A Study on Environmentally aware Business Models Lean, Green, Zero Waste Technology, and Corporate Social Responsibility

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Abstract

Population growth and Industrialization has resulted in global warming. This paper explores a framework of new business model such as Lean, Green Manufacturing and Zero waste technologies for the tanning sector. Green and Lean Manufacturing systems help to minimize environmental impact of manufacturing processes and products. An integrated Lean and Green manufacturing system model, Zero waste manufacturing is pro- posed as a solution for economically and environmentally sustainable manufacturing. The outcome of lean model results in reduced inventory levels, decreased material usage, optimized equipment, reduced need for factory facilities, increased production velocity, enhanced production flexibility, eliminating waste throughout the production process, employee involvement, supply chain investment and so forth.

A green manufacturing system consists of an Environmental management system that defines the corporate environmental policies and procedures such as ISO 14001, waste reducing techniques and results. It is re- ported that Lean manufacturing substantially reduces the facility footprint of production.

Keywords: Lean - Green Technology, Supply Chain Management, Chemical Leasing, Value Stream Mapping

1. Introduction

The Leather industry has considerable environmental impacts through the process of manufacturing leather
from raw to finished product. Although absolute measurements of the environmental impacts can be obtained
by detailed Life Cycle Assessment (LCA) studies, relative measurements should not be overlooked to indicate the gap between the current and the "leanest" performance.

This paper therefore aims to investigate the applicability of a relative measurement of the environmental impacts of Leather Manufacturing. The "lean" and "green" practices help to reduce the impact. The only logical approach to reduce environmental impact is to adopt a continuous process of waste minimization. Companies ignoring environmental issues are in danger of losing market penetration and being viewed as part of the problem and not part of the solution.

2. Concept of Business Environment

A business firm [1] is an open system. It gets resources from the environment and supplies its goods and services to the environment. There are different levels of environmental forces. Some are internal forces whereas others are external forces. External forces may be related to national level, regional level or international level. These environmental forces provide opportunities or threats to the business community.

3. Materials and Methods

Lean Manufacturing and Techniques

Lean manufacturing [2] provides a way to do more and more with less and less. Lean manufacturing achieves this objective through a group of methods and tools that eliminate wastes in the manufacturing system and focus on the value added activities. Lean manufacturing can be defined as a collection of operational techniques focused on productive use of resources. It is as an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing supplier, customer, and internal variability while delivering quality products on time at least cost with greater efficiency.

Lean production techniques often create a culture of continuous improvement, employee empowerment, and waste minimization, which is very compatible with organizational characteristics encouraged under environmental management systems (EMS) and pollution prevention. Lean production typically represents a paradigm shift from conventional "batch and queue," functionally aligned mass production to "one-piece flow," product-aligned pull production. It targets eight types of manufacturing waste such as defects, waiting, unnecessary processing, overproduction, movement, inventory, unused employee creativity and complexity.

Improved Lean & Environmental Performance Lean can be leveraged to produce more environmental improvement, by filling key "blind spots" that can arise during lean implementation. Although lean currently produces environmental benefits and establishes a systemic, continual improvement-based waste elimination culture, lean methods do not explicitly incorporate environmental performance considerations, leaving environmental

improvement opportunities on the table. The following lists the ways of identifying environmental wastes at Organizational level:

1. Value stream level : Value stream mapping
2. Process level : Kaizen events
3. Work area level : 6-sigma

Value Stream Mapping

Value Stream Mapping (VSM) is a Process Mapping Method used to document the current and future states of the information and material flows in a value stream from customer to supplier. A value stream is a set ofspecific actions (value-added and non-value added) required to bring a specific product through three criti- cal management tasks of any business: problem solving, information management, and physical transforma- tion. VSM is used as a communication tool, a business planning tool, and a management tool. Material and information flows in a tannery. In other words, an end- to-end system map is created - this is called the Current state map(Fig 1.0). A Future state map (Fig 2.0) shows how things should work in order to gain the best competitive advantage and highlights opportunities for improvement. The key to VSM is to see the big picture as a sum of the parts.

VSM Case study: Waste water in the Tannery [3]

Operation	Quantity(m3)
Soaking	9.0-12.0
Liming	4.0-6.0
Deliming	1.5-2.0
Pickling	1.0-1.5
Chrome Tanning	1.0-2.0
Neutralization	1.0-1.5
Wet finishing	1.0-2.0
Washings	11.5-13.0

Table 1.0 Quantity of wastewater discharged

Leather processing involves pre-tanning, tanning, post tanning and finishing processes. Pre tanning steps are designed to clean the skin collagen from unwanted materials and prepare them for tanning; tanning stabilizes the protein against putrefaction and finally incorporation of an aesthetic appeal is the objective of post- tanning and finishing. With mounting pressures from the environmental agencies, the need to contain the discharge of toxic substances as well as to dramatically reduce the biochemical oxygen demand (BOD), chemical oxygen demand (COD) and total dissolved solids (TDS) is being felt in recent years. To maintain quality of ground water, cleaner technological options to contain the pollutants as well as to minimize the usage of water in processing are becoming essential. Quantity of wastewater discharged for processing 1T of skin/hide in a traditional operation is listed below in Table 1.0. Characteristics of wastewater is listed in Table 2.0. Table 3.0 lists Water consumption before and after VSM.

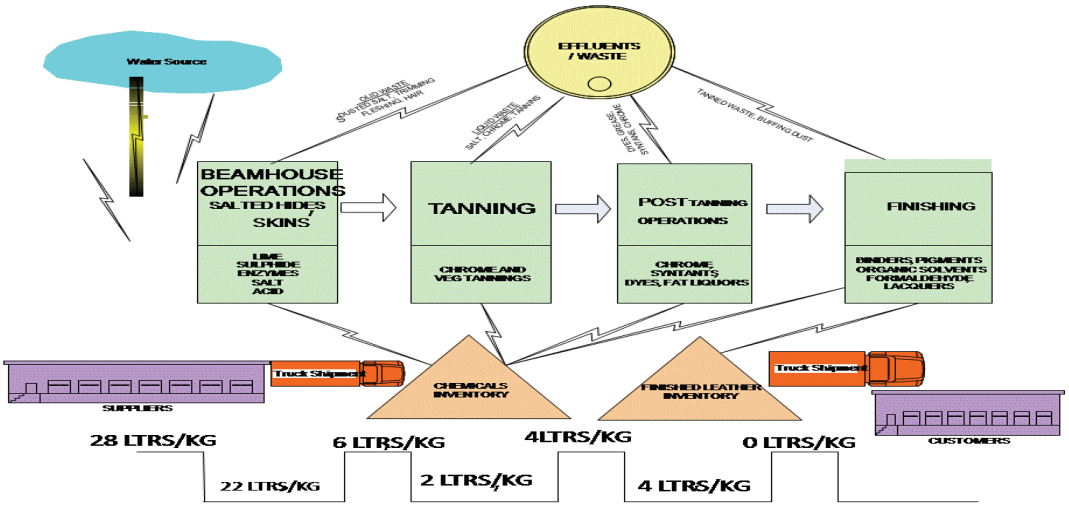

Figure 1.0 Current state of Map

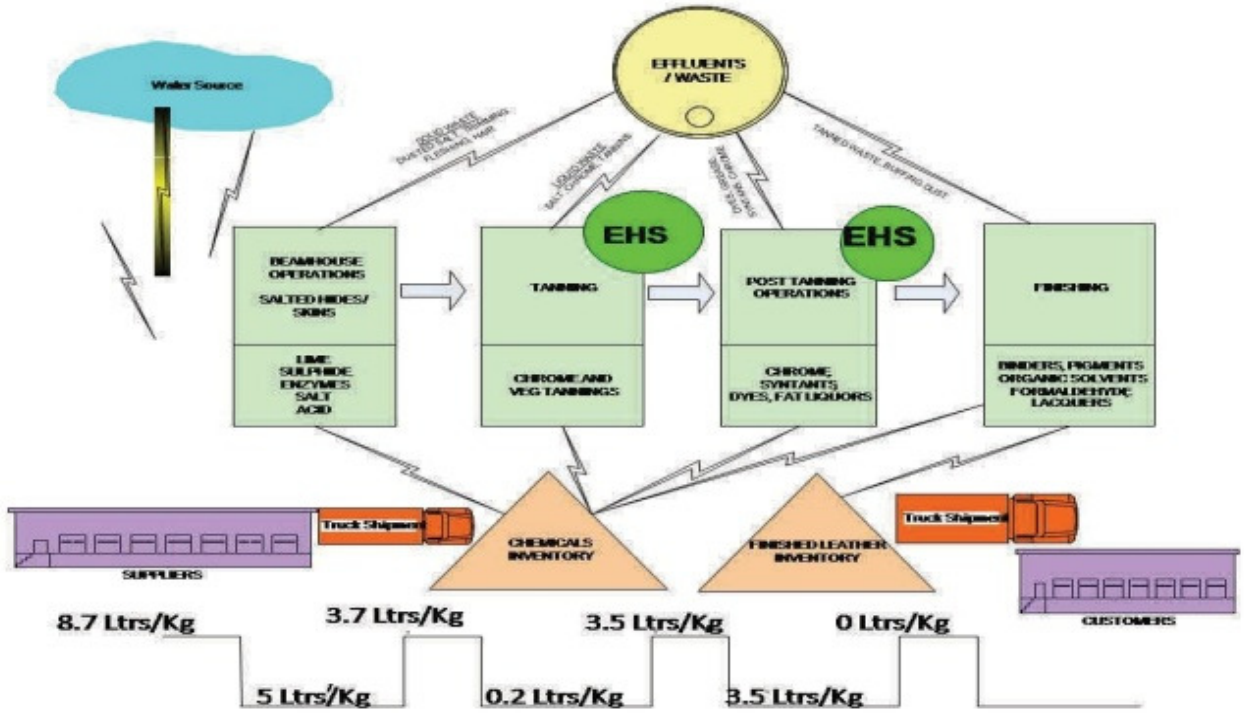

Fig 2.0 Future State of Map

Parameter	Soaking	Liming	Deliming	Pickling	Chrome Tanning	Dyeing and fat liquoring	Composite (incl. Washing)
pH	7.5-8.0	10.0-12.8	7.0-9.0	2.0-3.0	2.5-3.0	3.5-4.5	7.0-9.0
BOD	1100-2500	5000-10,000	1000-3000	400-700	350-800	1000-2000	1000-3000
COD	3000-6000	10000-25000	2500-7000	1000-3000	1000-2500	2500-7000	2500-8000
Total Solids	25000-40000	25000-35000	3000-8000	30000-70000	25000-60000	3000-8000	15000-25000
Dissolved solids	22000-33000	20000-33000	1500-4000	29000-67000	24000-57500	2400-7000	13000-21000
Suspended solids	3000-7000	5000-10,000	1500-4000	1000-3000	1000-2500	600-1000	2000-4000
Chloride as Cl-	15000-30000	4000-8000	1000-2000	20000-30000	15000-25000	500-1000	6000-9500
Total Chromium as Cr	---	---	----	----	2000-5000	40-100	100-250

Table 2.0 Characteristics of Tannery waste water

Process	Conventional(kL)	Advanced	%of reduction
Soaking	12.0	4.7	61
Liming	6.0	3.6	40
Reliming		0.84	86
Deliming	1.5	0.2	87
Pickling&	1.8	0.21	88
Chrome Tannin washing	7.5	3.5	53
Total			
Without	21.3	8.71	59
With washing	28.8	12.21	58

Table 3.0 Water consumption before and after VSM
(Water consumption for 1 t raw hides/skins processed to tanned leather).

The results show a reduction in the chemical and water usage and savings in the production cost.

The observations are:

- An increasing recognition that end-of-pipe treatment, in isolation is not an adequate strategy to meet the requirements of wastewater norms and standards.
- Strategies for pollution prevention and control need to integrate cleaner process options with the better water management practices.
- The volume of effluent has a direct bearing on the cost of end-pipe treatment.
- The reuse of spent solutions after removal of the unwanted materials forms an integral part of in process control strategy.

The ideal approach is to target the zero or near zero discharge of waste liquors. The progressive adoption of cleaner technologies by the tanners depends on the following factors: a) Proven reduction of emission loads in terms of quantity and quality; b) quantifiable economic benefits to tanners through quality improvement, cost reduction and material saving; c) ease of application with minimum additional investments hardware and d) trade advantages on account of improved environmental positioning in the global market.

The quantity of chemicals was reduced by 40% through the application of advanced technologies. This resulted in cost saving of US$31 for processing 1 t of raw hides. Closed loop pickle tanning has lead to savings of US$30, due to savings in post tanning chemicals.

6. Supply Chain Management

Supply chain management (SCM) promotes the integration between companies and their suppliers through the development of supplier partnerships and strategic alliances. Therefore, the set of practices selected to manage the relationships with suppliers, named by up- stream supply chain (SC) practices, is a critical issue, since it affects companies and overall SC performance. The growth of industrial activity in leather sector has increased demand –pull for raw hides and skins. The supply of raw hides and skins however is related to the demand for meat and meat products on the one hand and extent of recovery of fallen animals on the other. Since the primary producer of raw hides and skins sourced from Indian live stock is weakly coupled to the tanning industry, inadequate attention of raw hides and skins management could cause loss of quality or raw materials. Typically Indian tanning industry invests about Rs 80 billion annually on raw hides and skins. It is estimated that about 800,000 people are involved in collection of raw hides and skins. The supply chain involves a large number of traders and middle men. An integration of meat handling leather sector could well ensure a better and equitable sharing of economic benefits from the animal breeders, people engaged in meat handling and tanners systems with leather sector could well ensure a better and equitable sharing of economic benefits from the animal breeders, people engaged in meat handling and tanners. This helps the human development within the community.

Animal has formed an important renewable resource in the synthesizing of the rural economy. The chain involved in livestock holding is more complex in India compared to what is obtaining in the industrial countries. The typical system [4] used for trading is represented in Figure 3.0. The transportation route of animals is shown in Fig 4.0.

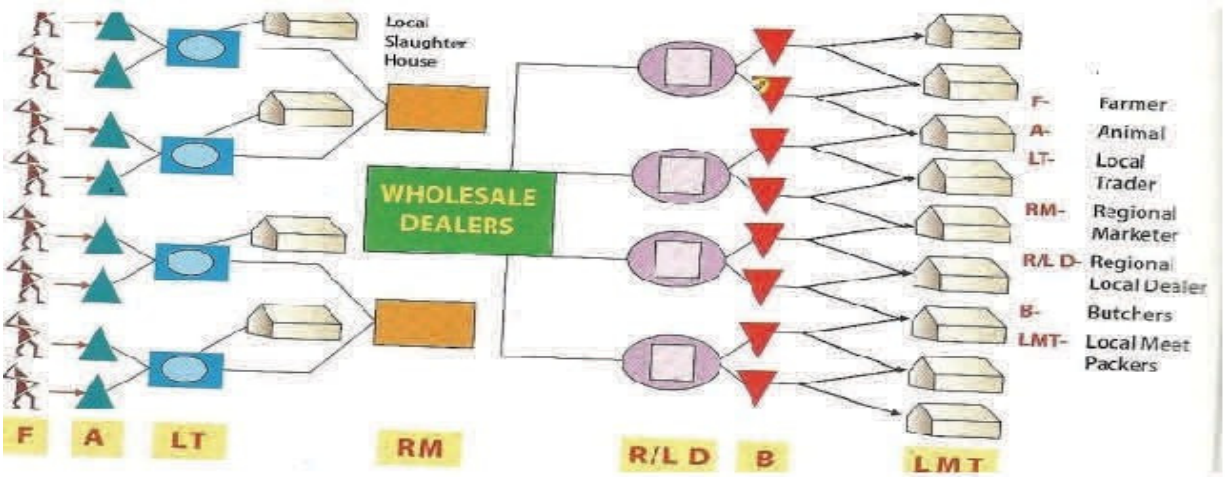

Fig 3.0 SCM in transporting animals to slaughter

SCM system is connected with enterprises on other nodes of the supply chain through Internet/Intranet. The system exchanges information with upstream suppliers through EOS (Electronic Ordering System) to realize pull type stock control on the upstream.

It exchanges information with downstream retailers through DPR (Distribution Resource Planning) system to realize the drive-type stock control on the down- stream. Through this system, clients can check the goods in the warehouse, on the way and receiving status at any time, any place conveniently, at real time and correctly, and carry out online settlement. Conformity on capital flow, materials flow and information flow has been emphasized on the design characteristics of the system to highly integrate information of enterprises on upstream and downstream so as to form smooth SCM mode.

7. Green Supply Chain Management (GSCM)

Green SCM is getting more attention as a sustainable development mode for modern enterprises and is increasingly a part of Corporate Social Responsibility (CSR) initiatives. Green supply chain best practices are align green supply chain goals with business goals, evaluate the supply chain as a single life cycle system, Use green supply chain as a catalyst for innovation, focus on source reduction to reduce waste.

Green management system comprises of environ- mental management systems (ISO 14001 certified), Green waste reduction techniques comprising of process , product redesign, reduce, ,remanufacturing, that leads to good business results in terms of costs, lead times, quality, market position, reputation. Information technology can enable reduction in resources usage while executing business processes.

Fig 4.0 Transport route of Animals

The GSCM = Green purchasing + Green manufacturing/materials management + Green Distribution / marketing + Reverse logistics.

8. Chemical Leasing (ChL)

UNIDO defines “Chemical leasing is a service-oriented business model that shifts the focus from increasing sales volume of chemicals, toward a value-added approach”. The producer mainly sells the functions performed by the chemical, and functional units are the main basis for payment. Within chemical leasing business models, the responsibility of the producer and service provider is extended and may include the management of the entire life cycle.

9. Conclusion

Leather Processing is an important activity in many developing countries. The process involved in making of leather remains traditional in many developing countries which resulted high environmental impact. Chemical Inputs into leather sector have to be thoroughly assessed for Life Cycle Analysis. Disposal of unused leather products may pose challenges in future. Any sustainable development of the industrial sector like leather with global market is no longer limited only to technical and economic issues. Environmental economics as well as health and safety play vital role in greener economy. Process audit for eco-acceptance of chemicals employed in Indian leather sector is an essential step.

Lean and green improves business results. A model that integrates the two into one comprehensive program focused on reduction of all wastes (those targeted by Lean systems and those targeted by Green systems) can be the most effective and efficient path to long- term organizational sustainability. In Future the distinctions between Lean and Green systems will end and Zero Waste Manufacturing will emerge as a new holistic manufacturing system. Elimination of all forms of waste is the new vision. Synergy is realized as aggressive efforts are put to reduce waste results in continuous efficiency, quality, service and environmental improvements.

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