Chapter 24
A Locational Decision Making Framework for Shipbreaking Under Multiple Criteria

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ABSTRACT

The decision making process for shipbreaking is complicated and is dependent on multiple factors. However, due to the vastly unorganized nature of shipbreaking industry in major shipbreaking locations, there is little work done to the best of the authors' knowledge, wherein these factors are mapped, weighed and integrated in the form of a comprehensive decision making framework. In recent years, although there have been significant efforts by researchers to capture the process of shipbreaking and recycling in literature, a comprehensive decision support system that encapsulates the multiple criteria for shipbreaking in a quantifiable form, is yet to be developed. This paper attempts to bridge this gap, by formulating a decision making framework, particularly for selecting the shipbreaking facility and the extent of recycling subsequent to ship disassembly, using AHP methodology. The framework considers the relevant factors, and is useful not only for shipping companies and cash brokers for decision making, but also provides insights vis-à-vis the migrating pattern of shipbreaking industry, particularly from Indian subcontinent to China, as observed in the contemporary business environment.

INTRODUCTION

Shipbreaking is a multi-billion dollar industry, flourishing largely in the developing Asian countries; particularly in India, Bangladesh, China and Pakistan (UNCTAD, 2012). The industry gained the attention of environmental activists, regulators, researchers and media during the recent years; environmental impact due to shipbreaking and dangerous working conditions for laborers in the shipbreaking yards of the third world, being the visible symptoms that raised the alarm, placing the industry in focus. With

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the subsequent microscopic scrutiny that followed, there have been several studies on shipbreaking and ship recycling activities around the world, with special attention on yards in the Indian Subcontinent, i.e. Alang-Sosiya Ship Recycling Yard (Gujarat, India) and Chittagong Ship Breaking Yard (Bangladesh), which accounted for the bulk of global shipbreaking in the last two decades. Due to the largely unexplored nature of the shipbreaking industry, most of the pilot research studies conducted in recent years, are predominantly qualitative in nature, concentrating on process mapping (Asolekar, 2006, 2012; Demaria, 2010; Hiremath et al., 2015; Hossain & Islam, 2006; Hossain et al., 2010; Pelsy, 2008; Sivaprasad, 2010; Thomas 2007; Upadhyay 2002); with few studies on social & environmental impact assessment (Islam & Hossain, 1986; Pathak, 1997; Reddy et al., 2003, 2004a, 2005a 2005b; Sonak et al., 2008), and developing methodological frameworks for shipbreaking industry (Carvalho et al., 2009; Huang, 2010). A taxonomic listing of relevant research papers on shipbreaking is represented in Table 1.

Table 1. Taxonomic listing of research papers and articles on shipbreaking and recycling

Classification	Author (Year)	Notes	Study Location
Qualitative	Anderson (2001)	Worker safety in ship breaking	-
	Asolekar (2006)	Solid Waste generation during shipbreaking	Alang (India)
	Asolekar (2012)	Greening of Shipbreaking – Facility Upgrade	Alang (India)
	Demaria (2010)	Economics of waste disposal in shipbreaking	Alang (India)
	Dev (2010)	Prospects for sound ship recycling	South Asia
	Gökdeniz et al. (2008)	Shipbreaking: Health & Environmental issues	Turkey
	Hiremath et al. (2015)	Significant steps in ship waste recycling	Alang (India)
	Sonak et al. (2008)	Implications of shipping hazardous wastes	South Asia
	Hossain & Islam (2006)	Impact of shipbreaking on coastal zones	Chittagong
	Hossain et al. (2010)	Recent Status of Shipbreaking & Prospects	Bangladesh
	Sivaprasad (2010)	Best practices for sustainable ship-breaking	-
	Upadhyay (2002)	Problems & Prospects of Shipbreaking	Alang (India)
	Xiangli (2007)	Environmental protection during shipbreaking	-
Quantitative	Mikelis (2007)	Statistical overview of ship recycling	-
	Reddy et al. (2003)	Quantitative assessment of ship-scrap waste	Alang (India)
	Reddy et al. (2004a)	Assessment of energy potential of solid waste	Alang (India)
	Reddy et al. (2004b)	Heavy metal concentration in coastal sediment	Alang (India)
	Reddy et al. (2005b)	Combustible waste: energy content modeling	Alang (India)
	Reddy et al. (2005b)	Study of contamination levels in coastal water	Alang (India)
	Pathak (1997)	Impact of shipbreaking on water sediments	Alang (India)
	Tewari et al. (2001)	Effect of waste from ship scrapping industry on biomass production and biodiversity	Alang (India)
Case Studies	Thomas (2007)	French Aircraft carrier "Le Clemenceau"	Alang (India)
	Pelsy (2008)	Cruise Liner "Blue Lady"	Alang (India)
Methodology	Carvalho et al. (2009)	Method for environmental impact modelling	Portugal
	Huang (2010)	Treatment methods for polychlorinated biphenyls (PCBs) in ship recycling facilities	China
	Deshpande et al. (2012)	To estimate heavy metal exposure to workers	Alang (India)
	Deshpande et al. (2013)	To develop emission factors for pollutants	Alang (India)
Other / Misc.	Dimakopoulos (2005)	Design for Environment / Remanufacture	-
	Shama (2005)	Life Cycle Assessment of Ships	-
	Endresen et al. (2008)	Environmental impacts of increased shipping	-
	Sundelin (2008)	Scope to improve IMO's Convention (draft)	-
	Hayman et al. (2010)	Technologies to reduce environmental emissions from ships during its life cycle	-
	Mikelis (2009)	Effectiveness of IMO's recycling regulations	-