Vol. XIV & Issue No. 05 May - 2021
INDUSTRIAL ENGINEERING JOURNAL

CURRENT TRENDS IN SUPPLY CHAIN MANAGEMENT OF SHIPBUILDING IN INDIA – AN OVERVIEW

M. Jaison

Abstract

Indian shipbuilding industry has made considerable progress over the years and continues to provide compelling reasons for further infusion of energy and resources specifically aimed to realise its full potential. The Covid-19 pandemic and the renewed thrust for self-reliance has necessitated a deeper examination of the shipbuilding industry for suitable policy interventions. This study undertaken to examine the current trends of supply chain management in shipbuilding in India is based on primary data obtained from selected shipyards of the Indian shipbuilding industry. The main contribution of this study is in identifying the current status of important drivers in supply chain management of shipbuilding in India. Based on the study of current status of supply chain management of Indian shipbuilding and important imperatives for achieving AtmaNirbhar Bharat, focus areas for policy initiatives for realising the shipbuilding industry's potential were identified, which are particularly relevant in the current scenario of increased global preference and advantage for India, which is a positive consequence of the Corona Pandemic. This study will help policy makers to frame suitable policies, in the identified focus areas, based on successful policies implemented in the IT sector in India and oversee their implementation on mission mode. This study is among the first to examine the current status of supply chain management of commercial shipbuilding in India, based on primary data obtained from selected shipyards in India, from the perspective of drivers of supply chain management viz. the logistic drivers -facilities, inventory and transportation and the cross-functional drivers – sourcing, information and pricing. This article does not discuss warship building, warship repair or warship recycling.

Keywords: Atma Nirbhar Bharat, Shipping, Shipbuilding, Ship Repair, Ship Recycling, Supply Chain Management (SCM), Shipyards in India, Drivers of SCM.

1. INTRODUCTION

India's national fleet carries only 9.7% of India's Export-Import (EXIM) trade and around 59% of domestic coastal cargo, as in Financial Year 2019 [1]. All of the balance is carried by foreign ships, which simply walk away with the freight (business) tax free. Reference [1], also argues that the situation can be reversed by bringing all these EXIM cargo on to ships owned by Indian Companies. The directive by the Ministry of shipping to all major ports to procure or charter tug boats made in India, as part of Atma Nirbhar Bharat [2], intended to help promote shipbuilding in India is an enabling policy initiative of the Government to foster the shipbuilding industry.

It is also learnt that the Government could make domestically manufactured barges mandatory for coastal and inland waterways movement, as part of the plan to promote the ship building industry in India [3], a decision reportedly being mooted as part of the shipping ministry's exercise to formulate the Maritime Vision 2030.

As brought out in the Government of India Report [4], the Indian shipbuilding industry has distinct advantages of an abundant coastline close to international sea routes and low manpower cost. India's shipbuilding capabilities, however, still need to catch up with its economic development, market demand and human resource potential [4].

As per the Manufacturing Plan [5], Indian Shipbuilding and Ship Repair are amongst sectors of strategic importance, where greater focus is required to increase indigenization in production.

Supply Chain Management refers to the entire process from sourcing of raw materials to the delivery of the final product to the customer. It is defined as the systematic, strategic co-ordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain, as a whole [6]. Supply Chain Management encompasses all the traditional business functions, such as Logistics, Operations, Financing and Marketing.

According to Chopra and Meindl [7], the objective of every supply chain is to maximise the supply chain surplus. The supply chain surplus (also called supply chain profit) is the difference between the revenue generated from the customer/s and the overall costs across the supply chain. The supply chain strategy determines the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operations to provide the service, and distribution of the product to the customer, along with any follow-up service and a specification of whether these processes will be performed in-house or outsourced.

In the above background, a study was undertaken with primary data obtained from four shipyards in India, to examine the current trends in supply chain management (SCM) of shipbuilding in India, along with its subsector of ship repairs. This study will be useful in formulating policy initiatives for development of shipbuilding, ship repair and ship recycling in India, based on the current status of SCM of shipbuilding in India, and the imperatives of the Post Covid-19 Pandemic scenario for self-reliance in the shipbuilding industry.

The shipbuilding industry, in the context described here, includes the ship repair and the ship recycling industries, which are considered as subsectors of the shipbuilding industry. The scope of discussions here excludes warship building, repair and recycling.

2. METHOD USED FOR THE STUDY

At present, Indian shipbuilding is mainly based on 27 shipyards, comprising of 8 Public Sector shipyards and 19 Private Sector shipyards [4]. For the purpose of this study Private Sector Shipyards were divided into two categories of Large and Medium & Small shipyards, depending on their capacities, as listed in the Government of India Report [4]. To examine the current trends in SCM of shipbuilding in India, information pertaining to various aspects of supply chain management of shipbuilding in India was obtained from four shipyards (One Public Sector Shipyard, one Large Private Sector Shipyard and two Medium & Small private sector shipyards), primarily by means of a questionnaire.

Theory of SCM stipulates that the three logistic drivers -facilities, inventory and transportation and the three cross-functional drivers – sourcing, information and pricing, determine the performance of any supply chain. The performance of a supply chain can be measured by means of the efficiency and responsiveness of the supply chain, both of which contribute to the supply chain surplus. Supply chain efficiency is the inverse of the cost of making and delivering a product to the customer. Increases in cost lower the efficiency. Supply chain responsiveness includes a supply chain's ability to: respond to a wide range of quantities demanded, meet short lead times, handle a large variety of products, build highly innovative products, meet a high service level and handle supply uncertainty. Responsiveness, however, comes at a cost. For instance, to respond to a wider range of quantities demanded, capacity must be increased, which increases costs. Given the trade-off between efficiency and responsiveness, a key strategic choice for any supply chain is the level of responsiveness; it seeks to provide [7].

A detailed examination of the growth of the South Korean shipbuilding industry, presented in Reference [8], showed that the approach adopted for growth and the progress achieved fitted the SCM paradigm and that depending on the strengths and weaknesses of the various drivers of SCM, the shipyard/s, with given conditions, adopted certain SCM Adaptations. For instance, outsourcing of design is one such adaptation in the Indian context. These SCM adaptations naturally mediate in the influence of the various drivers of SCM on efficiency and also similarly mediate in the influence of the various drivers of SCM on responsiveness of the supply chain. Growth in efficiency and/ or responsiveness would result in greater shipbuilding supply chain surplus.

The questionnaire focussed on the various drivers of SCM, viz. Facilities, Inventory, Transportation, Information, Sourcing and Pricing. The questionnaire also probed the Supply Chain Management Adaptations, used by the shipyards, with the aim of maximising the efficiency and responsiveness, for greater shipbuilding supply chain surplus.

The shipyards selected for the study, by means of the purposive sampling adopted, were Cochin Shipyard Limited (**CSL**) (A Public Sector Shipyard), Larsen & Toubro Shipbuilding Limited (**L&T**) (A Large Private Sector Shipyard), Dempo Shipbuilding and Engineering Pvt. Ltd. (**Dempo**) and Chowgule and Company Pvt. Ltd. (Shipbuilding Division) (**Chowgule**) (Two shipyards among Medium & Small Private Sector shipyards). Personal interviews with executives at the shipyards and telephonic discussions were also conducted to obtain current data and clarifications. Secondary data available from the shipyards' web sites, annual reports ([9] to [11]) and publications, as available in the open domain, were also used for the study.

3. RESULTS OBTAINED

Certain specific aspects of the operational and technical profiles of the shipyards were obtained through the questionnaire. Secondary data available in the open domain through Annual Reports and websites of the respective shipyards were also utilised. Major shipbuilding facilities at the shipyards surveyed are tabulated in Table 1

Table 1 (a) Major Shipbuilding Facilities-Physical Infrastructure

S. No.	Dry Docks/ Slipways/ Ship Lifts	Crane Capacity	Draft
1.	**CSL**		
	Repair Dock – 270X45X12 m (1,25,000 DWT) Dock No: 2 – 255X43X9 m (1,10,000 DWT) 3 Quays 280 m long 208 m long 460 m long	40T 300T 15T 10T 20T	 10 m

S. No.	Dry Docks/ Slipways/ Ship Lifts	Crane Capacity	Draft
2.	**L&T**		
	20000 DWT 160 m side launching slipway (Hazira) 21050 T Ship Lift 200X46 m, (Kattupalli) Quay 200 m long	15 T 42T	10 m 10 m
3.	**Dempo**		
	Slipway 120X 20 m (Up to 82 m long vessel with 2.20 m draft), Side Launching Bays 110 m and 80 m (Up to 125 m long vessel) 2 Dry Docks 90X 18 m	Mobile Cranes 8 to 75 T	2.25 m
4.	**Chowgule**		
	Slipway 220 m (Loutulim) Side Launching Bay 123 m (Rassaim) Shiplift 7655 Tons (Lavgan) 6 Dry berths (150 m long) 260 m Quay	70T 60T 200 T	3.3 m 7.0 m

Table 1 (b) Major Commercial Shipbuilding Facilities-Shipyard Capabilities

S. .No	Shipyard	Max Capacity of Commercial Vessel that can be built ((DWT	Rate of Steel Fabrication for Shipbuilding [Tons/ [Day	Rate of Steel Fabrication for Ship [Repair [Tons/ Day	Rate of Surface Preparation [Sqm/ [Day	Design Capability [Length of vessel [in m
.1	CSL	*110000	100	10	600	100
.2	L&T	21050	50	5	150	50
.3	Dempo	10000	20	5	100	30
.4	Chowgule	5000	20	5	100	30

*- A 310mX75/60m Dry Dock being built by CSL [12] would increase this capacity to about 200000 **Dead Weight Tons (DWT)**

Details of recent Commercial shipbuilding/ ship repair projects are tabulated in Table 2

Table 2 (a) Recent Commercial Shipbuilding Projects

.S. No	Major Commercial Shipbuilding Projects in Hand/ Completed after 2010	Source of Con-cept Design	Source of majori-ty of equipment (By Value)
1	**CSL**		
	DWT - 500 PAX Cum 150T MT Cargo Vessels for Andaman & Nicobar Administration 1125 ((02 Vessels	Outsourced	Imported
	(DWT Ro-Pax Vessels for NW1 and NW2 for IWAI (08 Vessels 80	**In-house**	Imported

.S. No	Major Commercial Shipbuilding Projects in Hand/ Completed after 2010	Source of Concept Design	Source of majority of equipment (By Value)
	50T DWT - Tuna Long Liner Cum Gillnetter Fishing Vessels for Dept of Fisheries Tamil (Nadu (16 Vessels	**In-house**	**Indigenous**
	8000T DWT – Mini Bulk Carriers for Utkarsh Advisory Services Pvt. Ltd. (JSW Group) (4 (Vessels	Outsourced	**Indigenous** -Being at-tempted
	(Pax Cum 1000 MT Cargo Vessels for Andaman & Nicobar Administration (2 Vessels 1200	Outsourced	Imported
	(DWT – 100 Pax Hybrid Catamarans for Kochi Metro (23 Vessels 90	**In-house**	Imported
	(DWT Ro-Pax Vessels for NW3 for IWAI (2 Vessels 400	**In-house**	Imported
.2	**L&T**		
	(Heavy Lift Ship (1 Vessel	Outsourced	Imported
	(MP Heavy Lift Ro Ro Semi Submersible (03 Vessels	Outsourced	Imported
	(m Platform Supply Vessels (06 Vessels 80	Outsourced	Imported
	(T BP AHTSV (02 Vessels 90	Outsourced	Imported
	(T BP AHTSV (02 Vessels 150	Outsourced	Imported
.3	**Dempo**		
	((Pax Passenger Vessel (16.82 (L)X5.00(B)X1.40(T 30	Outsourced	Imported
	((Multi Utility Vessel (18.5(L)X7.00(B)X2.25(T	Outsourced	Imported
	((DWT Utility Vessel (46.75(L)X9.50(B)X2.60(T 440	Outsourced	Imported
	((DWT Self Propelled Grab Hopper Dredger (57.00(L)X12.00(B)X3.00(T 1200	Outsourced	Imported
	((DWT Iron Ore Carrier (72.00(L)X14.00(B)X3.00(T 2100	Outsourced	Imported
	((DWT Heavy Duty Crane Barge (60.00(L)X24.00(B)X3.40(T 3014	Outsourced	Imported
.4	**Chowgule**		

	DWT Ice Class General Cargo Vessel (98.20(L)X13.40(B)X7.80(D)) for Wunne and 4220 .(Basends, Netherlands (06 Vessels	Outsourced	Imported
	DWT General Cargo Vessel (79.79(L)X15.40(B)X7.80(D)) for Shree Krishna Steve- 2650 .(dores Pvt Ltd. (01Vessel	Outsourced	Imported
	TEU Container Feeder Vessel (RS-IV) (67.20(L)X13.30(B)X4.20(D)) (02 Vessels) for 106 .Indian Customers	Outsourced	Imported
	DWT Multi-Purpose General Cargo Vessel (89.95(L)X14.40(B)X7.85(D)) (12 Vessels). 4450 .For customers abroad	Outsourced	Imported
	DWT Multi-Purpose General Cargo Vessel (101.15(L)X14.40(B)X7.85(D)) (03 Ves- 5650 .sels). For customers abroad	Outsourced	Imported

Table 2 (b) Major Commercial Ship Repair Projects

S. No.	Shipyard	Numbers of Major Commercial Ship Repair Projects in Hand/ Completed after 2015
1.	CSL	07
2.	L&T	01
3.	Dempo	10
4.	Chowgule	25

The methods used by the above shipyards for sourcing steel and equipment for the above projects, as reported by the shipyards are tabulated in Table 3.

Table 3 Methods of sourcing steel and equipment

S. No.	Shipyard	Method of sourcing steel	Method of sourcing equipment
1.	CSL	Ship specific indents on supplier on Open Tender Basis	Ship specific indents on supplier on Open Tender Basis
2.	L&T	Ship specific indents on supplier on Open Tender Basis	Ship specific indents on supplier on Open Tender Basis and Nomination of equipment by owner
3.	Dempo	Ship specific indents on supplier on Open Tender Basis	Ship specific indents on supplier on Open Tender Basis
4.	Chowgule	Ship specific indents on supplier on Open Tender Basis	Ship specific indents on supplier on Open Tender Basis

Average lead times for procurement from imported and indigenous sources for major components for shipbuilding are tabulated in Table 4.

Table 4 (a) Average Lead Times for Procurement of Major Components for Shipbuilding – Imported

S. No.	Material/ Equipment	Average Lead Time [Months]			
		CSL	L&T	Dempo	Chowgule
1.	Steel	4	4	7	7
2.	Main Engines	8	7	9	9
3.	Gear Boxes	8	7	9	8
4.	Shafting	10	10	9	9
5.	Propellers	6	6	9	9
6.	Generators	6	6	7	7
7.	Switchboards	#	5	4	4
8.	Steering Gear	6	6	9	9
9.	Large Pumps	5	5	5	5
10.	Deck Cranes	6	6	9	9
11.	Davits	6	5	6	6
12.	Main Valves	4	4	5	5
13.	HVAC Equip- ment	6	6	9	8

Table 4 (b) Average Lead Times for Procurement of Major Components for Shipbuilding - Indigenous

S. No.	Material/ Equipment	Average Lead Time [Months]			
		CSL	L&T	Dempo	Chowgule
1.	Steel	3	#	#	#
2.	Main Engines	8	#	#	#
3.	Gear Boxes	6	#	#	#
4.	Shafting	8	#	#	#
5.	Propellers	4	#	#	#
6.	Generators	4	#	#	#
7.	Switchboards	5	#	#	#
8.	Steering Gear	4	#	#	#
9.	Large Pumps	#	#	#	#
10.	Deck Cranes	6	#	#	#
11.	Davits	5	#	#	#
12.	Main Valves	4	#	#	#
13.	HVAC Equip- ment	6	#	#	#

- Indicates that procurements were not made in the recent past through this route for commercial ships built by the yard.

Source of design in percentages for shipbuilding projects in hand/ completed after 2010 are tabulated in Table 5.

Table 5 Source of Design for Commercial Shipbuilding Projects in Hand/ Completed after 2010

S. No.	Shipyard	Percentage of Indigenously designed commercial shipbuilding projects	Reason for sourcing designs from abroad
1.	CSL	57%	Owner wanted a proven design sourced from abroad as indicated in the RFP
2.	L&T	Nil	Owner wanted a proven design sourced from abroad as indicated in the RFP
3.	Dempo	Nil	Owner wanted a proven design sourced from abroad as indicated in the RFP
4.	Chowgule	Nil	Owner wanted a proven design sourced from abroad as indicated in the RFP

Based on inputs received from the shipyards, it was observed that a computerised Warehousing Management System Linked to ERP system is used for management of inventory by all the shipyards.

4. CURRENT STATUS OF SUPPLY CHAIN MANAGEMENT OF SHIPBUILDING IN INDIA

Based on the study carried out the current status of supply chain management of shipbuilding in India was examined under the various drivers of SCM and is presented in subsequent paragraphs.

4.1 Facilities: Facilities at Indian Shipyards, examined under the various parameters shown in Table 1, are moderate in nature. It is opined that the current available facilities, coupled with infrastructure developments in progress and the various initiatives taken to effectively utilise existing facilities, can meet the recommended targets of achieving 5% of the global shipbuilding market and 10% of the global ship repair market, originally set for 2020 in the Manufacturing Plan [5], by 2025. It is pertinent to mention that South Korea has 24 dry docks with lengths above 500 metres, commensurate with global leadership in shipbuilding [13].

4.2 Inventory: It is a matter of concern to note that imported steel is used for majority of the commercial shipbuilding and ship repair in India. Shipbuilding quality steel, though available in India, is not commercially competitive with imported steel. Similar is the case with majority of equipment, which are required to be imported to be installed in ships built/ replaced in ships repaired. These aspects reduce the competitiveness of shipbuilding/ ship repair in India.

4.3 Transportation: The current available capacity for transportation of pre-fabricated/ pre-outfitted blocks by means of higher capacity cranes/ transporters etc. are moderate in Indian shipyards and are commensurate with set targets for shipbuilding and ship repair in the Manufacturing Plan [5], with target date revised to 2025.

4.4 Information: Computerised warehousing management system is currently in use at all shipyards surveyed. The penetration of enabling technologies for Industry 4.0, relevant to manufacturing and supply chain, such as Radio Frequency Identification (RFID), Internet of Things (IoT), Cloud Computing (CC)/ Cloud Manufacturing, Big Data Analysis (BDA), Block Chain etc. [14] is low at present.

4.5 Sourcing: Large majority of concept designs for commercial shipbuilding is outsourced by the shipyards in India. It is encouraging to note that shipyards have taken up enhancing their design capabilities and are taking up concept designs of small ships themselves. CSL was observed to be a front runner in this, taking up concept designs for small ships manufactured by them. As also seen from Tables 4, majority of steel and equipment for commercial shipbuilding are sourced from abroad.

4.6 Pricing: Difficulty in producing good quality shipbuilding steel at internationally competitive prices is a problem to be overcome by India, to increase the competitiveness of shipbuilding in India. Overcoming the necessity to import concept designs and majority of equipment for commercial ships built in India is to be pursued vigorously, as once these constraints are overcome, it can deliver considerable advantages in pricing of commercial ships built in India. Ship repair, which is widely acknowledged to have a large untapped potential in India, would be similarly positively impacted by availability of indigenous steel and equipment for replacement for ships under repair in India. The above feat once achieved would result in profound increase in competitiveness of shipbuilding and ship repair in India.

5. DISCUSSION

The Covid Pandemic provided further urgency and impetus to serious introspection on self reliance, as evidenced by a host of recent policy measures adopted by the Government of India. The directive by the Ministry of shipping to all major ports to procure or charter tug boats made in India, as part of Atma Nirbhar Bharat [2], intended to help promote shipbuilding in India is an example. The directives also address the need to short list around five variants/ types of tugs and prepare an 'Approved Standardised Tug Design Specifications (ASTDS)'. It is heartening to note that the ASTDS would outline specifications; general arrangements, basic calculations, basic structural drawings, key system drawings and other construction standards etc, which post 'approval in principle' by Indian Register of Shipping (IRS) will be published by the Indian Ports Association on its website, thereby addressing the issue of indigenous design for the tugs also, in the above directives.

It is also learnt that the Government could make domestically manufactured barges mandatory for coastal and inland waterways movement, as part of the plan to promote the ship building industry in India [3]. A lead time of one to two years is likely to be given before implementation of the rule and the

decision is reportedly being mooted as part of the shipping ministry's exercise, among other such measures, to formulate the Maritime Vision 2030.

The list of 101 Defence Items that India announced that it will stop importing in a bid to achieve total indigenisation includes Multi Purpose Vessels, Offshore Patrol Vessels, Next Generation Missile Vessels, Anti-Submarine Warfare Shallow Water Crafts, Ammunition Barges, 50 Ton Bollard Pull Tugs, Survey Vessels, Floating Dock, Diving Support Vessels , Pollution Control Vessels, 500 Ton Self Propelled Water Barges; with indicative embargo date of December 2020; and Conventional Submarines with an indicative embargo date of December 2021. The impact of the total list is estimated to result in placement of contracts upon the domestic industry, worth almost Rupees 4 trillion, in the next 6 to 7 years [16]. A substantial part of the above investment is expected to boost the domestic shipbuilding industry and associated ancillary industries.

The commercial shipbuilding projects and commercial ship repair projects with the shipyards surveyed leave considerable room for greater exploitation of available capacities at the shipyards.

The importance of the shipbuilding industry extends well beyond the shipyards themselves, with around 70% of the value of commercial shipbuilding typically being in the supply chain, benefitting steel and equipment manufacturers. The diversified high economic value of commercial shipbuilding has been utilised as part of national economic development strategies in Japan, South Korea and, most recently China [17].

It is interesting to note that the Country Program 2018-2022 for India, steered in consonance with the United Nations Industrial Development Organisation (UNIDO) focuses on the four key result areas, namely (i) productive and resilient MSMEs, (ii) solutions for climatic resources and environment, (iii) inclusive and responsible value chains and (iv) strategic policy for industrial transformation [18].

While the National Association of Software and Services Companies (NASSCOM) provided considerable support to the successful development of IT industry and sustenance of its growth in India, such an organisation of stake holders in ship building, ship repair and ship recycling needs to be formed and nurtured, to form inclusive and responsible value chains and for providing suitable policy inputs for fostering the growth of the industry and sustaining its competitive advantage.

All the above point to the need for making the best of the present opportunity and putting the shipbuilding and ship repair industry on a sure footing, for AtmaNirbhar Shipbuilding and AtmaNirbhar Shipping in India.

6. CONCLUSION

Based on the analysis of current trends in supply chain management of shipbuilding in India, considering the various initiatives set in motion in the shipping and shipbuilding sectors, as part of the AtmaNirbhar Bharat mission (which appear to acknowledge the enormous potential of the shipbuilding industry, along with untapped potential of its subsectors of ship repair and ship recycling in India) and the renewed impetus the current World Health, International Market and Security scenario demands for self-reliance, the following focus areas are identified for future policy initiatives for leveraging the potential of shipbuilding and ship repair industry in India: -

a) Set up an empowered body to steer the commercial shipbuilding, ship repair industry and ship recycling industry, as part of the national economic development strategy, with its mandate extending over major inputs to commercial shipbuilding and ship repair, such as steel, indigenous ship design and mechanical & electrical equipment fitted onboard ships. The body is recommended to be tasked with identification of interventions required and implement corrective measures, on mission mode, for fostering commercial shipbuilding, ship repair and ship recycling industry in India. It is suggested that such a body could be named Shipbuilding, Ship Repair and Ship Recycling Research and Technology Mission of India (SHIP-RTMI) (similar to the Steel Research and Technology Mission of India (SRTMI)).

b) Adopt urgent and suitable measures to facilitate availability of shipbuilding steel in India, at internationally competitive prices. While the National Steel Policy 2017 [15] recognizes the multiplier effect of steel on GDP and employment, and is an effort to enhance steel production, with a focus on high value and value added steels, it is opined that there is a need to examine feasibility for faster progress in the direction, administered by SRMTI, to ensure early availability of shipbuilding steel in India at internationally competitive prices.

c) Progressively bring all EXIM cargoes to ships built in India/ Indian Shipping companies.

d) Incentivize indigenous development of all equipment to be installed on new commercial ships/ replaced on existing ships during ship repairs, with a wide technical support for operations, at all ports of call for Indian commercial ships, under a carefully planned AtmaNirbhar Ship Equipment Programme, to progressively achieve total self-reliance in manufacture and maintenance of mechanical and electrical equipment for ships.

e) The empowered body, recommended to be set up, to steer the shipbuilding, ship repair industry and ship recycling industry in India, is also recommended to be assigned the task of identifying research areas and facilitating speedy implementation of: -

(i) Infusion of advanced shipbuilding, ship repair and ship recycling technologies for commercial shipbuilding in India, for increased productivity in each of the above areas, with due attention to sustainability.

(ii) Building up and sustaining self reliance in commercial ship design in India, by progressively removing existing hurdles, which preclude the development of this strategic capability, for commercial shipbuilding in India.

Warship building, warship repair and warship recycling are not

covered in this article, except for brief reference to the report on the list of 101 Defence Items that the country announced that it would stop importing, in a bid to achieve total indigenisation, which includes warships.

An in-depth study of the reasons for inability to use indigenous designs for large commercial ships in India is a recommended area for future research. Similarly a detailed study of the reasons for slow development of the ancillary industries for mechanical and electrical equipment, for installation in new ships and replacement for ships in repair, although considerable development in the automotive sector was achieved in the recent past, is another area of recommended future research.

7. ACKNOWLEDGEMENTS

I take this opportunity to thank my guide Prof (Dr) Kemthose P Paul and mentor Prof (Dr) CK Madhusoodhanan at the Research Centre at Sree Narayana Gurukulam College of Engineering (SNGCE) Kadayirippu, affiliated to the School of Management and Entrepreneurship (SME), KUFOS. I thank Prof. (Dr) V Ambilikumar, Director and all faculty, staff and fellow research scholars at SME, KUFOS for their support.

8. REFERENCES

[1] *Ghanekar, R (2020) 'Towards a Larger Indian Shipping Industry'. Viewed on 04 April 20. <https://www.orfonline.org/expert-speak/towards-a-larger-indian-shipping-industry- 63662/>*

[2] *PIB Delhi (2020). 'A step towards bolstering the revival of Indian Shipbuilding and a big move towards AtmaNirbhar Shipping and AtmaNirbhar Bharat: Shri Mandaviya'. Viewed on 04 September 20. <https://www.pib.gov.in/PressReleasePage.aspx?PRID1651276>*

[3] *Saluja, N (2020). 'Govt could make locally manufactured barges mandatory for coastal and inland waterways movement'. Viewed on 07 September 20. <https://www.economictimes.com/industry/transportation/shipping/transport/articleshow/77976687.cms>*

[4] *Government of India, Ministry of Shipping Road Transport and Highways Report (2007). Report of Working Group for Shipbuilding and Ship repair Industry for the Eleventh Five Year Plan (2007 – 2012), pp 4-65.*

[5] *Government of India, Planning Commission (2011). The National Manufacturing Plan: Strategies for accelerating growth of manufacturing in India in the 12th Five Year Plan and beyond, pp 126-140*

[6] *Mentzer, JT (2004) Fundamentals of Supply Chain Management – Twelve Drivers of Competitive Advantage, Sage Publications, California.*

[7] *Chopra, S. and Meindl, P. (2007), Supply Chain Management – Strategy, Planning & Operation, 3rd edn, Dorling Kindersley (India) Private Limited, New Delhi, pp. 60-82.*

[8] *Mc Wiggins, D.P. (2013), Sunrise in the East, Sunset in the West: How the Korean and British Shipbuilding Industries changed places in the 20th Century. PhD thesis. University of Texas at Austin.*

[9] *Cochin Shipyard Annual Report 2018-19. 47th Annual Report. Accessed on 04 Apr 20. <https://www.cochinshipyard.com/annual-report>*

[10] *Cochin Shipyard Annual Report 2017-18. 46th Annual Report. Accessed on 05 Apr 20. <https://www.cochinshipyard.com/annual-report>*

[11] *Cochin Shipyard Annual Report 2016-17. 45th Annual Report. Accessed on 06 Apr 20. <https://www.cochinshipyard.com/annual-report>*

[12] *Anandan, S (2018). 'Work Afoot to Turn Kochi into a Maritime Hub'. The Hindu, 29 October, p. 2.*

[13] *Clarksons Research, World Shipyard Monitor (2017), vol 24, No 12, p. 22.*

[14] *Raut, R.D., Gotmare, A., Narkhede, B.E., Govindarajan, U.H., Bokade, S.U. (2020). Enabling Technologies for Industry 4.0 manufacturing and supply chain: concepts, current status and adoption challenges. IEEE Transactions on Engineering Management (EMR), DOI 10.1109/EMR 2020.2987884*

[15] *Gazette of India: Extraordinary – Ministry of Steel (Establishment Division) Notification, New Delhi, 8th May 2017, National Steel Policy 2017 (GSR 452 (E)).*

[16] *Swarajyamag (2020). 'Here is the list of 101 Defence Items that India announced it will stop importing in a bid to achieve total indigenization'. Viewed on 10 August 20. <https://www.swarajyamag.com/insta/here-is-the-list-of-101-defence-items-that-India-announced-it-will- stop-importing-in-a-bid-to-achieve-total-indigenisation>*

[17] *Stott, P. (2017). Competition and subsidy in commercial shipbuilding, PhD thesis. Newcastle University.*

[18] *Government of India, Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade. Annual Report – 2019 -20, p. 58. <https://www. dipp.gov.in/sites/default/files/annualReport_English2019-20.pdf>*

AUTHOR

M.Jaison, B Tech (Naval Architecture & Shipbuilding), DIIT (NC), MBA (OR) Research Scholar, School of Management & Entrepreneurship, KUFOS, Panangad PO, Kochi -682506. Email address: jaisonsaya@yahoo.com, Mobile - 8447880180