

VALUE CHAIN MODEL FOR STEEL MANUFACTURING SECTOR: A CASE STUDY

S G Acharyulu¹, K Venkata Subbaiah² and K Narayana Rao³

¹Research Scholar, Department of Mechanical Engineering, Andhra University,
Visakhapatnam, India.

²Professor, Department of Mechanical Engineering, Andhra University,
Visakhapatnam, India.

³Principal (FAC), GMR Polytechnic, Paderu, Visakhapatnam District, India.

ABSTRACT

Michael E Porter developed a value chain model for manufacturing sector with five primary activities and four supporting activities. The value chain model developed by Porter is extended to a steel manufacturing sector due to expansions of steel plants has become a continual process for their growth and survival. In this paper a value chain model for steel manufacturing sector is developed considering five primary activities and six support activities.

KEYWORDS

Value chain model, steel manufacturing sector, integrated steel plant, primary activities, supporting activities.

1. INTRODUCTION

Value chain is defined as “a chain of value added activities; products pass through the activities in a chain, gaining value at each stage”. Michael E Porter (1985) first introduced the value chain concept in his book “Competitive Advantage: Creating and Sustaining Superior Performance”. The concept of value chain is used to an individual organizations supply chain networks. It needs addition of value for each and every activity through which the product/service moves through the product life cycle.

Porter developed a general-purpose value chain that manufacturing companies can use to examine all of their activities, and to see how they're connected. The value chain activities of an organization determine the costs, thus affects the profits. The value chain tool is useful to analyse the sources to improve the value of any organization. Value chain focuses on systems, and how business inputs are changed into business outputs purchased by customers. The value chain developed by Porter is shown in Fig-1.

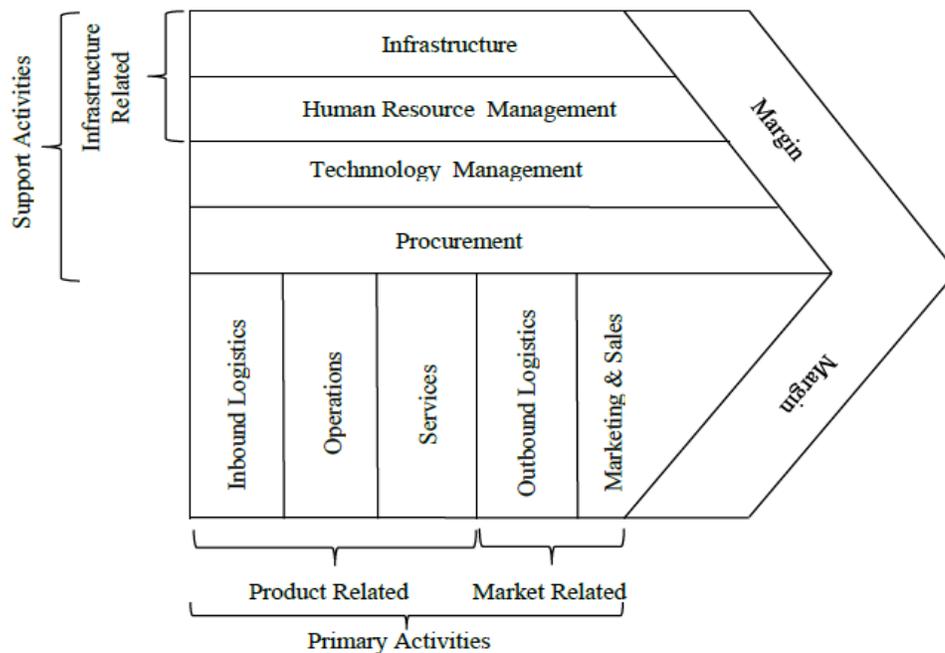


Figure-1: Porter's Generic Value Chain: Source: Porter (1985)

Porter (1980) created value chain approach and strategies used to examine the development of the organization among its competitors. The value chain is a network of independent activities. These activities produce goods/services creating value for the organization. Employing Porter's value chain analysis approach, Ching Chyi Lee and Jie Yang (2000) developed a knowledge value chain model. Vorster (2001) constructed a mining value chain for functional transformations. Van der Merwe and Cronje (2004) introduced educational value chain. Gabriel (2005) developed the value chain model for higher education sector, since the components like Inbound and Outbound Logistics can not be directly applied to the service industry. Ilyas et al. (2005) identified the key parameters of effective value chain management in an information technology-driven industry using Interpretive Structural Modelling (ISM) methodology.

Based on some characteristics of services, Gabriel (2006) proposed a value chain framework customized for services. Ilyas et al. (2006) proposed a model for decision making to establishing relationships between the value chain partners. Rijejan Landry et al. (2006) developed a knowledge value chain framework to translate the knowledge in health organizations. Ilyas et al. (2007) conducted a study of the relative efficiency of value chain relationships in the Indian Steel Industry using Data Envelopment Analysis (DEA). Ruskov and Ruskov (2007) presented an approach to modelling educational processes as a value added chain. Ilyas et al. (2008) conducted an ISM-based study for outsourcing the value chain activities effectively. Makkar et al. (2008) presented a modified value chain for higher education sector. Tamara Almarabeh et al. (2009) proposed knowledge value chain (KVC) model to be applied on the knowledge organisations in knowledge management field. Pathak and Pathak (2010) presented a reconfigured higher education value chain by redefining the value driving activities for higher education.

Peter H. Antoniou et al. (2011) illustrated a model with certain attributes for evaluating the value chains. Wang Aimin and Li Sunxi (2011) built a model of Value Chain Management (VCM) based on Customer Relationship Management (CRM). Khaled Abed Hutaibat (2011) proposed a value chain model for the Higher Education context. Chien-Liang Kuo et al. (2011) used the

concepts of value chain and value co-creation in developing a framework for service trade mode selection.

Claudine Soosay et al. (2012) conducted a study using Sustainable Value Chain Analysis (SVCA) for identifying areas for improvement. Leopoldo Laborda Castillo and Daniel Sotelsek Salem (2012) proposed various models using DEA approach for examining the technical efficiency of value chains. Anni-Kaisa Kahkonen and Katrina Lintukangas (2012) analysed supply management role in value thinking of a firm. Seyed Mohammad Adeli et al. (2012) described charity value chain. The framework is strongly related to Gabriel's (2006) proposed service chain framework. Mahsa Dorri et al. (2012) made a review of previous researches done on value chain in higher education sector and analysed the results. Vesa Karvonen et al. (2012) proposed a tuned value chain model for a research institute.

Rupa Rathee et al. (2013) reviewed and discussed various models of value chain in higher education proposed by previous researchers. Abid Sultan and Dr.Saurabh (2013) presented various sources along the value chain of an organization for achieving sustainable development. Daiva Rapcevicience (2014) developed a value chain model for public sector service. V.V. Devi Prasad Kotni (2014) proposed models for fresh fish value chain and cost effective value chain for fresh fish.

There is a limited research regarding in developing value chain model for steel manufacturing sector. In lieu of this a value chain model was developed for steel manufacturing sector using a case of an integrated steel plant.

2. VALUE CHAIN MODEL FOR STEEL MANUFACTURING SECTOR

In integrated steel plants steel is manufactured from the basic raw materials like iron ore, coking coal and fluxes like lime stone and dolomite. The main production units are raw material handling plant, coke ovens, sinter plant, refractory material plant, blast furnace, steel melt shops, light and medium merchant mills, wire rod mills, medium merchant and structural mills, special bar & structural mills. In addition to these main production units, there are several auxiliary units like power plant, engineering shops, oxygen plant, etc.

Hot metal produced at blast furnaces is converted into steel through the process of removing impurities in the metal by oxidation. This steel is further refined in the secondary refining facilities provided in the steel melt shop. Blooms are produced at steel melt shop, which are converted into various finished products like wire rod coils, rebars, rounds, structurals, squares etc. in various rolling mills. These products are called as long products used in construction and infrastructure building and manufacturing sectors.

The value chain model developed by Porter with five primary activities and four supporting activities as explained above can be used as a generic one. This model cannot be used directly in steel manufacturing sector due to expansions of steel plants has become a continual process for their growth and survival. Due to nature of the activities, a different version of the value chain for steel manufacturing sector is developed with five primary activities and six supporting activities. The shape of the Value Chain for Steel Manufacturing Sector (VACSMS) will be the same as that of Porter but the difference is in some of the activities and their application. The VACSMS is shown in Fig-2 and a brief description on each of the activity given in it is as follows:

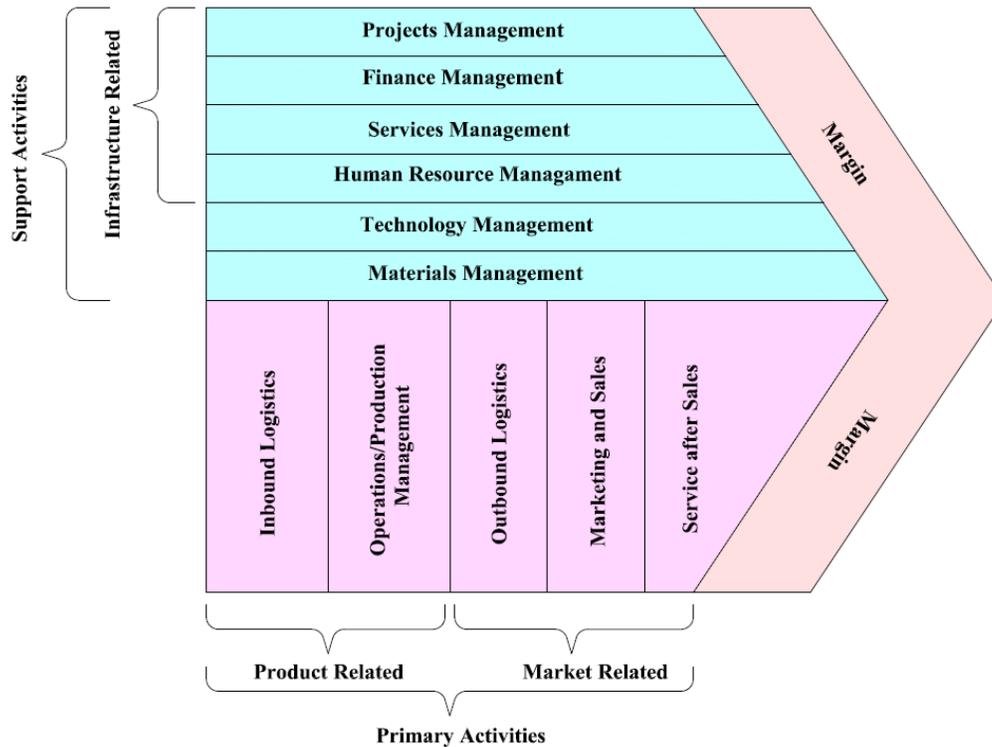


Figure-2: Value Chain for Steel Manufacturing Sector

2.1. Value Chain - Primary Activities

Primary activities are those activities, directly involved in the conversion process of basic raw materials into final output/products including the receipt of basic raw materials from suppliers and marketing of output/ products to customers. They are grouped into two types of activities related to product and market. Product related activities are the activities, performed by the organization to add value to the product and services itself. Market related activities are the activities, performed by the organization to transfer the finished product or services to the customers.

2.1.1. Inbound Logistics

These include receiving the basic raw materials required for the steel making process, stacking and reclaiming the materials, and distribution of materials to various departments etc. Inbound Logistics activities can be included to primary activities.

2.1.2. Operations/Production Management

These include raw material handling and processing (receiving and handling of major raw materials like coking coal, iron ore, fluxes, boiler coal etc., crushing, lump ore crushing and screening); making of coke, sinter, lime and calcined dolomite, pitch bonded magnesia bricks; production of iron, steel, wire rods, TMT bars, rounds, squares, structurals (angles, channels and beams); blooms, billets etc. and preparation and repair of rolls.

Generation of air, steam, electricity, gaseous oxygen, gaseous nitrogen, gaseous argon, liquid oxygen, liquid nitrogen, liquid argon, plant air, dry air, chilled water etc.

Generation of crude coke oven gas, BF gas, granulated slag; making ammonium sulphate, crude tar, crude benzol, and cleaned coke oven gas etc.

Manufacturing of spares and components to meet the plant requirements; carrying out the major repairs of equipment in plant units; vibration and condition monitoring of equipment; repair of electrical and electronics equipment (control panels, electrical meters, PLCs etc.) etc.

Planning and monitoring production, equipment design support by plant design.

Operation/Production Management activities can be included to primary activities.

2.1.3. Outbound Logistics

These include planning and despatch, distribution management, transportation, warehousing, and order fulfilment. Outbound Logistics activities can be included to primary activities.

2.1.4. Marketing and Sales

These include product management; price management; placement (distribution) management; promotion management; domestic sales (project sales, actual user sales, retail sales); export sales; sale of special steels; by products sales; planning and despatch; pricing and policy; contracts; customer relations management etc. Marketing and Sales activities can be included to primary activities.

2.1.5. Service after sales

These include commercial terms; quality aspects; delivery aspects; pre/post sales contact; complaint settlement procedure. Service after sales activities can be included to primary activities.

2.2. Value Chain - Support activities

Support activities are those activities, not directly involved in the conversion process but support the primary activities in their functions. These activities are classified as:

2.2.1. Materials Management

2.2.1.1. Vendor Development

These include registration; categorization; performance rating & continuous monitoring; encouraging local SSI's; regular interaction with local SSI's etc.

2.2.1.2. Purchase

These include identifying sources for various materials; selection of suppliers; taking requests from plant units (indents); processing of indents; procurement of raw materials, components and parts, machinery and spares, consumables, stationery, servicing; ensure supply of materials etc.

2.2.1.3. Logistics

These include utilization of port facilities; handling of vessels at ports etc.

2.2.1.4. Stores

These include receipt of raw materials at ports and spares & consumables; custody of spares and consumables; stock control; issue of spares & consumables to various departments; disposal of non-moving spares & consumables; transport contract; discrepancy receipt & inventory control etc.

2.2.2. Technology Development

These include quality assurance and technology development (QA&TD); research and development (R&D); processes automation etc.

2.2.3. Human Resource Management

These include corporate coordination (manpower planning, recruitment, executive establishment, rules & policies, welfare, parliament cell); Human resources - non works (human resource development, non works personnel, mines, industrial relations, SC&ST cell, sports); Human resources - plant (plant personnel); Management services (quality circles, suggestion schemes, awards, incentive schemes); Corporate social responsibility; Medical; Town administration; Administration (general administration, law, hospitality, RTI, Liaison Office, Agro Forestry); Human Resources Development (training, management development, Hindi cell, HR information systems).

2.2.4. Services Management

These include corporate offices (CMD and Directors' offices), corporate strategic management, corporate communications, company affairs, information technology (process control, materials management system, marketing system, payroll system and financial accounting system)

2.2.5. Finance Management

These include treasury management, budgeting, costing, corporate accounts, raw material accounts, sales finance, operations & general accounts and works accounts, central excise and insurance, pay sections (payments to present employees i.e. employees on rolls and payments to retired and expired employees), stores accounts, purchase bills (payments to indigenous and imported materials), project accounts, mines accounts, internal audit and stock verification.

2.2.6. Projects Management

These include the activities of Design & Engineering for the existing plant and the activities of Design & Engineering, Project Contracts, Construction and Project Monitoring for plant expansion.

2.2.6.1. Existing plant

2.2.6.1.1. Design & Engineering

These include conceptual planning, basic engineering and detailed engineering, implementation of automation to improve production, implementation of major Additions, Modifications, Replacements (AMR) & Non AMR schemes in the plant, Modifications/alterations for debottlenecking, improvements during operation of the plant.

2.2.6.2. Plant expansion

2.2.6.2.1. Design & Engineering

These include preparation/scrutiny of project reports; engaging consultants wherever required; obtaining various clearances/approvals of PIB, MOEF, GOI etc.; executing the expansion from concept to commissioning (preparation & scrutiny of basic engineering concepts; preparation, scrutiny & finalisation of technical specifications; issue of NIT & receipt of bids; conducting techno-commercial discussions & finalising techno-economic recommendations; detailed engineering; active involvement in order placement and finalisation of the contract specifications; design supervision; liaison with statutory bodies; indexing, storage & retrieval of technical documents).

2.2.6.2.2. Project Contracts

These include preparation of special conditions of contract (SCC), general conditions of contract (GCC), payment terms of contract; issue of notice inviting tenders (NIT); enlistment of contractors; preparation & issue of tender documents to tenderers; scrutiny & evaluation of commercial offers; preparation of contract documents; handling arbitration cases.

2.2.6.2.3. Construction

These include executing the contract; construction supervision to ensure quality; accounting of materials & processing bills of contractors for payment; implementing statutory obligations; ensure adherence of safety practices; processing gate passes, work permits, shut downs etc.

2.2.6.2.4. Project Monitoring

These include submission of timely feedback information to management on progress, delays and critical activities of project; preparation of various reports to the management related to status of approval of various projects, erection, testing & commissioning by indicating critical areas over progress of project; furnish periodical reports on actual expenditure with respect to estimates.

2.3. Value Chain - Margin

The organization incurs certain costs for creating value for its final products/services. The margin is the difference between the sum of all the values created at the activities in the value chain and the total cost incurred by the organization to create such values.

CONCLUSION

The generic value chain developed by Porter is useful, mostly for manufacturing sector but not in all cases in the value systems of other sectors. However it can be used as stepping stone for developing the value chains for other sectors. Therefore a value chain model for steel manufacturing sector is developed using a case of an integrated steel plant with five primary activities and six supporting activities and presented in this paper. In the primary activities operations is proposed as operations/production management under product related activities and services is excluded from product related activities and included in market related activities as service after sales. In the support activities procurement is proposed as materials management and infrastructure is proposed as services management. Finance is separated from infrastructure and shown as a separate support activity as finance management. Projects management which is important activity in the expansion of integrated steel plants is added as a support activity. This

study can be extended to identifying critical activities of proposed value chain model for steel manufacturing sector and evaluating its overall assessment.

REFERENCES

- [1] Anni-Kaisa Kahkonen, Katrina Lintukangas (2012), "Supply management as a value creating element in a firm", *International Journal of Value Chain Management*, 2012, Vol. 6, No. 4, pp.358-374.
- [2] Abid Sultan and Dr.Saurabh (2013), "Achieving sustainable development through value chains", *International Journal of Managing Value and Supply Chains (IJMVSC)*, Vol.4, No.2, June 2013, pp.39-46.
- [3] Ching Chyi Lee and Jie Yang (2000), "Knowledge Value chain", *Journal of Management Development*, Vol.19, No.9, pp.783-793.
- [4] Chien-Liang Kuo, Fu-Ren Lin and Ming-Yen Wu (2011), "A Proposed Framework for Service TradeMode Selection: The Value Chain and Value Co-creation Perspectives", *The Economic Geography of Globalization*, Prof. Piotr Pachura (Ed.), ISBN: 978-953-307-502-0, InTech.
- [5] Claudine Soosay, Andrew Fearne and Benjamin Dent (2012), "Sustainable value chain analysis - a case study of Oxford Landing from 'vine to dine' ", *Supply Chain Management: An International Journal*, Vol.17, No.1, pp.68-77.
- [6] Daiva Rapceviene (2014), "Modelling a Value Chain in Public Sector", *Social Transformations in Contemporary Society*, Vol.2, pp.42-49.
- [7] Gabriel, E. (2005), "An assessment of value co-creation and delivery systems in the higher education sector of Tanzania: A case of CBE, TIA & IFM", *The African Journal of Finance and Management*, Vol.13, No.2, pp.60-79.
- [8] Gabriel, E. (2006), "Value Chain for Services - A new dimension of Porter's Value Chain". *The IMS International Journal*, Vol.34, pp.1-30.
- [9] Ilyas, R.M., Ravi Shankar., Banwet, D. K., (2005), "Interventional Roadmap for Digital Enablement Leading to Effective Value-chain Management in the Manufacturing Sector", *Global Business Review*, Vol. 6, No. 2, pp.207-229.
- [10] Ilyas, R.M., Ravi Shankar., Banwet, D. K., (2006), "Value Chain Relationship - A Strategy Matrix", *Supply Chain Forum: An International Journal*, Vol.7, No.2, pp.56-72.
- [11] Ilyas, R.M., Ravi Shankar., Banwet, D.K., (2007), "A study of the relative efficiency of value chain relationships in the Indian steel industry using DEA", *International Journal of Value Chain Management*, Vol.1, No. 3, pp.239-265.
- [12] Ilyas, R.M., Ravi Shankar., Banwet, D.K., (2008a), "Value chain outsourcing - a solution for flex-lean-agile manufacturing using ISM", *International Journal of Value Chain Management*, Vol. 2, No. 2, pp.227-268.
- [13] Ilyas, R.M., Ravi Shankar., Banwet, D.K., (2008b), "Creating flex-lean-agile value chain by outsourcing - An ISM based interventional roadmap", *Business Process Management Journal*, Vol. 14, No. 3, pp.338-389.
- [14] Khaled Abed Hutaibat (2011), "Value Chain for Strategic Management Accounting in Higher Education", *International Journal of Business and Management*, Vol.6, No.11, pp.206-218.
- [15] Leopoldo Laborda Castillo, Daniel Sotelsek Salem (2012), "Value chain and technical efficiency: an empirical analysis in the Eastern European industrial firms", *International Journal of Value Chain Management*, Vol.6, No.3, pp.187-215.
- [16] Makkar, U., Gabriel, E., & Tripathi, S.K. (2008), "Value chain for higher education sector case studies of India and Tanzania", *Journal of Services Research*, pp.183-200.
- [17] Mahsa Dorri, Mohammad H. Yarmohammadian and Mohammad Ali Nadi (2012), "A review on value chain in higher education", *Procedia - Social and Behavioral Sciences*, Vol.46, pp.3842-3846.
- [18] Pathak, V & Pathak, K (2010), "Reconfiguring the higher education value chain", *Management in Education*, Vol.24, No.4, pp.166-171.
- [19] Peter H. Antoniou, Catherine E. Levitt and Cynthia Schreihans (2011), "Managing Value Chain Strategy", *Journal of Management and Marketing Research*, Vol.9, pp.1-11.
- [20] Porter, M.E., (1980), "Competitive Strategy: Techniques for Analyzing Industries and Competitors", New York, The Free Press.

- [21] Porter, M.E., (1985), "Competitive Advantage: Creating and Sustaining Superior Performance", The Free Press, New York, NY, pp.38.
- [22] Rejean Landry, Nabil Amara, Ariel Pablos-Mendeo, Ramesh Shademani & Irving Gold (2006), "The knowledge-value chain: a conceptual framework for knowledge translation in health", Bulletin of the World Health Organization, Vol.84, No.8, pp.597-602.
- [23] Ruskov, P., & Ruskov, A., (2007), "Academic Education Chain Operation Model", Proceedings of the TENComptence Open Workshop, pp.122-129.
- [24] Rupa Rathee & Pallavi Rajain (2013), "Service Value Chain Models in Higher Education", International Journal of Emerging Research in Management & Technology, Vol.2, No.7, pp.1-6.
- [25] Seyed Mohammad Adeli, Silvia Elaluf Calderwood, Claus Oskar Heintzeler, Javier Huerta and Caroline Legler (2012), "Mobile Value Chain and Services", MOBILITY: The Second International Conference on Mobile Services, Resources and Users.
- [26] Tamara Almarabeh, Amer Abuali, Sanaa Alsharrab and Alkareem lasassmeh (2009), "Value Chain Model in Knowledge Management", International Journal of Recent Trends in Engineering, Vol.2, No.2, pp.196-198.
- [27] Van der Merwe, A. & Cronje, J. (2004), "The educational value chain as a modelling tool in re-engineering efforts", Proceedings of the 2004 international Symposium on information and Communication Technologies, ACM International Conference Proceedings Series, Vol.90, No.1, pp.122-127.
- [28] Vesa Karvonen, Matti Karvonen and Andrzej Kraslawski (2012), "A Tuned Value Chain Model for University Based Public Research Organization. Case Lut Cst", Journal of Technology Management & Innovation, Vol.7, No.4, pp.164-175.
- [29] Vorster, A. (2001), "Planning for value in the mining value chain", The Journal of The South African Institute of Mining and Metallurgy, March/April, pp.61-68.
- [30] V. V. Devi Prasad Kotni (2014), "A Study on Value Chain Management Practices of Fresh Fish: An Empirical Study of Coastal Andhra Pradesh Marine Fisheries", IOSR Journal of Business and Management (IOSR-JBM), pp.80-90.
- [31] Wang Aimin & Li Shunxi (2011), "A Model of Value Chain Management Based on Customer Relationship Management", Journal on Innovation and Sustainability, Vol.2, No.3, pp.17-21.