Modeling Cold Chain Management: A Lean Perspective

Satish S Bachhav[1], Dr.Santosh B Rane[2], Dr.S. K.Mahajan[3]
[1]Research scholar, Sardar Patel College Of Engineering, Mumbai, India
[2]Associate Professor, Sardar Patel College Of Engineering, Mumbai, India
[3]Jt. Director, DTE, Mumbai, Maharashtra

Abstract- Context- *Cold Supply Chain is heavily affected due to poor infrastructural issues, coordination issues and lack of business strategy. A lean implementation across the entire cold supply chain can reduce the waste dramatically and improve the profit of the supply chain.*

Purpose *– Purpose of this paper is to present a research proposal on Modeling Cold Supply Chain Management: A Lean Perspective.*

Design/methodology/approach *– The research proposal includes the methodology of Literature Survey, Expert Interviews, Problem Definition, Hypothesis statements, Data Collection plan, Plan for Data Analysis, Hypothesis Tests, Research Plan, Technical Feasibility check and Economic Viability check, Plan for use of Multi-Criteria Decision making Tools .*

Findings *– The paper presents a complete proposal for the research undertaken which offers the framework and strategies for successful lean implementation in Cold Supply chain.*

Conclusion- *Lean Implementation in Cold supply chain will be giving the essential support to cold supply chain by improving the profit across the supply chain.*

Practical implications *– Farmers managing Milk, Fruits and Vegetables supply chain will receive positive effect of lean implementation. It will create the new further opportunity for researcher to take up research project.*

Social implications *– The research project will increase the value of stakeholder, increase reliability of project, more employment opportunities.*

Originality/value *– This paper will put forward the key barriers, Critical success factors for successful lean implementation in cold supply chain. The research will also develop the model to explore the interaction among the barriers of lean implementation in cold supply chain.*

I. INTRODUCTION

The cold supply chain is the special kind of supply chain which includes the various equipments and facilities to protect the perishable items such as medicine, blood, dairy, meat, food, vegetables, mushrooms, flowers and fruits [1]. The cold chain starts at the farm level and covers up to the consumer level [2]. A typical cold chain infrastructure generally consists of pre-cooling facilities, cold storages, refrigerated carriers, packaging, warehouse, retailer, and consumers, under the aegis of information management systems [3],[4]. The transportation system is a main component of the Cold chain [5]. The cold chain logistics is at a nascent stage in developing countries like China and India [6]. Recently fruits and vegetables cold chain has been identified the weak links [7]. There is tremendous scope of improvement of cold chain logistics in developing countries [8]. Comprehensive risk prediction of cold chain logistics can be calculated using improved neural network algorithm [9]. Cold chain management is a more complicated barrier for exporters [10]. Performance factors (performance of product, Profitability [11], qualitative factors (customer satisfaction), quantitative factors (return on investments), services and processes need to be stressed and evaluated in order to improve performance of the entire cold chain [12], [13]. Supply chain practitioners are working to implement tools and techniques of Lean Practices (LPs) in order to decrease non-value activities and wasted effort across the supply chain. [14]. Hence, understanding these advantages can facilitate the implementation of the tools and techniques of LPs in cold chain sector. Therefore, there is need to investigate the different barriers for successful lean cold supply chain implementation to improve the overall performance of companies.

II. LITERATURE SURVEY

Now it is the time to articulate the research work with ideas gathered in above steps by adopting any of below suitable approaches:

A. Lean implementation

Womack et.al. is attributed as the first to coin the name lean production (LP) [15], [16]. Toyota production system had applied Lean principles, and continues with great interest in operation community [17]. Lean is one of the most popular business performance improvement approaches of the last decade which concentrates on increasing business value by eliminating the waste within the organization [18]. Lean operation helps a firm to eliminate the waste by removing inefficient processes and improve the overall value chain activities of the firm [19]. Lean as a total system approach pull the best practices and concepts together which includes total quality management (TQM), Just In Time (JIT), continuous improvement, resource planning and supply chain management (SCM) to create an efficient operation [20]. Lean systems take a total system approach and pull together best practices and concepts. This includes concepts such as just in time (JIT), total quality management (TQM), continuous improvement, resource planning and supply chain management (SCM) [20]. Lean philosophy basically enters in the automobile industry and spread various firm of repetitive manufacturing and finally to the service industry [21]. Manufacturer of developing countries i.e. China and India willing or working to transform their manufacturing base traditional rigid production to higher value, more flexible and more productive "lean" manufacturing systems since decade [22]. Outside of manufacturing firm, Lean acts as performance improvement method [23]. Superior performance for customers, shareholders, employees and society in great extent is achieved by implementing Lean as a business model [24]. Lean supply chain strategies focus on waste reduction, helping firms eliminate non-value adding activities related to excess time, labor, equipment, space, and inventories across the supply chain [25]. Such strategies enable firms to improve quality, reduce costs, and improve service to customers as traditional batch and queue mass production and supply chain approaches are transformed [26]. Lean implementation introduces the completely different management ideas and systems, management methods and management techniques [27]. Lean implementation in entire value stream irrespective of implementing at different points within the organization results in reduced human effort, less space, less capital and less time required making products and services at less costs and with negligible defects [28]. However very few organizations outside the Japan has been effective in implementing lean framework [29]. Lean implementation process faces challenges or barriers and there are many factors which enables lean implementation [30]. Culture, human and geographical is prominent factors which cause the problem for lean implementation [31]. The range of success in lean manufacturing (LM) practices is near about 10 percent [32]. 70 percent of the lean implementation practice is not successful in manufacturing sectors and following the traditional/previous method [33]. The survey states that generally Western organizations i.e. US automotive are working hard to practice lean philosophy like Toyota system and has got considerable success and reasonable improvement initially however due to lack of performance consistency and continuity success rate goes down [34]. In UK success rate for lean implementation is 10 percent[35]. There is no unique roadmap of lean implementation [36]. Lean practice bundle which includes eight Lean practices i.e. Waste elimination practice bundle, Conformance quality practice bundle, Delivery reliability practice bundle , Volume flexibility practice bundle, Low cost practice bundle, Human resource management practice bundle, Health and safety practice bundle and Creativity & innovation practice bundle [37]. To implement Lean successfully, sustenance of Lean practices and perfection at each phase are absolutely Essential [38]. The interrelationship between lean practices and order of its proper execution is the key for successful Lean deployment [39]. There are the various barriers which affect the effective and successful lean implementation, the identification and investigating of influence and interaction of these barriers would be helpful to implement lean strategy effectively within the organization [40]. The Indian business is as yet attempting to execute lean standards and methods of insight [41]. Various barriers to lean implementation are shown in following table.

Table.1: Barriers to lean implementation

Category	Barriers
Resources	Lack of consultants and trainers in the field [42], Lack of formal training for workers/ manager [35] [44], The lack of resources to invest (time, expertise, financial, Incompatibility of lean with the company bonus, rewards or incentives systems [35].
Involvement and support	Lack of top management commitment[27], Lack of top management involvement[46][48], Lack of top focus leadership[18],Lack of support from top management [48][44][45][42],Employee resistant to change [49][44], Management resistance to change [47][36],Lack of communication between management/workers[39][42],Lack of logistic support[47],Lack of empowerment

	of employees[46][42],Lack of cooperation and mutual trust between management and employees[50], Poor supplier commitment [47],Backsliding [39][44]
Organization culture	Lack of long term philosophy[30][31],Absence of a lean culture in the organization[28][50][43][15],Absence of a lean culture in the partners[43],Cultural difference[18][, Cross fictional conflict [34].
Organization structure	Hierarchies in organizational structures, Lack of a long-term objective and benefits, Geographical dispersion, Strategic misalignment Competing value streams, Insufficient/ inconsistent value stream measures, Poor material flow, Fear of job cutting.
Technology	Problems with machines and plant configuration [45], Disparate manufacturing environment Lack of standardization, Absence of a sound strategic action/logistical planning system [47][35].
Knowledge and skill	Incompetent professional skills, Inadequate educations to the growers, Insufficient knowledge of lean/awareness, Insufficient management skill, Lack of understanding about why change is to take place, Fail to understand the Lean terminologies, Lack of awareness about reverse logistics adoption.
Outsourcing	Slow response to market, communication with suppliers and customers [47], Improper collaboration planning, Lack of direct collaboration across all supply chain partners, Lack of interest and commitment in lean by supplier and customer [42][44], Lack of influence over suppliers or lack of involvement of suppliers in the actual implementation Lack of supplier collaboration, Quality problems with supplied material [44].
Regulatory	Government regulations, Stringent requirements/approvals, High level regulation and safety.

B. *Multi Criteria Decision Making Techniques (MCDM)*

MCDM began in the 1960s [51]. Figueira et al. (2005) gives more detailed description regarding the historical influences, origins and categorization of MCDM methods.

[52]. In MCDM following tools will be used for analysis and modeling for lean cold supply chain.

C. *Interpretive Structural Modeling (ISM)*

Warfield developed the ISM tool for understanding mutual relationship among the variables of a particular context [53]. ISM repressed the complex system in a visual hierarchical structure [54], poorly articulated mental, unclear model of a system is been transformed into valid, well defined hierarchical models [55] Application of ISM is to establish interrelationship between barriers/variables in different fields [56].

D. *PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations):*

The PROMETHEE family for outranking includes PROMETHEE I-partial ranking, PROMETHEE II-complete ranking [57] PROMETHEE III- interval ranking, PROMETHEE IV-human brain representation, PROMETHEE V-segmentation constraints [58],PROMETHEE GDSS-group decision [59], and GAIA (Geometrical Analysis for Interactive Aid)-complicated decision- making situations[60]. Fugueiraet al. suggested two approaches i.e. PROMETHEE TRI for sorting problems and the PROMETHEE CLUSTER for nominal classification [61]. PROMETHEE method is applied to many areas researchers especially using for MCDM analysis. Success of this method is due to their user friendliness [62].

E. *2.2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS):*

TOPSIS approach used for complex systems that deals withcomparison of considered alternative and making the preferred choice between the several alternatives [63]. TOPSIS is simple intuitive concept; the purpose of the TOPSIS approachto find the order of preference between various alternatives which are closest to positive ideal solution and farthest from the negative ideal.[64].

III. RESEARCH GAP IDENTIFIED

There is lack of studies for implementing lean strategies in cold supply chain management; also there is lack of studies for new framework for lean implementation in cold supply chain management.

IV. PROBLEM STATEMENT

The current research seeks to identify and priorities the influential barriers, critical success factors and enablers for successful implementation of lean in cold supply chain management. It will also develop a framework for lean implementation in cold supply chain management.

V. RESEARCH METHODOLOGY FLOWCHART

The full length research methodology flowchart has been developed and is available for reference.

VI. CENTRAL RESEARCH THEME

Central Research Questions: What are the key barriers in building and implementing a lean in cold supply chain in India? What are the key performance factors for the lean implementation in cold supply chain related to perishable commodities? How potential barriers affect performance of lean cold supply chain? What are the critical success factors and enablers for Lean Implementation in Cold Supply Chain. What are the interactions among the barriers for lean cold supply chain? What is the Framework for implementing lean in Cold supply Chain?

VII. RESOURCES NEEDED

Literature on Cold supply chain, ISM, TOPSIS, PROMITHEE, Expert Inputs on Lean and Cold Supply chain management.

VIII. TECHNICAL FEASIBILITY CHECK

Data required for the research will be made available through surveys/interviews, experts inputs, literature, historical data from ERP and other sources, real time data from systems, data will be collected from industry and there systems.

IX. ECONOMICAL VIABILITY CHECK

The research may receive the grants from TEQIP, Ph.D. Funding, University Funding, AICTE Funding, Ministry of Human Resources, Industrial Funding etc,

X. FINANCIAL EXPENSES REQUIRED:

The research requires Recurring expenses (Field work and travel, Conferences, Contingency including special needs, Internet etc.) Rs. 150000/-, Nonrecurring expenses (Equipment, Software, Book and journal) Rs. 195000/- and total expenses sum up as Rs: 345000.

XI. DATA COLLECTION PROCEDURE:

Primary data; Questionnaires, Interviews, Schedules, Observation Techniques, Rating Scales, pilot, project execution etc. Secondary data: technical publications, literature, manuals, handbooks, data sheets, and standards, books and journals, official publications of the Central government, state governments, local bodies, etc.

XII. EXPECTED RESULTS

Barriers, Critical success factors, Enablers to implement lean in cold supply chain in India will be explored and prioritized. Development of successful lean cold supply chain model . MCDM tools will help to overcome the shortcoming of lean cold supply chain model. The research will develop strategies to Minimize the losses, damages and increase efficiency of the lean cold supply chain network.

XIII. VALIDATED RESULT

The developed lean cold supply chain model will be validated by adopting it in the industries. The results of model implementation will be verified with theory developed.

XIV. PROJECT DELIVERABLES

1.Industry: The current research will provide the useful solution and guideline for the industries to develop the strategy to mitigate the barriers to lean cold supply chain in India. 2.Academics: This research will provide the new dimension to the academic which will help in modeling their teaching aligned with the requirement of industry. 3.Market: This research will help industries to improve their processes, services and operations which will gain customer confidence and the faith in the company; this in turn will help to secure key position in the market.

XV. EXPECTED CONCLUSION

To conclude this research will provide new framework and strategies to remove the barriers to lean cold supply network in India. This research will also prioritize the barriers, critical success factors and enablers for effective implementation of lean in cold supply chain.

ACKNOWLEDGMENT

KIND NOTE

Full length research proposal of 25 pages is prepared and available for reference if required.

REFERENCES

[1] Salin V. and Nayga R.M., A cold chain network for food exports to developing countries, International Journal of Physical Distribution & Logistics Management, 33(10), 2003, pp. 918-933.

[2] R Joshi et al., Indian cold chain: modeling the Inhibitors, British Food Journal 111(11), 2009 pp. 1260-1283.

[3] Montanari, R., Cold chain tracking: a managerial perspective. Trends in Food Science & Technology, 19(8), 2008, pp. 425–431.

[4] Surajit Bag, Modeling Barriers of Green Cold Chain Management in India, Journal of Supply Chain Management Systems 5(1), January 2016.

[5] kacimi, R., Dhaou, R. and Beylot, R. 'Using energy-efficient wireless sensor network for cold chain monitoring', Consumer Communications and Networking Conference, Las Vegas, USA, (2009) pp.1–5.

[6] Xin,S., Qiao,L., & Dawei, Z., Evaluation of re¬gional agri-food cold chain logistics competiveness, Journal of Applied Sciences, 13(4), (2009), 2670-2675.

[7] Negi. S., Anand, N., Supply Chain Efficiency: An Insight from Fruits and Vegetables Sector in India, Journal of Operations and Supply Chain Management, 7(2), 2015, pp. 154 – 167.

[8] Verbic, M., Discussing the parameters of preserva¬tion of perishable goods in a cold logistic chain model. Applied Economics, 38(2), 2006, pp.137-147.

[9] Xu, W., Zhang, Z., Daqing, G., & Guan, X., Neural network model for the risk prediction in cold chain lo¬gistics. International Journal of Multimedia & Ubiquitous Engineering, 9(8), 2014, pp.111-124

[10] Sandrey, R., Smit, L, Fundira. T., & Edinger, H., Non-tariff measures inhibiting South African exports to China and India, tralac Working Paper 6 (2008).

[11] Da Silva, C.A. and Filho, S.M.D., Guidelines for rapid appraisals of agrifood chain performance in developing countries, Agricultural management, marketing and finance occasional paper.2008 FAO, Rome.

[12] Aramyan, L. H., et. al., Performance measurement in agri-food supply chains: A case study, Supply Chain Management: An International Journal, 12(4), 2007, pp.304–315.

[13] F.T.S. Chan, H.K. Chan, H.C.W. Lau, R.W.L. Ip, An AHP approach in benchmarking logistics performance of the postal industry, Benchmark. Int. J. 13, 2006, pp. 636–661.

[14] Shah, R.; Ward, P.T. Lean manufacturing: Context, practice bundles and performance. J. Oper.Manag.,21, 2003, pp.129–149.

[15] Womack, J., Jones, D.T. and Roos, D., The Machine that Changed the World, Harper Perennial, (1990), New York.

[16] Sawhney, R. and Chason, S., Human behavior based exploratory model for successful implementation of lean enterprise in industry, Improvement Quarterly, 18 (2), 2005, pp. 76-96.

[17] Staats, B.R., Brunner, D.J. and Upton, D.M., "Lean principles, learning, and knowledge work: evidence from a software services provider", Journal of Operations Management, 29(5), 2011, pp. 376-390.

[18] Peters, A., Your Journey to Lean: Continuous Improvement Supported by Tools, Forrester Research, 2012.

[19] Chual, J.L.Y., Eze, U.C. and Goh, G.G.G., Knowledge sharing and total quality management: a conceptual framework, Proceedings of the IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), China, 2010, pp. 1107-1111.

[20] Oduoza, C.F., Lean thinking constrains in traditional batch manufacturing environments, Advances in production Engineering and Management Journal, 3(4), 2008, pp. 181-192.

[21] Ballard, G. and Tommelein, I., Lean management methods for complex projects, Engineering Project Organization Journal,2 (1/2),2012 pp. 85-96.

[22] Panizzolo, R., Garengo, P., Sharma, M.K. and Gore, A., Lean manufacturing in developing countries: evidence from Indian SMEs, Production Planning and Control: The Management of Operations, 23 (10/11), 2012, pp. 769-788.

[23] Stone, K.B. (2012), "Lean transformation: organizational performance factors that influence firms'Leanness'", Journal of Enterprise Transformation, Vol. 2 No. 4, pp. 229-249.

[24] Bhasin, S., Performance of lean in large organizations, Journal of Manufacturing Systems, 31(3), 2012, pp. 349-357.

[25] Corbett, C.J. and Kirsch, D.A., International diffusion of ISO 14000 certification", Production and Operations Management, 10(3), 2001, pp. 327-42.

[26] Larson, T. and Greenwood, R., Perfect complements: synergies between lean production and eco-sustainability initiatives, Environmental Quality Management, 13(4), 2004, pp. 27-36.

[27] Magdalena K. Wyrwicka, Beata Mrugalska, Mirages of Lean Manufacturing in Practice, Procedia Engineering 182, 2017, pp.780 – 785.

[28] Sanjay Bhasin, Performance of Lean in large organizations, Journal of Manufacturing Systems 3, 2012, pp. 349– 357.

[29] Kadri, K., Cultural and habitual features and the implementation of lean principles in companies: mapping out the research, Proceedings of the Lean Advancement Initiative 5th LAI/EdNet Lean Educator Conference, Daytona Beach, FL,2010, pp.19-21.

[30] Aurelio, D., Grilo, A. and Cruz-Machado, V., A framework for evaluating lean implementation appropriateness, Proceedings of IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Singapore,2011 pp. 779-783.

[31] Benton, W.C. and Shin, H., Manufacturing planning and control: the evolution of MRP and JIT integration, European Journal of Operational Research, 110(3),1998, pp. 411-440.

[32] Sohal, A. and Egglestone, A., Lean production: experience among Australian organizations, International Journal of Operations and Production Management, 14(11), 1994, pp. 35-51.

[33] Schipper, T. and Swets, M., Innovative Lean Development: How to Create, Implement and Maintain a Learning Culture Using Fast Learning Cycles, Productivity Press, New York, 2010.

[34] Mohanty, R.P., Yadav, O.P. and Jain, R., Implementation of lean manufacturing principles in auto industry, Vilakshan-XIMB Journal of Management, 2007, pp. 1-32.

[35] Camagu, S., Investigating factors that negatively influence lean implementation in the eastern cape automotive industry, Master's thesis, Faculty of Business and Economic ciences, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa, 2010.

[36] Bhasin, S. and Burcher, P., Lean viewed as a philosophy", Journal of Manufacturing Technology Management, 17(1),2006, pp. 56-72.

[37] Jagdish Rajaram Jadhav. S. S. Mantha, Santosh B. Rane, Development of framework for sustainable Lean implementation: an ISM approach J Ind Eng Int 10:72, 2014, pp.1-27.

[38] J. R. Jadhav, S. S. Mantha, S. B. Rane, Roadmap for Lean implementation in Indian automotive component manufacturing industry: comparative study of UNIDO Model and ISM Model, Ind Eng Int 10:74, 2014, pp 1-20.

[39] Jagdish Rajaram Jadhav. S. S. Mantha, Santosh B. Rane, Development of framework for sustainable Lean implementation: an ISM approach J Ind Eng Int 10:72, 2014, pp.1-27.

[40] [40]. Jagdish R. Jadhav, Shankar S. Mantha, Santosh B. Rane, Exploring barriers in lean implementation, International Journal of Lean Six Sigma,5(2), 2014, pp. 122-148

[41] Singh, B., Garg, S.K. and Sharma, S.K. (2010), Scope for lean implementation: a survey of 127 Indian industries", International Journal of Rapid Manufacturing, Vol. 1 No. 3, pp. 323-333.

[42] Scherrer-Rathje, M., Todd, A.B. and Patricia, D., Lean, take two! reflections from the second attempt at lean implementation, Business Horizons, 52(1), pp. 2009, pp.79-88.

[43] Liker, J.K., The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill, New York, 2004.

[44] Wong, Y.C., Wong, K.Y. and Ali, A., A study on lean manufacturing implementation in the Malaysian electrical and electronics industry, European Journal of Scientific Research, 38(4), 2009, pp. 521-535.

[45] Houshmand, M. and Jamshidnezhad, B., An extended model of design process of lean production systems by means of process variables, Robotics and Computer-Integrated Manufacturing, 22(1), 2006, pp. 1-16.

[46] Urban, R., Lean-ing Large: a study of MG-Large in the scope of lean, Master's thesis, International Technology Management at Aalborg University, 2009.

[47] Hagström, M. and Wollner, M., Implementing lean procurement-opportunities, methods and hinders for medium sized enterprises-a case study, Master's thesis, Jönköping International Business School, Jönköping University, 2011.

[48] Hines, P., Found, P., Griffiths, G. and Harrison, R., Staying Lean; Thriving, not Just Surviving, Lean Enterprise Research Centre, Cardiff University, Cardiff, 2008.

[49] Sim, K.L. and Rogers, J.W., Implementing lean production systems: barriers to change, Management Research News, 32(1), 2008, pp. 37-49.

[50] Staudacher, A.P. and Tantardini, M., Lean production Implementation: a survey in Italy, XI Congreso de Ingeniería de Organización International Conference on Industrial Engineering and Industrial Management, Madrid, 2007.

[51] Dyer, J.S., MAUT – Multiattribute utility theory, in: Figueira, J., et al. (eds.): International Series in Operations Research & Management Science, New York, 2005,pp. 265-296.

[52] Fiigueira, J., Greco, S., Ehrgott, M.,. Multi Criteria Decision Analysis: State of the Art Surveys. Springer, 2005, New York.

[53] Warfield JW, Developing interconnected matrices in structural modeling, IEEE Trans Syst Manag Cyber,4(1)1974, pp:51–81

[54] Chang AY, Hu KJ, Hong YL, An ISM-ANP approach to identifying key agile factors in launching a new product

into mass production. Int J Prod Res 51(2),213,pp:582–597

[55] Alawamleh M, Popplewell K, interpretive structural modeling of risk sources in a virtual organisation. Int J Prod Res 49(20),2011, pp:6041–6063.

[56] Attri R, Grover S, Dev N, Kumar D, An ISM approach for modelling the enablers in the implementation of total productive maintenance (TPM). Int J Syst Assur Eng Manag 4(4), 2013, pp: 313–326.

[57] Brans, J.P. Lingenierie de la decision. Elaboration dinstruments daide a la decision. Methode PROMETHEE. In: Nadeau, R., Landry, M. (Eds.), Laide a la Decision: Nature, Instrument s et Perspectives Davenir. Presses de Universite Laval, Qu ebec, Canada, 1982, pp. 183–214.

[58] Brans, J.P., Mareschal, B.,PROMETHEE V – MCDM problems with segmentation constraints. INFOR 30 (2), 1992, pp.85–96.

[59] Brans, J.P., Mareschal, B.,The PROMETHEE VI procedure. How to differentiate hard from soft multicriteria problems. Journal of Decision Systems 4, 1995, pp.213–223.

[60] Mareschal, B., Brans, J.P., Geometrical representations for MCDA. The GAIA module. European Journal of Operational Research 34 (1), 1988, 69–77.

[61] Figueira, J., de Smet, Y., Brans, J.P., MCDA methods for sorting and clustering problems: Promethee TRI and Promethee CLUSTER, Université Libre de Bruxelles. Service deMathématiques de la Gestion, Working Paper 2004/02.

[62] Brans, J.P., Mareschal, B., In: Figueira, J., Greco, S., Ehrgott, M. (Eds.), Multiple Criteria Decision Analysis: State of the Art Surveys. Springer Science + Business Media, Inc.,2005, pp. 163–196.

[63] Gumus, A. T. Evaluation of hazardous waste transportation firms by using a two step fuzzy-AHP and TOPSIS methodology. Expert Systems with Applications, 36, 2009, pp-4067–4074.

[64] Lin, M. C., Wang, C. C., Chen, M. S., & Chang, C. A., Using AHP and TOPSIS approaches in customer-driven product design process. Computers in Industry, 59, 2008, pp 17–31.