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HOW DOES CHINA BUILD ITS WARSHIPS AT A FRACTION OF OUR COST?

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This article seeks to examine some key facets of the Shipbuilding Industry of China. No two countries are similar. However, when a neighbouring nation transforms its defence industrial complex and shifts it to high gear, it is time to sit up, take notes, do introspection and identify aspects any practices that we can incorporate into our own industry.

Let us start by examining if the statement made in the title of this article is factually correct. Shipbuilding costs are inextricably linked to scale. The scale at which naval ships are being built in China is mindboggling. This is apparent from the under-mentioned facts.

- **Aircraft Carriers.** China's yet to be named first indigenously built aircraft carrier (Type 001A) went to sea for her maiden sortie on 13 May 2018. From its keel-laying on 10 Mar 2015 at the New Dalian Shipyard of the China Shipbuilding Industry Corporation (CSIC), to the first sailing, the time elapsed is three years and two months. This is the shortest time post World War Two taken by any nation in the world to build an aircraft carrier. China has achieved this in their first iteration of a home grown carrier.

- **Type 55 Destroyer.** Save the U.S. Zumwalt Class for which the programme has been curtailed to three ships due to exorbitant cost escalation, the Type 55 at an estimated 12,500 to 13,000 tons is the largest destroyer in

the world. China launched two of these platforms simultaneously from the Dalian Shipyard on 02 Jul 2018. If one were to include the two launched earlier at the Jiangnan Changxing (JNCX) yard at Shanghai, a total of four have been launched within precisely one year and four days. And this is a brand new class of warship!

- **Type 54A Frigate.** The 30th Jiangkai II class of frigate was launched from the Huangpu Wenchong shipyard at Guangzhou on 30th June 2018. On an average, China has been launching one of these 4000 ton frigates every four months and ten days.

- **Type 56A Corvette.** The 45th and 46th hull of the 1400 ton Jiangdao Class corvette were launched in March 2018. China has been launching these vessels at a drumbeat of one every six weeks!

The list goes on. Since the beginning of 2018 up to the 15th of July, China has launched no less than 16 warships. These include one Luzhou Class (Type 071) Landing Platform Dock (LPD), three Renhai Class (Type 55) destroyers, one modified Luyang III Class (Type 52D+) destroyer, one Jiangkai II Class (Type 54A) frigate, five Jiangdao Class (Type 056A) corvettes, one Type 815A SIGINT ship, two Type 639A hydrographic research catamarans, one Type 837 ocean going tug and one Type 901 replenishment ship.

Analysing the Budget

How does China accomplish this? Are they expending enormous amounts of money in doing so? While there is little information in the open domain, let us attempt to do some number crunching based on figures available. China publishes a single figure pertaining to its defence spending. This is put up to the National People's Congress (NPC) for approval every March as part of the annual state budget. Countries measure their defence budget in different ways; including some expenses while excluding others. SIPRI undertakes the task of rationalising published figures to arrive at a common datum enabling an apples-to-apples comparison. In the case of China, the SIPRI estimate for the 2017 defence budget has been pegged at U.S. $ 228 Billion, a mark up of nearly 50% over the official figure of U.S. $ 151 Billion. For India, the corresponding figure is U.S. $ 63.9 Billion. It may thus be seen that China outspends us 3.6 times on defence.

What proportion of its budget does the PLA devote to capital spending? A substantial amount of research has been done on this and the figure that resonates with most scholars lies between 25 and 30 percent of the overall defence budget. This is not very different from our 2017-18 figures where a capital budget of 86,488 crores (U.S. $ 13.3 billion) amounted to 20.8% of the 63.9 Billion dollar SIPRI estimated budget. It is logical that the share of capital spending for China would be higher than ours as even though the PLA manpower is roughly one and a half times that of the Indian armed forces, its budget exceeds ours by a factor of 3.6. Let us conservatively go for the lower end of the band and settle for an estimate of 25% of the defence budget that the PLA spends on capital. For 2017, this would amount to 57 billion dollars.

The next question that one confronts is that what proportion of this capital budget goes to the PLA Navy. Insofar as we are concerned, for the year 2017-18, the Navy's share of 18,749 crores (U.S. $ 2.9 billion) amounted to 21.7% of the capital budget. With respect to China, some scholars have expounded numbers based on a simple formula wherein a four way split is made between the three services and the Rocket Force (with which the newly formed Strategic Support Force is clubbed). Using this approximation, the PLA Navy capital budget for 2017 may be estimated to be 14.25 billion dollars.

Quantification of the Differential in Shipbuilding Costs

In the year 2017, China launched 23 ships and commissioned 15. The corresponding figures for the Indian Navy are three and two respectively, discounting minor war vessels such as FACs and LCUs. It has already been mentioned earlier that till 15th July of the current year, The PLAN has launched 16 ships. The total number of launches for 2018 is therefore likely to exceed 25. Based on a comparison between the differential in capital allocation and the differential in asset creation, it becomes abundantly clear that the ability of China to convert capital into assets is far superior to ours.

An exact quantification of this attribute is difficult to establish due lack of transparency but we could use a few pointers. The *Diplomat* carried out a detailed analysis of the cost of a Jiangkai II Class frigate in 2015. The estimated cost that they arrived at came to U.S. $ 348 Million.[1] This figure compares well with the price of one billion dollars reportedly quoted to Thailand for three Jiangkai II class frigates in 2013. More recently, it has been stated that the four Jiangkai II ships ordered by Pakistani would set it back by U.S. $ 1.4 billion. How does this stack up against us? The contract value for the seven ships Project 17A is Rs 48,238.91 crores.[2] This amounts to about one billion dollars per ship – three times the cost of a Jiangkai II while being about 60% larger in displacement terms. Coming to another comparison: The price of the 1400 ton Type 56A Jiangdao class corvette has been reported to be 700 million Yuan (approx U.S. $ 100 million). Our four-ship Kamorta Class programme has cost us Rs 7852.39 crores thereby putting the cost of each ship at about 300 million dollars.[3] While acknowledging that the displacement of a Kamorta is nearly two and a half times that of the Type 54A, from an armament viewpoint, the Type 54A with its HHQ 10 SAM and YJ 83 SSM, scores high. Trying to build some objectivity into what are essentially subjective comparisons (as no two classes of ships are identical) one could conservatively say that the cost of warship construction in China, ton-for-ton is no more than half our cost. Thus while the capital budget of the PLAN is probably four to five times ours, their ability to generate assets is nine to ten times that prevailing here.

Analysing the Reasons Behind Cost Efficiency

How does China achieve this? It's tempting to brush this issue under the carpet by stating that an authoritarian regime has to contend with far fewer imponderables. Higher directives are implicitly complied with thereby compressing timelines and increasing efficiency. This, however, is based on a flawed assumption on the nation that China is today. With low unemployment and high demand for skilled labour, it is no longer feasible for industry, State Owned Enterprises (SOEs) inclusive, to run rough-shod over their employees. Aspirations of workers in terms of compensation and quality of life have to be met. Further, no amount of arm twisting by high-handed state officials can circumvent technological bottlenecks. China has obviously made major strides in their ability to construct large combatants in a time-bound and cost effective manner. How have they managed to do so? A deeper analysis of their military ship building industry throws up some interesting inferences that could explain this phenomenon.

- **Concurrent Construction.** Unlike most nations in the world, practically all Chinese shipyards are engaged in concurrent construction of civil and military ships. So much so, it is not unusual to see men-of-war and commercial vessels being fabricated simultaneously in the same dry-dock. This is probably a fall out of the sanctions regime wherein access to western technology was restricted to commercial vessels. Concurrent construction allowed easy diffusion of dual use technology from civil to military projects. Adoption of such an

approach also has strategic benefits in that it allows for a smooth surge in naval production should the need so arise.There are also, however, strong economic reasons for doing so. These are: -

- **Balancing of Boom and Bust Cycles.** Shipping as we know is a cyclic industry that mirrors the undulations of global growth patterns. Producing a mix of commercial and military vessels allows a yard to shift emphasis between the two, so as to dampen the crests and troughs of the commercial shipping industry's cyclic nature. This leads to better utilization of infrastructure and consequently lowers the cost of overheads.

- **Culture of Efficiency.** Commercial shipbuilding is a high risk venture as non-adherence to time lines could result in customers walking away from contracts by cashing-in on their bank guarantees. Survival in such an environment breeds a culture of discipline and efficiency that permeates to all projects being executed by the yard. China has done exceptionally well in executing commercial orders. According to data released by the British shipbuilding analysis agency Clarkson Research Services, in 2017, China took the first place in the three primary indices measuring the development and capacity of a country's shipbuilding industry: the completion of ships, new orders, and volume of holding orders.

- **Advanced Ship Production Methods.** There are several spheres in this industry where cutting edge innovation takes place in the commercial space. These have potential applications in military shipbuilding. Examples would be modular construction of vessels and adoption of Integrated Electric Propulsion (IEP).

- **Taut Timelines.** This is the single most important factor for keeping cost growth in check. China takes an average of two and a half to three years to make a frigate/destroyer sized vessel. The average for us is seven to eight years. How does this impact cost?

  - **Cost of Capital.** The cost of capital is high in India (roughly 4% more than China). In the first three years of construction, the differential cost of capital deployed would be at the rate of 4% per annum. At this stage of the analysis, China already has its ship built while we continue with construction. Therefore, for the next four to five years, the differential in cost of capital rises to about 8% p.a. (a conservative estimate of the cost of raising capital in India). If these figures were to be compounded over the period mentioned above, we would approach a net differential of nearly 65% (on the first stage payment and declining thereafter) on capital alone! What's more, the cost of unscheduled delays often tends to get glossed over because no one is accounting for the opportunity cost of payments made. If these were to be factored in, the differential would be even higher.

- **Yard Productivity.** This is directly related to sound management practices. While recent figures are not available in the open domain, archival data indicates that while Mazagaon Docks Ltd took 10.8 million man-hours to build a Godavari Class frigate, the average labour used by a U.S. yard to build a Perry Class frigate (of roughly the same dimensions) was 2.5 million man-hours.[4] This is a sordid testimony to the state of our yards. While things may have improved in the recent past, there is still a long and arduous journey ahead in this respect.

- **Yard Overheads.** The clock for yard overheads never stops. These get added on year on year irrespective of yard productivity. In short, the longer the programme, the greater the overheads in what is clearly a linear relationship.

➢ **Amalgamation of Shipyards into Large Conglomerates.** I have dealt with this subject in depth in a recently published paper (CENJOWS Synodos Paper, Vol VII, No. 15/Jul 2018). China consolidated all its government owned shipyards under one State Owned Enterprise (SOE), the China State Shipbuilding Corporation (CSSC) in 1982. On 01 July 1999, under a State Council initiative, the Chinese government split the top five Defence and Technology Corporations into ten new enterprises. The China Shipbuilding Industry Corporation (CSIC) was thus carved out of the China State Shipbuilding Corporation (CSSC) and both remain large SOEs today. There is, however, currently an ongoing debate on merging these two entities once again.[5] Each of these entities is colossal in size. CSIC for instance consists of five listed platform companies and 84 second-level units, comprising 54 second-level enterprises, 28 research institutes and 18 overseas institutions engaged in an extraordinarily wide spectrum of marine related work. Amalgamation of these units under a single holding company has brought about the following advantages: -

- **Optimization of Loading through Pooling of Resources.** Having a large number of production facilities answerable to a single holding company permits rationalization of allocated work so as to ensure optimal utilization of infrastructure and labour. Similarly overheads are curtailed by the pooling of technical and human resources. Duplication of expensive pieces of equipment with unique, though limited use, is avoided through sourcing all such requirements from a common facility.

- **Unimpeded Diffusion of Skills and Best Practices.** Lessons learnt and best practices garnered are seamlessly transferred from one facility to the next. This greatly contributes to shortening the learning curve associated with new programmes. It comes particularly useful when more than one yard is engaged in the production of the same class of ship. In our case, for instance, it is a well known fact that GRSE had to relearn several lessons pertaining to the Brahmaputra Class programme at considerable cost. This was inevitable in the manner in which we are

structured as MDL, which executed the almost identical Godavari Class programme, back-pedalled furiously when it came to sharing experiences as they viewed GRSE as a commercial competitor.

- **Standardization and Creation of a Robust Vendor Base.** Single point sourcing allows standardization of equipment across different classes of ships. This not only streamlines logistics but also reduces the training burden. The consequent larger order quantities results in the creation of a robust and reliable vendor base that are receptive to making the necessary investments to meet demand.

- **High Indigenisation.** Most sources quote indigenisation levels in PLA Navy ships as above 90%. Corresponding figures for us are woefully short. The report of the Parliament's Standing Committee on Defence for the year 2017 mentions that the import content for the Project 17 Shivalik Class as 48% and that for the 15A Kolkata Class as 43%.[6] Goods produced in developing countries are intrinsically cheaper as currencies tend to be undervalued. The World Bank approaches this problem by using a Purchasing Power Parity (PPP) matrix that takes into consideration the cost of a standard basket of goods and services to arrive at a more meaningful value of the currency. Going by most recent figures, the Chinese Yuan is undervalued by a factor of 1.87 and the Indian Rupee by 3.65. This advantage will, however, only accrue with genuine indigenisation (as against licensed production) where there is minimal outflow for goods/services to foreign suppliers which perforce have to be priced at market determined exchange rates. Imported products or for that matter, even Indian made products with a high import content, are a double whammy as not only is the pricing in accordance with market determined exchange rates but there is normally also a premium charged over home country rates.

- **Colossal Production Runs.** It has been estimated that if one were to aggregate and the research, development and engineering (RD&E) costs associated with building a new class of ship, it would amount to the cost of one ship. So if a programme is for three ships, in essence you pay for four. As mentioned earlier, the Chinese launched the 45th and 46th iteration of the Jiangdao class simultaneously in March 2018. It is estimated that possibly 80 ships of the class will be finally produced. With respect to the larger Jiangkai II, as the initial order of 30 hulls draws to a close, the slack is being taken up by export orders (four for Pakistan) as well as by using the same hull design for the China Coast Guard (CCG). This not only allows the RD & E costs to be defrayed over a large number of hulls but also caters for greater yard productivity as lessons learnt from previous ships get applied over subsequent hulls in a constantly ascending learning curve.

- **Corporatisation of R & D and Leveraging Academia.** China follows a unique model wherein it has placed its R & D institutes under the production conglomerates. The CSIC for instance has 28 Research Institutes in its fold, each employing several hundred (in some cases even a few thousand) staff. They are engaged in designing equipment ranging from marine nuclear power reactors (Wuhan Second Ship Design and Research Institute,Research Institute No719), Gas Turbines (Harbin Ship Boiler Turbine Research Institute, Research Institute No 703), Diesel Engines (Shanghai Marine Diesel Engine Research Institution, Research Institute No 711) and Acoustic Systems (Hangzhou Institute of Applied Acoustics,Research Institute No 715) to name a few. What's more, as the

production agencies for most of the ship-borne equipment such as Gas Turbines, Marine Diesel Engines, Sonar, Radar etc. are also group companies, there is seamless hand holding between the design and production agency. Several of the Research Institutes are located within University Campuses or in their close vicinity. They have signed MoUs with leading scientific and engineering institutes to tap into their resources. They also have a sprinkling of Naval Officers on their staff to provide the much needed user interface. Under a not so well understood arrangement, CSIC Research Institutes provide cover to the other SOE behemoth, that being CSSC so as to avoid unnecessary duplication. However, should the two SOEs get merged; this process will become even more efficient. The Ministry of Defence through the PLA Academy of Science provides broad policy guidance to the defence related SOEs and even undertakes research in some cutting edge areas. Corporatization of the R & D ensures a high degree of efficiency with a strong emphasis on fielding products in a time bound and cost effective manner. This has undoubtedly been a successful approach as may be gauged by the growing capabilities of Chinese hardware across the entire spectrum of naval warfare.

What can we Learn from the Chinese Model?

There are many things we could learn from the Chinese model of naval shipbuilding. Some of these are enumerated below.

- **Merger of Shipyards and Corporatisation.** As mentioned earlier, this has been dealt with extensively in an earlier paper. It is high time we set up our own equivalent to China's CSIC/CSSC or for that matter, Russia's United Shipbuilding Corporation (USC) with all its consequent advantages. Home grown examples of SAIL and HPCL could also been used as models.
- **Shipyard Efficiency.** This is critical for any notable price reduction. Merger and corporatization would assist this process. Best practices from foreign/ well run domesticyards need to be studied and adopted across the industry.
- **Indigenisation Driven Production.** The indigenous content of our ships has to be raised in a time bound manner. Merger will once again assist this process by raising order quantities and reversing the fragmentation of suppliers. It would encourage the larger players with sound engineering capabilities to make necessary investments to meet the needs of industry. The private sector also needs to be encouraged to enter the weapon and sensor market so as to break PSU monopolies.
- **Reduction in Classes with Long Production Runs.** Production runs need to be increased to defray RD & E costs over a larger number of platforms. Common hull designs to serve multiple requirements could be adopted for doing so. For instance, the corvette, OPV, training ship and hydrographic vessel requirements could be rationalized to enable a common hull form to be used across all these ships. Similarly, coast guard and Indian Naval designs could be amalgamated to cater for longer production runs.
- **Get Shipyards to Invest into R & D in Conjunction with Academia.** The entire burden of Ship Design cannot be left to the Indian Navy. Shipyards have to get into the business of designing their own ships based on broad requirements/specifications given by the Navy. Where this is being done, exsisting capabilities need to get augmented. For doing so, it would

be wise to tap the talent available in educational institutions. For instance, a merged PSU shipbuilding undertaking could set up ship design centres focusing in different fields, in the campuses of IITs. Private players could be encouraged to partake in this process. While corporatization of DRDO yards may not be feasible in our context, corporates setting up parallel centres of excellence in conjunction with academia lies in the realm of the possible. This will also increase the pressure on DRDO as their performance could be benchmarked against these institutes.

Conclusion

In conclusion, it can be seen that there is a lot that we need to do to increase the efficiency of our shipbuilding programmes. For one, we need to rapidly dump our self-congratulatory approach. Recognition of the fact that we are faced with numerous challenges is essential to go down the path of reform. Steps mentioned above could be examined and where feasible adopted. By no means are the recommendations exhaustive. A detailed professional study would undoubtedly add many more bullets to those listed above. Private sector participation is key to the process as their very survival is intertwined with efficiency. Sunk costs in PSUs need to be recognised for what they are – sunk costs! It would be unwise to continue to throw good money over bad without a sound and economically viable strategy in place. Lastly, there needs to be much more agility and dynamism in policy formulation, anchored in nurturing a vibrant industry. Undoubtedly this is an uphill task but very much in the realm of reality. It is time that we put ourselves through an unbiased reality check and there is no better a way to do so than by comparing ourselves with China.

(Endnotes)

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4 Gabriel Collins, Note 1.

5 Lee Hong Liang, 'Merger of CSIC and CSSC may be Completed 'In One Year', *Seatrade Maritime News*, 05 November 2015. http://www.seatrade-maritime.com/news/asia/merger-of-csic-and-cssc-may-be-completed-%E2%80%98in-one-year%E2%80%99.html, accessed on 23 Sep 2017.

6 Ajai Shukla, 'US is India's top Arms supplier; France to fly into the spot this year due to Rafale deal',*Business Standard*, https://www.business-standard.com/article/economy-policy/us-is-india-s-top-arms-supplier-france-to-fly-into-the-spot-this-year-due-to-rafale-deal-117031300009_1.html, 14 March 2017, accessed on 28 Jul 2018.