Juni Khyat ISSN: 2278-4632
(UGC Care Group I Listed Journal) Vol-10 Issue-9 No.04 September 2020

A Review on Optimization Models in Supply Chain Network Design (SCND)

Kailash Chandra Nayak, Research Scholar, Department of Mathematics, North Orissa University, Baripada, Odisha, India, Mail ID: kcnayak2008@rediffmail.com
Dr. Jibendu Kumar Mantri, Dept. of Comp. Science, North Orissa University, Baripada, Odisha, India, Mail ID: jkmantri@gmail.com
Dr. Monalisha Pattnaik*, Dept. of Statistics, Sambalpur University, Burla-India-768019, Mail ID: monalisha_1977@yahoo.com

Abstract:
Introduction: Supply chain network design efficiently works in different models in optimization and a number of models have been formulated to meet the necessity of business. Basically models are organised in mixed integer linear programming (MILP) and robust optimization approach. The applications of models are represented in case study and comparative study with sensitivity analysis.
Methodology: This paper deals with the recent survey in supply chain network design (SCND) and analysis on single or multiple items in different stages.
Results: The study is focused on the effects of economic, social and environmental factors on the business decisions and emphasizes generalised models, aspects, and design networks and optimization techniques.
Conclusion: The reviews find that there are a number of gaps and scopes in SCND and provide issues for future research directions.

Introduction

Now a days' supply chain networks is a vital topic of research and practice of engineering .so its designs attracted to researcher and industry .hence it provides the idea for distribution, storage and production of product. SCND involves different strategic decisions about location, facilities in production centre to distribution centre. It's the intersection of different discipline in science and management .therefore SCND is the discipline used to derive optimal location and facility size and flows of facilities. So there are many models in SCND literature in different tiers in supply chain.

Five decades ago, the seminal paper by Hakimi generalized the original Weber problem from a single facility location problem to a multiple facility location problem. This publication marked of the facility location problem, which has become one of the standard problems in the operations research community. In current research scenario SCM includes the economic, social and environmental aspects of optimization models. A number of review papers have been published in recent years, which relate to major trends in supply chain management and investigate and suggest research.

In this paper we reviewed SCND problems and related to mathematical models (linear, nonlinear and mixed integer variables) with clear assessment. Our research questions are identified as follows: (1) how mathematical models are integrated in SCND (2) different approaches in supply chain management (SCM) (3) real life applications in SCND.

Review Methodologies

A comprehensive search of related peer reviewed papers from 1990 to 2018 was applied to produce a review of literature. We searched papers published in international peer–reviewed journals, from the main electronic bibliographical sources (Scopus, Web of Science) using keywords such as sustainable development, with classic keywords such as supply chain, supply chain network design in the titles of the topics covered. From the collected material, we filtered the papers according to the optimization models and its applications in single stage, single product, and multiple products multistage in optimization.

We classify papers in two categories like the first categories papers dealing with supply chain management in general with facility location is studied or not studied and optimizations methods used and unused and the second categories regroups review papers on SCND. It is clearly mentioned in Table 1.

Table 1: Related existing peer-reviewed papers

Authors	Facility Location	Sustainability Models	Optimization Methods	Shared References
Nikolopoulou &Ierapetritou [2012]	No	Yes	No	12
Boukherroub et al. [2012]	No	Yes	Yes	12
Dekker et al. [2012]	No	Yes	No	5
De Meyer et al. [2014].	No	Yes	No	5
Barbosa Póvoa [2014]	No	Yes	No	2
Devika et al. [2014]	Yes	No	Yes	5
ZanjiraniFarahani et al. [2014]	Yes	No	No	3

Yes = consider # No=not considered

Supply Chain Network Design (SCND) under Uncertainty

SCND problem deals different parameter of costs, demand, and supply has inherent uncertainty. Moreover, supply chain (SC) networks can be affected by major man-made or natural disruptions such as floods, terrorist attacks, earthquakes, and economic crises. However, these kinds of disruptions usually have a low likelihood of occurrence, but their impacts on SC network are prominent. The objective of SCND under uncertainty is to achieve a configuration so that it can perform well under any possible realization of uncertain parameters. Based on the definition of different decision-making environments by Rosenhead, Elton, and Gupta (1972) and Sahinidis (2004), uncertain environments for the SCND problem can be categorized according to the following groups. A SC network converts raw materials into final products and then delivers them to customers. It includes various types of facilities, and each type plays a specific task in the network. A set of facilities with the same task and type is called a layer or echelon. A crucial aspect of SCND studies is the number and type of layers and the layers in which location decisions are determined. The usual layers of SC networks are composed of suppliers, plants, distribution points, warehouses, and customers and the typical material flows are often from suppliers to customers. It is noteworthy that another issue driven by real life applications is the necessity to deal with multi-product problems.

Regarding the material and product flows in a SC network, some studies have the assumption of being single-sourcing, which means a facility or a customer can be served by only one facility from its upstream layer Georgiadis, Tsiakis, Longinidis, & Sofioglou, (2011); Shen ; & Daskin, (2005) and Pattnaik & Gahan (2020). Moreover, some studies have regarded the material/product flows in one layer of SC, called intra layer flows Aghezzaf, (2005); Mousazadeh, Torabi, & Zahiri, (2015) Furthermore, direct flows from upper layers to customers have been taken into account in the literature Govindan, Jafarian, & Nourbakhsh, (2015); Vila, Martel, & Beauregard,(2007).

Different Paradigms in Supply Chain Management

In any business organization affects by SCND problems in fact a perfect design to attain organizational goal in competitive scenario. In a SC, the initial goals include meeting demand of customers, functionality of SC's processes, and accessibility of SC's resources Heckmann et al. (2015). SCND was seeking traditionally to achieve these goals economically. If we want to become successful in today's market, both its SC and strategies should be fit together to attain the goal. So, various paradigms have been proposed in SCM that influence designing a SC network.

- *Responsive SCND*

  Different definitions exist for the SC responsiveness the ability of a SC to produce innovative products, meet short lead-times, cope with a wide range of products, and meet a high service level Chopra & Mind (2013). Gunasekaran, Lai, and Cheng (2008) defined the SC responsiveness as a paradigm that has emerged in response to the volatile and competitive business environment; thus, a responsive SC has to be highly flexible to changes of market or customer requirements. In a optimization problem for designing responsive SC networks, several studies considered objective functions such as minimizing service time of customers Cardona-Valdés, Álvarez, & Ozdemir, 2011; Mirakhorli, 2014; You & Grossmann, (2011), maximizing fill rate of customers' demands Shen & Daskin, (2005), and minimizing lateness of products' delivery to customers Pishvaee & Torabi, (2010). Represent the studies that dealt with responsive SCND models under uncertainty. Recently, Fattahi, Govindan, and Keyvanshokooh (2017) presented a stochastic model for designing responsive and resilient supply chain networks with delivery lead-time sensitive customers.
- *Green SCND*

  Due to different issues SCND problems emphasized environmental factors instead of economic models. This integration can be applied as either environmental measures in objective functions or environmental constraints in the mathematical model. Green SCND is another paradigm that aims to merge economic and environmental factors in designing SC networks. It specifies studies that regarded environmental concerns on the uncertain parameters in Guillén Gosálbez and Grossmann (2010), Guillén-Gosálbez and Grossmann (2009), Pishvaee, Razmi, and Torabi (2014), Pishvaee, Torabi, and Razmi (2012), and Babazadeh, Razmi, Pishvaee, and Rabbani (2017).
- *Sustainable SCND*

  Sustainable SCs plays an essential role in conserving natural resources for the next generation and gaining the attention of many researchers over recent years. Based on this paradigm, several scholars have tried to design SC networks consistent with economic aspects, environmental performance, and social responsibility that are called sustainable SCND Eskandarpour, et al. (2015). We have identified that the majority of studies in this area presumed a deterministic

ISSN: 2278-4632
Vol-10 Issue-9 No.04 September 2020

decision-making environment such as Mota, Gomes, Carvalho, and Barbosa Povoa (2015) and You, Tao, Graziano, and Snyder (2012). Recently, Eskandarpour et al. (2015) have presented a survey on sustainable SCND and investigated existing approaches for assessment of the environmental impact and social responsibility performance of SCs.

Optimization in Supply Chain Network Design (SCND)

In this section, optimization aspects of the related literature are investigated in separate subsections. Here we studied the reference papers in terms of mathematical modelling, solution methods, and optimization techniques.

Evaluation of SC Networks in Optimization

To design a SC network under uncertainty, single or multiple objectives are often considered for a numerical optimization procedure based on SC goals. Heckmann et al. (2015), in accordance to Borgström (2005), defined efficiency as "a way to attain the SC's goals through taking minimal resources and thereby achieving the cost-related advantages." Further, they defined effectiveness as "obtaining pre-determined SC goals even in the face of inverse conditions or unexpected events." In SCND, most studies have assumed a single objective function for their optimization models, which usually seeks to achieve economic goals for SC in terms of either cost minimization or profit maximization Melo et al., (2009). In the profit maximization, a SC's profit is calculated based on revenues minus costs. Sometimes, particularly for designing a global SC, the after-tax profit is presumed as an objective function Goh et al. (2007). Moreover, for a profit-maximization problem, it is often not necessary to serve all potential customers; indeed, SC prefers to lose some potential customers whose service costs are high compared with their revenues Melo et al., (2009). To measure SC's performance in terms of economic goals, a SC's costs are usually made of some components like inventory costs, transportation costs, facility location (FL) costs and so on. These components can be different in various optimization problems and have direct relation with the planning decisions.

Robust models in this category we studies Different robustness measures with or without probability distributions common measures for scenario-based programs are minimax cost and minimax regret. The minimax cost measure obtains a solution minimizing maximum cost over all scenarios. However, in the minimax regret, (absolute or relative) regret is determined as the (absolute or percentage) difference between the cost of a solution and the cost of the optimal solution for a scenario. Snyder (2006) reviewed various minimax models in the area of FL problem. The minimax absolute regret measure is utilized by Realff, Am- mons, and Newton (2004) and Ramezani, Bashiri, and Tavakkoli- Moghaddam (2013b) to design a RL and CLSC network, respectively. It should be mentioned that a study minimizing the expected relative regrets for all scenarios in a situation where the probabilities of scenarios are available is presented by De Rosa, Gebhard, Hartmann, and Wollenweber (2013). Further, Ahmadi- Javid and Seddighi (2013) and Govindan and Fattahi (2017) examined a SCND problem with minimax cost measure. Another approach for obtaining solution robustness is presented by Kouvelis, Kurawarwala, and Gutierrez (1992). By adding some constraints, they made sure that the relative regret is not greater than p, where $p > 0$ is a pre-determined parameter, for each scenario. Snyder and Daskin (2006) called this method as p-robustness in the area of FL. In the related literature, some studies including Hatefiand Jolai (2014), Li, Liu, Zhang, and Hu (2015), Peng, Snyder, Lim, and Liu (2011), Tian and Yue (2014) , and Torabi et al. (2016) utilized this approach. This method could lead to in- feasibility for some values of p. Several studies have applied the risk measures for SCND problem and called them as robustness measures. In this regard, variance is

ISSN: 2278-4632
Vol-10 Issue-9 No.04 September 2020

used by Jin, Ma, Yao, and Ren (2014) and absolute deviation is applied by Jabbarzadeh et al. (2014), Kara and Onut (2010b), Pan and Nagi (2010), and Sadghiani et al. (2015). It is worth noting that only Aghezzaf (2005), Jin et al. (2014), and Sadghiani et al. (2015) examined model robustness measures for a SCND problem.

Optimization Approaches in SCND

As SCND with disruptions has received much attention recently, we discuss different optimization approaches to cope with this problem in this section. Lately, Snyder et al. (2016) provided a review paper regarding the management science and operation research models Further, Laporte et al. (2015) examined the existing FL models under disaster events. SCND studies with disruptions can be divided into business and non-business SCs. The goal of a business one is to design a SC such that it can perform well even after disruption occurrence. The non business SCs such as Liu and Guo (2014), Noyan (2012) and Jeong et al. (2014) are often designed to deliver relief items to the established demand points after disasters and is called humanitarian SC. While SC disruptions can have substantial influence on key SC parameters such as demand, supply, delivery time of products, and costs, they may also result in reducing capacity of SC facilities and transportation links or even eliminating them.

In addition, in humanitarian SC the demand for relief supplies has a great deal of uncertainty, depending on the type, magnitude, and location of a disaster. In this area, most studies assume a failure probability for a facility or transportation link in the face of disruption as a pre-specified parameter. They are also called reliable SCND models. These studies include Azad et al (2014), Azad, Saharidis, Davoudpour, Malekly, and Yektamaram (2013), Cui et al. (2010), Hatefi, Jolai, Torabi, and Tavakkoli-Moghaddam (2015a), Li and Savachkin (2016), Li, Zeng, and Savachkin (2013), Marufuzza- man, Eksioglu, Li, and Wang (2014), Vahdani et al. (2012), Vah- dani, Tavakkoli-Moghaddam, Jolai, and Baboli (2013), Vahdani, Tavakkoli-Moghaddam, and Jolai (2013) , and Hatefi, Jolai, Torabi, and Tavakkoli-Moghaddam (2015b) customers are assigned to more than one facility and hence in the face of disruption, each customer can be served by the nearest operational (non-disrupted) facility. Azad et al. (2014) presumed that if a failure occurs for a facility of SC, then the percentage of its disrupted capacity is a stochastic parameter.

In this regard, HatefiandJo- lai (2014), Peng et al. (2011) and Li et al. (2015) utilized the *p* -robustness approach. Also, Ahmadi-Javid and Seddighi (2013), Noyan (2012), Sadghiani et al. (2015) and Baghalian, Rezapour, and Farahani (2013) developed some risk-averse scenario-based stochastic models by using well-known risk measures in the stochastic programming context. It is worth noting that most SCND models with disruptions in the literature are single period and only a few papers such as Klibi and Martel (2012a) and Klibi and Martel (2013) can be found which are multi-period. Survey papers by Tang (2006a), Tang (2006b), Tang and Tom- lin (2008), and Tang and Musa (2011) introduced mitigation strategies which could be utilized to improve SC's resiliency in the face of risks. Moreover, some mitigation strategies expressed by Tang (2006a) and Tang and Tomlin (2008) can be applicable for dealing with operational risks in SC. which reveals the fact that they are not developed only for disruption risks. However, in SCND, these strategies have been applied to handle a SC under the un- certainty induced by disruptions. Further, a few papers employed mitigation strategies for designing a resilient SC network. Here, we explore the most popular mitigation strategies in the related literature: Facility fortification: In this strategy, some facilities are chosen for an existing SC network or during the design phase of a SC network in order to fortify them against various disruptions. Hasani and Khosrojerdi (2016), Li and Savachkin (2016) and Qin, Liu, and Tang (2013) utilized this strategy. Strategic stock: Using this strategy, a SC can hold the inventory for raw materials, semi-finished and finished products in its facilities within different layers of SC.

This inventory is often utilized to satisfy the needs of customers and other manufacturing processes. Benyoucef, Xie, and Tanonkou (2013), Hasani and Khosrojerdi (2016), Mak and Shen (2012), Qi and Shen (2007), and Qi, Shen, and Snyder (2010) employed this strategy. Sourcing strategy: As pointed out by Snyder et al. (2016). This strategy is divided into multiple sourcing and backup sourcing. In the multiple one, sourcing is carried out by using multiple suppliers simultaneously before disruption. However, the backup sourcing exploits backup suppliers when primary suppliers are disrupted. Pattnaik & Gahan (2019), Cui et al. (2010), Hasani and Khosrojerdi (2016), Klibi and Martel (2012a), Klibi and Martel (2013), Mak and Shen (2012), Qi and Shen (2007), and Li et al. (2013), Pattnaik & Gahan (2019) used one or both strategies.

Applications in Supply Chain Network Design (SCND)

Here, some studies that deal with applications of SCND problem under uncertainty have been reviewed. In this regard, some of them investigated real-life case studies and some others solved randomly generated test instances in an industrial context. One of the essential challenges in designing a SC network based on a specific industrial context is that the design decisions have to be often made according to required processes for producing products (e.g., Schütz et al. (2009) and Govindan and Fattahi (2017) that studied a SC for a meat and glass industry, respectively). In a survey paper by Barbosa Povoa (2014), SCs formed for process industries, named as process SCs, are examined. For this aim, the real-life case studies are divided into five major types including agricultural, biomass/biofuel, gas/hydrogen, pharmaceutical, and oil SCs. Unlike studies related to business SCs, non-business SC models are often developed based on a specified application. In Table 2, the reference papers developed for specific application or industry and the ones that examined some real-world case studies are listed. In the column for real-life case study, the dashes mean that the related reference paper did not examine a real-life case study and solved some randomly generated test instances for the consider industry or application. As shown in Table 2 about 24% of reference papers defined their SC networks on the basis of a specific industry or application. It is worthwhile to focus more on designing SC networks for specific industries in business SCs and applications in non-business SCs. Moreover, due to difficulties in collecting, preparation, and aggregation huge data sets, only 20% of reference papers concerned real-life case studies. In this regard, big data analytics tools and techniques would be helpful for future research works. In terms of the type of logistics networks, about 20% of papers treated the applications of RL or CLSC networks in Table 2 Here, the biomass/biofuel, chemical, gas/hydrogen, and pharmaceutical SCs include 28%, 10%, 10%, and 5% of studies, respectively. Thus, it can be concluded that researchers have paid more attention to bio fuel/biomass SCs recently. Furthermore, a review and systematic classification on biomass to energy SC networks is presented by Balaman and Selim (2015).

Table 2: Summary of applications and industrial contexts in the related literature

Authors	Industry or Application	Real-life case study
Realff et al. (2004)	Recovery network for carpet recycling	A case study in USA
Listes¸ and Dekker (2005)	Recovery network for recycling sand	A case study in Netherlands
Guillen et al. (2006)	A supply chain for chemical industry	-
You and Grossmann	A supply chain for polystyrene industry	-

(2008a)		
Rappold and Van Roo (2009)	A supply chain for handling reparable items	-
Guillén-Gosálbez and Grossmann (2009)	A supply chain for chemical industry	A case study in Europe
Schütz et al. (2009)	A supply chain for meat industry	A case study in Norway
Guillén-Gosálbez and Grossmann (2010)	A supply chain for chemical industry	A case study in Europe
Jouzdani et al. (2013)	Milk and dairy supply chain	A case study in Iran
Tong et al. (2013)	Hydro carbon bio fuel and petroleum supply chain	-
Marufuzzaman et al. (2014)	Biofuel supply chain	A case study in the southeast region of USA
Jabbarzadeh et al. (2014)	A supply chain network for blood distribution after occurrence of a disaster	A case study for Tehran's earthquake
Pattnaik (2020)	Milk supply chain network design	A case for Western region of Odisha

Conclusion

In this paper, a comprehensive review was presented on the studies in the area of SCND problem under optimization In particular, deterministic multi-period SCND problems in which there exists the possibility of changing the location and capacity of facilities over different strategic periods, have been widely addressed Melo et al., (2006); Thanh, Bostel, & Péton, (2008). These studies also have potential to be extended for an uncertain decision-making environment. Moreover, we could not find any SCND study under uncertainty that deals with a planning horizon where strategic and tactical periods are integrated. Designing humanitarian SC networks needs more investigations, and indeed many studies in this area can be done with respect to different disaster types and desired applications. Sometimes, it may not be possible to satisfy all demands in humanitarian SC networks, so there is a need to develop models considering fairness for shortages that may occur at different demand points, designing a SC network in which customers' demand is sensitive to SC's responsiveness is a valuable future research. More- over, defining other criteria for the SC's responsiveness based on business goals of companies is of importance in different applications. Finally, there were a few papers to cope with real-world situations. The reason is two folds: (1) the necessity for collecting a large data set to model comprehensive SCND problems, and (2) the difficulties in obtaining correct estimates for uncertain parameters. Thus, it would be worthwhile to carry out studies based on a SC network defined for real-life case studies. In this section, research gaps and potential future research guidelines in terms of optimization aspects are discussed. More than 50% of reference papers made use of commercial solvers to solve their optimization problem s. this type of solution approaches still remains a future research direction. It is worth noting that meta-heuristics cannot guarantee the optimal solution for an optimization problem. However, these approaches can solve large-scale problems within appropriate time. Therefore, developing this kind of solution approaches is worthwhile. Further, presenting solution algorithms, which are based on the combination of exact methods with heuristics or meta-heuristics, is another future area of research.

In addition, developing multi-stage stochastic programs and presenting efficient solution approaches for them is another challenging issue, and it needs greater consideration. In this regard, the progressive hedging algorithm, an applicable method for solving two and multi-stage stochastic programs, has been used scarcely in the related literature. In these aspects, exploring new applicable robustness measures to address solution or model robustness will be another promising research direction. Simulation is a powerful tool to validate obtained policies in uncertain decision-making environments and unfortunately, such a methodology has been rarely examined in the related SCND literature. Therefore, a systematic comparison between these modelling approaches will be required.

At last, it may be concluded that research studies for SCND problem optimization still needs more studies presenting realism models based on real-world applications and handling computational aspects to solve large-sized problems.

References

1. Abdallah, T. Diabat, A. & Simchi-Levi, D. (2012). Sustainable supply chain design: a closed-loop formulation and sensitivity analysis. Production Planning & Control, 23(2-3), 120–133.
2. Ahmadi-Javid, A. & Hoseinpour, P. (2015). Incorporating location, inventory and price decisions into a supply chain distribution network design problem. Computers & Operations Research, 56, 110–119.
3. Akçal E. Çetinkaya, S. & Üster, H. (2009). Network design for reverse and closed-loop supply chains: an annotated bibliography of models and solution approaches. Networks, 53 (3), 231–248.
4. Albareda-Sambola, M. Alonso-Ayuso, Escudero, L.F. Fernández, E. & Pizarro, C. (2013). Fix-and relax-coordination or multi-period location problem under uncertainty. Computers & Operations Research, 40(12), 2878–2892.
5. Almansoori, A. & Shah, N. (2012). Design and operation of a stochastic hydrogen supply chain network under demand uncertainty. International Journal of Hydro- gen Energy, 37 (5), 3965–3977.
6. Azad, N. Saharidis, G.K. Davoudpour, H. Malekly, H. & Yektamaram, S.A. (2013). Strategies for protecting supply chain networks against facility and transporta- tion disruptions: an improved Benders decomposition approach. Annals of Operations Research, 210(1), 125–163.
7. Azad, N. & Davoudpour, H. (2013). Designing a stochastic distribution network model under risk. The International Journal of Advanced Manufacturing Technology, 64(1), 23–40.
8. Baghalian A. Rezapour, S. & Farahani, R.Z. (2013). Robust supply chain network design with service level against disruptions and demand uncertainties: A real-life case. European Journal of Operational Research, 227(1), 199–215.
9. Bai, X. & Liu, Y. (2016).Robust optimization of supply chain network design in fuzzy decision system. Journal of Intelligent Manufacturing, 27(6), 1131–1149.
10. Balaman, S Y. & Selim, H. (2015). Biomass to energy supply chain network de- sign: an overview of models, solution approaches and applications. Handbook of bio-energy. 1–35.
11. Barbosa-Póvoa A.P. (2014).Process supply chains management – where are we? where to gonext?FrontiersinEnergyResearch,2(23).
12. Behdani, B. (2013). Handling disruptions in supply chains: An integrated framework and an agent-based model .TU Delft: Delft University of Technology.
13. Ben-Tal, A. Goryashko, A. Guslitzer, E. & Nemirovski, A. (2004). Adjustable robust solutions of uncertain linear programs. Mathematical Programming, 99(2), 351–376.

14. Bertsimas, D. & Sim, M. (2003). Robust discrete optimization and network flows. Mathematical Programming, 98(1), 49–71.
15. Bertsimas, D. & Sim, M. (2004). The price of robustness. Operations Research, 52, 35–53.
16. Brandenburg, M., Govindan K, Sarkis, J. & Seuring, S. (2014). Quantitative models for sustainable supply chain management: developments and directions. European journal of Operational Research. 233(2):299–312.
17. Cardoso, S.R., Barbosa Póvoa, A.P.F & Relvas, S. (2013). Design and planning of supply chains with integration of reverse logistics activities under demand un- certainty. European Journal of Operational Research, 226(3), 436–451.
18. Caunhye, A.M. Nie, X. & Pokharel, S. (2012). Optimization models in emergency logistics: a literature review. Socio-Economic Planning Sciences, 46(1), 4–13.
19. Chen, C.W. & Fan, Y. (2012). Bio ethanol supply chain system planning under supply and demand uncertainties. Transportation Research Part E: Logistics and Transportation Review, 48(1), 150–164.
20. Chen, L., Olhager, J. & Tang, T. (2014). Manufacturing facility location and sustainability: a literature review and research agenda. International Journal of Production Economics . 149(0), 154–63.
21. Daskin, M.S. Snyder, L.V. & Berger, R.T. (2005). Facility location in supply chain design. Logistics systems: Design and optimization, 39–65.
22. Dayhim, M. Jafari, M.A. & Mazurek, M. (2014). Planning sustainable hydrogen supply chain infrastructure with uncertain demand. International Journal of Hydro- gen Energy, 39 (13), 6789–6801.
23. De Meyer, A.,Cattrysse, D., Rasinmäki, J. & Orshoven, J.V. (2014). Methods to optimize the design and management of biomass for bio energy supply chains. ,review rnewableandSustainableEnergyReviews,31(0), 657–670.
24. De Rosa, V. Gebhard, M., Hartmann, E. & Wollenweber, J. (2013). Robust sustainable bi-directional logistics network design under uncertainty. International Journal of Production Economics, 145(1), 184–198.
25. Defourny, B., Ernst, D. Wehenkel, L. (2011). Multistage stochastic programming: a scenario tree based approach. Decision theory models for applications in artificial intelligence: Concepts and solution. Hershey, Pennsylvania, USA: Information Science Publishing
26. Delage, E. & Ye, Y. (2010). Distributionally robust optimization under moment uncertainty with application to data-driven problems. Operations Research, 58(3), 595–612.
27. Devika K,JafarianA,NourbakhshV.(2014).Designing a sustainable closed-loop supply chain network based on triple bottom line approach: a comparison of meta heuristics hybridization techniques. European Journal of Operational Research. 235(3), 594–615.
28. Dubey, R. Gunasekaran, A. & Childe, S.J. (2015). The design of a responsive sustainable supply chain network under uncertainty. The International Journal of Advanced Manufacturing Technology, 80(1), 427–445.
29. Dupa ˇcová, J. (1995). Multistage stochastic programs: The state-of-the-art and selected bibliography. Kybernetika, 31(2), 151–174.
30. Keyvanshokooh, E. Ryan, S.M., & Kabir, E. (2016). Hybrid robust and stochastic op- timization for closed-loop supply chain network design using accelerated decomposition. European Journal of Operational Research, 249(1), 76–92.

31. Longinidis, P. & Georgiadis, M.C. (2011). Integration of financial statement analysis in the optimal design of supply chain networks under demand uncertainty. International Journal of Production Economics, 129(2), 262–276.
32. Longinidis, P. & Georgiadis, M.C. (2013). Managing the trade-offs between financial performance and credit solvency in the optimal design of supply chain networks under economic uncertainty. Computers & Chemical Engineering, 264–279.
33. Madadi, A. Kurz, M.E. Taaffe, K.M., Sharp, J.L., & Mason, S.J. (2014). Supply net- work design: risk-averse or risk-neutral. Computers & Industrial Engineering, 55–65.
34. Mak, H.Y. & Shen, Z.J. (2012). Risk diversification and risk pooling in supply chain design. IIE Transactions, 44(8), 603–621.
35. Mari, S.I. Lee, Y.H. & Memon, M.S. (2014). Sustainable and resilient supply chain network design under disruption risks. Sustainability, 6(10), 6666–6686.
36. Nasiri, G.R. Zolfaghari, R., & Davoudpour, H. (2014). An integrated supply chain production distribution planning with stochastic demands. Computers & Industrial Engineering, 77, 35–45.
37. Nickel, S. Saldanha-da-Gama, F. & Ziegler, H.P. (2012). A multi-stage stochastic supply network design problem with financial decisions and risk management. Omega, 40(5), 511–524.
38. Nikolopoulou, A., & Ierapetritou, M. (2012). Optimal design of sustainable chemical processes and supply chains: a review Computers and Chemical Engineering,44, 94–103.
39. Noyan, N. (2012). Risk-averse two -stage stochastic programming with an application to disaster management. Computers & Operations Research, 39(3), 541–559.
40. Oliver, R.K. & Webber, M.D. (1982). Supply-chain management: logistics catches up with strategy. Outlook, 5(1), 42–47.
41. Owen, S.H. & Daskin, M.S. (1998). Strategic facility location: a review. European Journal of Operational Research, 111(3), 423–447.
42. Özceylan, E. & Paksoy, T. (2014). Interactive fuzzy programming approaches to the strategic and tactical planning of a closed-loop supply chain under uncertainty. International Journal of Production Research, 52(8), 2363–2387.
43. Pattnaik, M. & Gahan, P. (2019). Integrated Multi-level Supply Chain Models, Lambart Academic Publishing. Germany.
44. Pattnaik, M. & Gahan, P. (2019). Multi-product Discrete Supply Chain Models, Lambart Academic Publishing. Germany.
45. Pattnaik, M. & Gahan, P. (2020). Preservation effort effects on retailers and manufacturers in integrated multi-deteriorating item discrete supply chain model. *OPSEARCH* (2020). https://doi.org/10.1007/s12597-020-00477-2
46. Pattnaik, M. (2020). Milk Supply Chain Network Design (SCND): A Case of Milk Industry in Western Region of Odisha. International Journal of Strategic Decision Sciences, 11(3), 1-58.