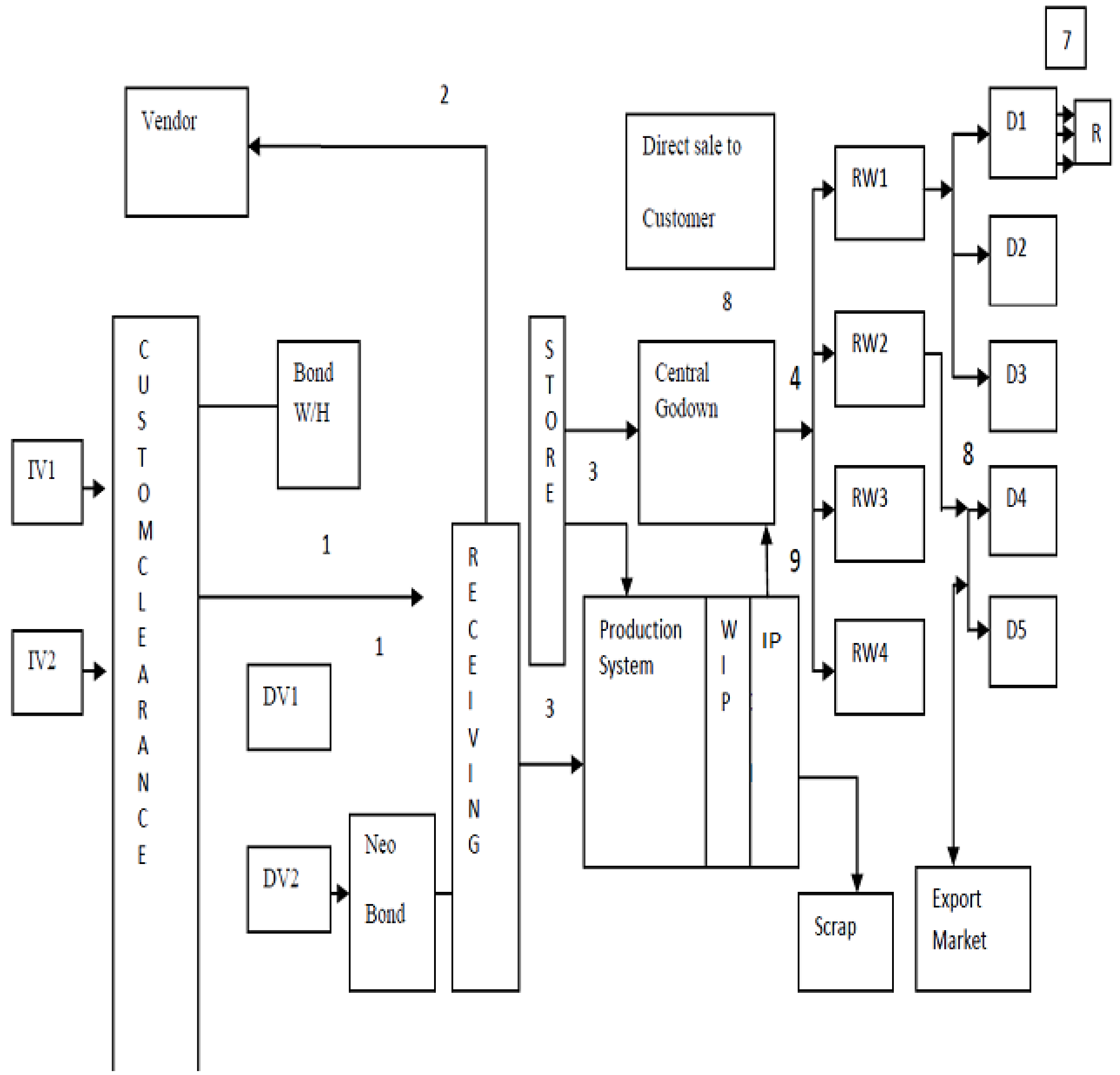
a) Conceptualize, and other methods to model supply chain and supply systems, and material flow processes.

b) How and why costs are incurred in supply systems, what costs are avoidable and which are not.
c) Why and where inventory is 'necessary' and what should be the 'correct' levels of inventory, how cycle times correlate with customer service level.
d) How management can approach the function strategically, and act proactively, instead of reactively.
e) What is therefore required is an integrative systems and process oriented approach which looks holistically at supply chain management and does not ignore important elements of the problem.

Such a systems approach is proposed here. We would like to call it supply chain analysis.

5. Supply Chain Costs Analysis (SCCA)

The primary process of material flow through the MFS involves expenditure or costs at each and every node and flow path of the supply chain. Whether the expenditure/cost is justified or not depends upon whether the supply chain has been carefully designed or not. However, it is extremely important to note that cost will be incurred at each node/flow path. This is one of the primary characteristics of supply chains.



IV : Import Vendor, DV : Domestic Vendor , W/H : Ware house,
W/P : Work-in-process, RW : Regional warehouse, D : Dealer/ Distributor
R : Retailer, C : Customer: Neo Bond: Thru Bank Transaction, IP : Inspection

Symbols
(a) Nodes
(b) Flow paths

Node 1: Domestic Vendor; Node 2: Storage; Node 3: Production System, Work in progress & Inspection; Node 4: Central Godown; Node 5: Dealers/ Distributors; Node 6: Exporters; Node 7: Retailers.

Figure 1: Quantity of materials or finished goods to be stored at each node and the flow rate between nodes.

Table 1: Solution of RUNGE KUTTA METHOD FOR PROFIT AGAINST SCC

SCC (x)	Profit (y)	SCC (x)	Profit (y)	SCC (x)	Profit (y)	SCC (x)	Profit (y)
188025	311310.46	213025	274775.96	238025	245915.97	263025	222542.15
189025	309663.53	214025	273492.11	239025	244887.14	264025	221699.27
190025	308033.94	215025	272220.2	240025	243866.89	265025	220862.75
191025	306421.41	216025	270960.07	241025	242855.1	266025	220032.51
192025	304825.67	217025	269711.55	242025	241851.67	267025	219208.5
193025	303246.47	218025	268474.48	243025	240856.49	268025	218390.63
194025	301683.54	219025	267248.71	244025	239869.48	269025	217578.85
195025	300136.65	220025	266034.08	245025	238890.52	270025	216773.07
196025	298605.53	221025	264830.45	246025	237919.52	271025	215973.25
197025	297089.96	222025	263637.65	247025	236956.38	272025	215179.3
198025	295589.7	223025	262455.55	248025	236001.01	273025	214391.17
199025	294104.51	224025	261284.01	249025	235053.31	274025	213608.79
200025	292634.17	225025	260122.87	250025	234113.19	275025	212832.1
201025	291178.46	226025	258972.01	251025	233180.56	276025	212061.04
202025	289737.16	227025	257831.29	252025	232255.33	277025	211295.55
203025	288310.06	228025	256700.58	253025	231337.41	278025	210535.56
204025	286896.95	229025	255579.74	254025	230426.73	279025	209781.02
205025	285497.62	230025	254468.64	255025	229523.18	280025	209031.87
206025	284111.88	231025	253367.17	256025	228626.69	281025	208288.05
207025	282739.52	232025	252275.18	257025	227737.18	282025	207549.51
208025	281380.36	233025	251192.57	258025	226854.57	283025	206816.18
209025	280034.2	234025	250119.22	259025	225978.76	284025	206088.02
210025	278700.87	235025	249054.99	260025	225109.7	285025	205364.97
211025	277380.17	236025	247999.79	261025	224247.29	286025	204646.97
212025	276071.92	237025	246953.48	262025	223391.47	287025	203933.98

For each unique supply chain, a unique supply chain cost (SCCj) can be defined as follows: For the jth supply chain

$$SSC_j = \sum_{i=1}^{m} \text{INCi} + \sum_{i=1}^{n} \text{FCi} + \sum_{i=1}^{p} \text{BCi} + \sum_{i=1}^{q} \text{NACi} + \sum_{i=1}^{r} \text{CTUi}$$

where, m =No. of input nodes, n=No. of flow paths, p=No. of barrier flow paths,
q= No. of intermediate nodes,r=No. of nodes/flow paths where CTU is incurred,
INC_i= Input node cost, FC_i=Flow cost, BC_i=Barrier cost,NAC_i=Node activity cost,
CTU_i = Capital Tie-up Cost.

$$\frac{dy}{dx} = -c^2/x^2$$

Solution of Equation by Numerical method
When $x_0 = 187025$, $y_0 = 312975$, $h = 1000$, $c = 241938.3173$, $x_n = 287025$;

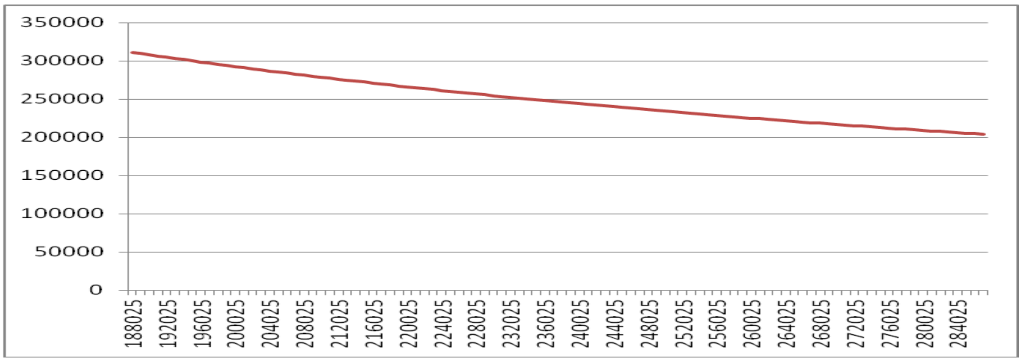


Figure 2: The graph is in between profit and SCC

x-axis of the graph is SCC and y-axis is Profit.

From the above results it can be conclude that with the increase in SCC, the profit of the company decreases. So, to maximize the profit the SCC has to be minimized.

From the table of SCC it is concluded that the value of SCC directly depends upon the Flow cost (FC). Also the flow cost directly depends upon the square of the distance.

$$SCC \propto FC$$

$$FC \propto d^2$$

$$FC = 0.5 \times C \times d^{1.5}$$

Where d = distance & C = constant; Now for solving the above problem let us suppose FC is taken as y and distance d is taken as x.

$$\frac{y}{x^{1.5}} = 0.5 \times C$$

$$\frac{dy}{dx} = 0.75 \times c \times x^{0.5}$$

6. Conclusions

The research presented in this paper is a part of a larger initiative to change the way data about physical objects is acquired, understood, represented as useful information and utilized efficiently. A work into the requirements for successful implementation of the Runga Kutta Method to maximize the profit of the company. To illustrate impact on costs and profit in the Supply chain, the Runga Kutta Program in language C can be run under differing conditions of information. The result shows that the efficiency is raised by 16.35%.

References

1. Handfield, R. Nichols, E. (1999): Introduction to Supply Chain Management, Prentice-Hall, Upper Saddle River.
2. Chopra, S., Meindl, P. 2001, *supply chain management*, Prentice Hall.
3. Corso, M., & Paolucci, E. (2001). Fostering innovation and knowledge transfer in product development through Information Technology. International Journal of Technology Management, 22, 126–148.
4. Tah, J., & Carr, V. (2001). Towards a framework for project risk knowledge management in the construction supply chain. Advanced Engineering Software, 32, 835–846.
5. Wu, D. J. (2001). Software agents for knowledge management: coordination in multi-agent supply chains and auctions. Expert Systems with Applications, 20, 51–64.
6. Raisinghani, M. S., & Meade, L. L. (2005). Strategic decisions in supply-chain intelligence using knowledge management: an analytic-network-process framework. Supply Chain Management: An International Journal, 10, 151–170.
7. Douligeris, C., & Tilipakis, N. (2006). A knowledge management paradigm in the supply chain. EuroMed Journal of Business, 1, 66–83.
8. Huang, C. C., & Lin, S. (2010). Sharing knowledge in a supply chain using the semantic web. Expert Systems with Applications, 37, 3145–3316.
9. Olivier Lavastre, Angappa Gunasekaran , Alain Spalanzani, Supply chain risk management in French companies, Decision Support Systems 52 (2012) 828–838.
10. Jianxi Fu ,Yuanlue Fu, Case-Based Reasoning and Multi-Agents for Cost Collaborative Management in Supply Chain, Procedia Engineering 29 (2012) 1088-1098.
11. Hai Quoc Le, Somjit Arch-int, Huy Xuan Nguyen, Ngamnij Arch-int, Association rule hiding in risk management for retail supply chain collaboration, Computers in Industry 64 (2013) 776–784.
12. Emilie Chardine-Baumann, Valérie Botta-Genoulaz, A framework for sustainable performance assessment of supply chain management practices, Computers & Industrial Engineering 76 (2014) 138–147.
13. Choi, T. Y., Budny, J., & Wank, N. (2004). Intellectual property management: a knowledge supply chain perspective. Business Horizons, 47, 37–44.