Value Chain Analysis of Aerospace Cluster in Bengaluru Using Porter's Diamond Model

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Abstract:

The Aerospace industry comprises the largest value chain network as compared to other industries in the world. Densely based on innovation and knowledge sharing, each tier contributes value to components and assembly of parts and services. In this regard, this paper is an attempt to explore the possibility of establishing a local partnership among SMEs in aerospace value chain, particularly in Component Manufacturing segment. This research uses the Content Analysis Method (manual mode) to categorize SMEs into different tiers in Component Manufacturing based on their products and services they manufacture. Major findings indicate that i) value is progressively added by firms in multiple tiers. ii) Coordinated linkages can improve competitive position iii) R&D and Simulation centers increase knowledge spillover and development of ecosystem iv) Vertical integration among SMEs lead to achievement of risk intelligence, make the organization lean and competitive.

Keywords: Value Chain, Aerospace Industry, Component Manufacturing, SMEs, Local Partnership

1. Introduction

In 1985, Michael Porter introduced to the concept of 'Value Chain' in one of his popular work, "Competitive Advantage: Creating and Sustaining Superior Performance". He defined value as the amount; buyers are willing to pay for what a firm provides. Though value chain represents a combination of many general value-added activities, it is specifically the internal activities engaged in inbound logistics, operations, outbound logistics, marketing and sales and serviceof a firmwho transform inputs into outputs and build value at every step. That means, as a concept it represents those activities which add value to the final product directly and support activities (like MIS) that add value indirectly. (1)

In the current era, where complex outsourcing and cluster partnerships are customamong key industries around the globe, value added activities take an all-inclusive perspective. As interdependent firms involve in different integration of resource flows across the networks, they nurture innovation and outlays in new products, processes and services, creating a sustainable competitive advantage in the value chain thereby, besides positioning SMEs as well. Therefore, the objective of a value chain in a network is to augment performance in an industry using the pooled expertise and abilities of the associatesin the chain.

Effective value chain is the galactic center of local partnership. Partner firmsin a value chain cooperate with each other to solve problems, exchange resources and services and coordinate information. (2)

2. Aerospace Industry in India

The Aerospace industry is densely oriented on high technology which manufactures aircraft, space vehicles, aircraft engines, propulsion units, and related parts. Its value chain is typified by anextensive project life cycle spanning R&D, engineering design, manufacturing, assembly, maintenance, repair, and overhaul.

The Aerospace industry in India is on a trajectory of high-growth. At present, India is 9th largest civil aviation market in the world and strives to become 3rd largest by 2020 and largest in the world by 2030. (3)Predominantly, it consists of PSUs which are fostered by Government of India since the time of their inception. HAL was the lone flag bearer of Indian aerospace industry since 1940 (earlier Hindustan Aircraft). Headquartered in Bengaluru, it was the first to manufacture a military aircraft in South Asia. But in the contemporary times, Bengaluru

has emerged as a high-tech cluster of the aerospace industry in India thanks to a burgeoning of aerospace firms, organizations such as research institutions and design centers such as Boeing, Airbus, Mahindra Aerospace, NAL, IISc and ISRO to name a few. All these are supported and promoted by an investor-friendly government and fast-track business approvals through the state level single-window clearance mechanism (for investments greater than Rs.50 Cr) which has made Karnataka a very attractive destination for the aerospace industry. Also, under the Aerospace Policy of Karnataka 2013-2023, 100 percent FDI is permitted under the automatic route for MRO, flying training institutes and technical training institutes. (3)

3. An Analysis of Indian Aerospace Industry through Porter's Diamond Model

The Five Forces Model, also popularly known as Porter's diamond model is an analytical framework which measures industry competitiveness across four dimensions: Factors conditions, strategy structure and rivalry, demand conditions, and related supporting industries. Government andchance factors are catalyst dimensions in the framework.

This section provides a brief description of the various dimensions of Porter's model.

3.1. Factor Conditions: They are benefactions which can be organically found in an environment like minerals, flora, fauna, climate, water or/and in-built like scientific and technical knowledge.

3.2. Strategy, Structure, & Rivalry: They are bound by perspectives which play an immense role in developing competitive advantage through encouraging innovation and upgrading technology.

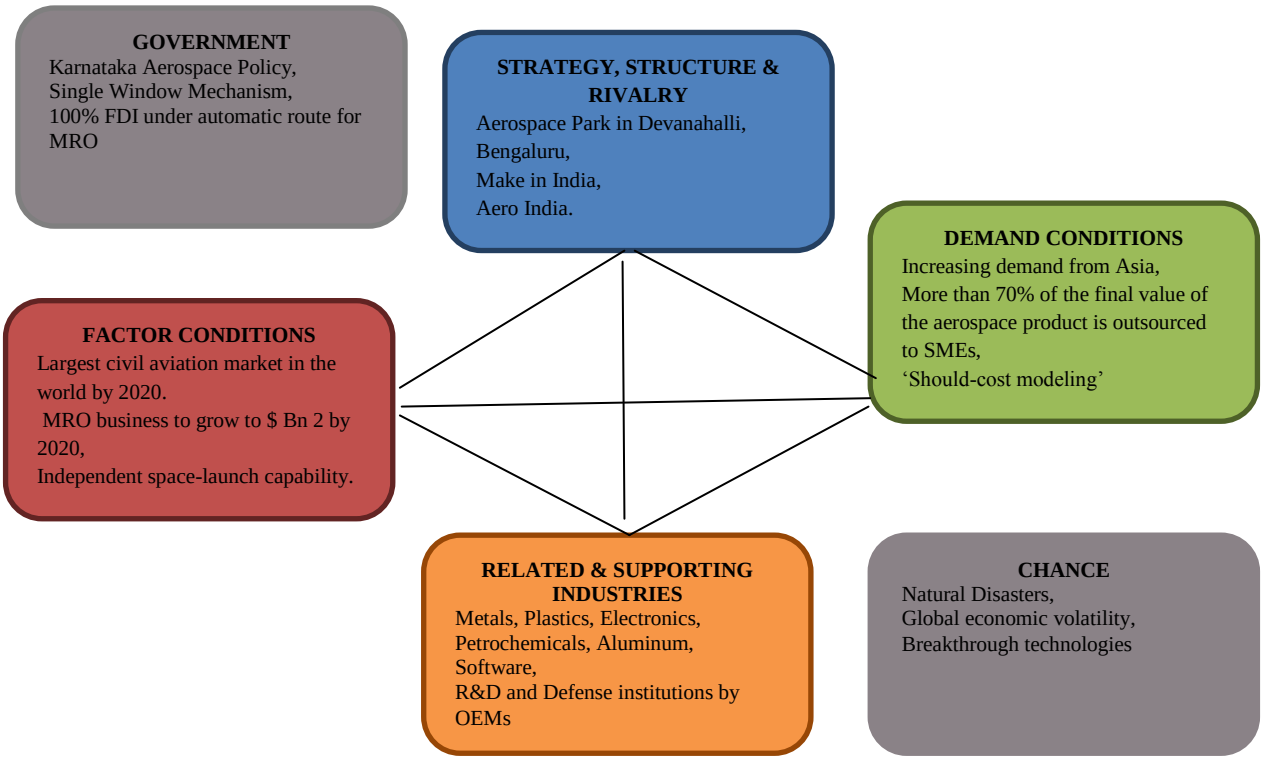
3.3. Demand Conditions: They are a big stimulant and a primary driver of growth particularly in a firm's home country through major attributes, viz, nature of buyer needs, size and growth rate of local demand and expansion of local demand into foreign markets.

3.4. Related & Supporting Industries: Existence of related and supporting industries is crucial to any particular industry's growth since; they can provide "efficient, prompt, rapid, and privileged access to inputs", which are basic to production needs. (4)

3.5. Government: It can influencethese four dimensions of an industry either progressively or adversely through policies and regulations in terms of FDI limit, subsidiary policies, industry-specific regulations on competition and tax procedures.

3.6. Chance: They are those external factors which are uncontrollable (though sometimes predictable) by any industry. Like the government, they can have either a positive or a negative influence on the functioning fabrication of a firm or an industry. They can take place in any phase of the economic cycle or product lifecycle.

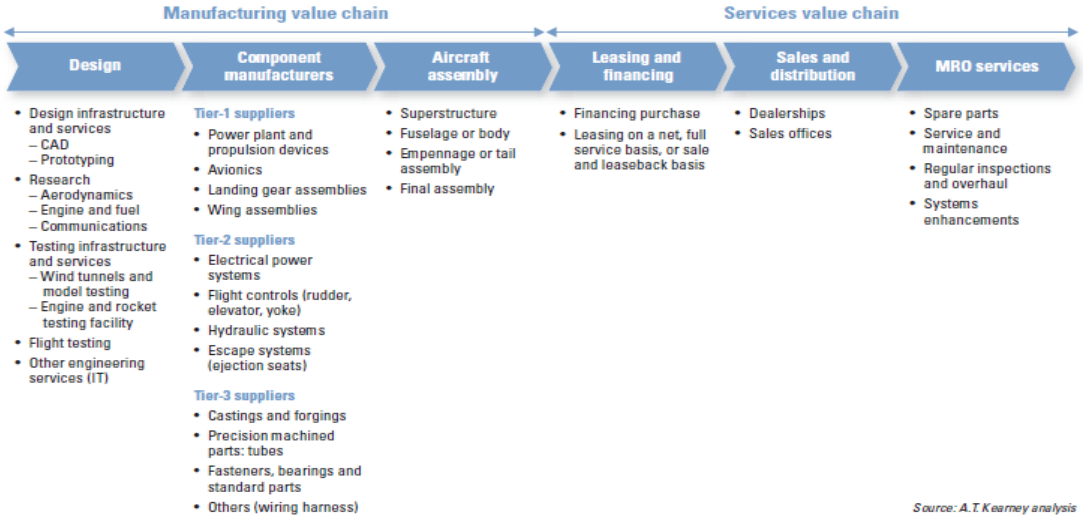
As discussed in earlier paragraphs, Bengaluru is fastly emerging as the aerospace hub of India. Expansion of production and MRO networks, transforming nature of inter-firm mobility and inter-industry relationships, nexuses of large, dynamic OEMs, persistent research orientation of scientific and technological research centers and academic institutions have started an usher of growth in the region. This is also evident in regional output and employment figures which have revealed a sustained growth every year.



Source: Own Compilation

4. Value Chain of Aerospace Industry

The Aerospace industry is one among the leading industries in the world which produce high-technology goods. Evidently, innovation is the crux of the industry.The value chain encompassessegments in the aerospace value chain from design to MRO which enhancethe value of aerospace products/intermediaries/residues plus hardware and software. It also includes design, research, development, and prototyping.



4.1. Category of Tiers

The aerospace industry is extremely dynamic and innovation driven. Its value chain is a long and complex tiered supply structure, due its functionality and compatibility with other

industries like communication, defense, transportation etc. This is also one of the rationales why there are complex barriers for entry in the value chain. Each tier in the value chain performs a designated task of manufacturing and supplying industry-specific components utilized in sub assemblies and is responsible for elevating revenue margins.

The relationship is highly collaborative and largely regulated by OEMs or the prime contractors who fix specifications. These specifications arecentered on design to build model (which are mostly trade secrets rather than patent protected).

The following section carries a brief description of the categories in the aerospace value chain and their relationships with other tiers arepresented. The value chain consists of manufacturing, and service segments. Manufacturing segment includes design, manufacturing and sub-assembly whereas service segment consists of functions like finance and investments, sales and support and MRO facilities.

Design: It is heavily oriented on engineering and R&D process. The idea of design primarily commences from customer demand, configuration and industrial specifications. An aircraft assembly takes at least 5 years to design, build, test and prototype. Research mechanisms like aerodynamics, engine and fuel and communications and prototype testing like wind tunnels and engine testing facilities in confirmwith the requisites like cost, performance, reliability, maintainability, and vulnerability. Transformation towards automation route has enhanced the advancements in precision machine tools and components.

Component Manufacturers: Aerospace industry value chain is segregated into several tires based on value addition. Consequently, the value chain consists of three-tiers functioning at different levels:

Original Equipment Manufacturers (OEMs) consist of manufacturers of aircrafts such as Airbus, Boeing, HAL, Bombardier, Embraer etc. Conventionally, OEMs outline specific requirements onto what Tier 1 suppliers are expected to manufacture.

Tier 1: consist of manufacturers of aero structures, avionics systems, engines etc. They become Large Scale System Integrators (LSSI) by bettering the complication of the modules they are manufacturing.

Tier 2: compromise manufacturers of landing gear, actuator subsystems, and sub-assembly etc.

Tier 3: companies which manufacture components and parts requisite for Tier 1 and Tier 2 suppliers.

One of the noticeable features of Indian aerospace industry is that Bangalore region is the hub for many Tier 2 and 3 SME manufacturers with HAL and NAL being the prime OEMs. Due to offset obligations, the need for airframe manufacturers will arise in future giving opportunities for Tier 2 and 3 industries (by 2020, India is likely to have the potential to service a fleet of 1,000 commercial planes and 500 general aviation aircraft.). Therefore it is of utmost importance that these SMEs increase their capability to realize and practice agglomerations and cluster networks for long-term profitability. (5)

Aircraft Assembly: Consists of manual and semi-automated operations like structural configuration drilling, fabricating and assembling fixtures and components. Fuselage assembly involves riveting/fastening operations which succeed assembly level functions.

Leasing and Financing: Aerospace finance is potentially expensive, but secure due to International regulations like Cape Town Treaty. Though there are predictive returns, it is also risky due to uncertainty in global economy amid rising passenger numbers.Added to this, are the incremental costs like MRO, modification, and customization. Another dominant area which has significant demand is second-hand fleets. It is a risky venture due to an oversupply of aircraft.

Sales and Distribution: This is an important part in the aerospace value chain since it requires a business model to strategically capture the opportunities around the world and

position the parts and product line on commercial and cargo segments in order to better serve the markets anywhere in the world. Most of the sales happen through contractual agreements without question.

MRO Services: Maintenance, Repair, and Overhaul services are aligned with after-sale services. This is an increasing revenue generating segment owing to growth in global aircraft fleets. MRO ingests a substantial part of total cost due to scheduled maintenance and usages.No wonder, airlines often outsource the services to third-party service providers and OEMs based in low-cost geographic locations that involve skilled labor.

5. Position of Value Chain Partners

5.1. Methodology

Using qualitative research method, the following data was mined from Aero India Exhibitors List 2017 held in Bengaluru. Aero India is a biennial air show and aviation exhibition held in Bengaluru at the Yelahanka Air Force Station, organized by the Defence Exhibition Organization, Ministry of Defence. The original list comprehendeda voluminous list of 443 exhibitors who participated in the show from diverse parts of the world. Since the spotlight of this paper is on the value chain of aerospace Industry vis-a-vis Bengaluru, the subject matteris streamlined to Aerospace Component Manufacturers only. The subsequent list was drawn using the manual method of content analysis.

The universe comprises of 'Component Manufacturers' and the unit of analysis is 'Category of Tier'

Sl.No	Company	Value Chain Position	Tier
1	Kaynes Technology India Pvt Ltd	Design and Component Manufacturers	2
2	LCA AF Mk-1	Component Manufacturers	1
3	LCA AF Mk-2 & Propulsion	Component Manufacturers	1
4	M/S Lakshmi Machine Works Limited	Component Manufacturers	3
5	MACH AERO	Component Manufacturers	3
6	MAINI GROUP	Component Manufacturers	2
7	Marposs India Pvt Ltd	Component Manufacturers	3
8	Microwave Tube Research & Development Center (MTRDC)	Component Manufacturers	2
9	NIR OR LTD.	Component Manufacturers	2
10	Paras wires private Limited	Component Manufacturers	2
11	RADIALL INDIA (P) LTD	Component	2

		Manufacturers	
12	Ray-Q interconnection Technologies India Pvt ltd	Component Manufacturers	2
13	RECAERO	Component Manufacturers	3
14	Renishaw Metrology Systems Ltd	Component Manufacturers	3
15	Rotary Electronics Pvt Ltd.,	Component Manufacturers	2
16	SAFT	Component Manufacturers	2
17	SHREE ENGINEERS	Component Manufacturers	3
18	Sansera Engineering Pvt Ltd., Aerospace Division	Component Manufacturers	3
19	SI2 Microsystems Pvt Ltd	Design and Component Manufacturers	1
20	Sikka n Sikka Engineers Pvt. Ltd	Component Manufacturers	3
21	SOURCE TECHNOLOGI	Component Manufacturers	2
22	Speciality Fasteners International	Component Manufacturers	3
23	STEIN SEAL COMPANY.	Component Manufacturers	3
24	Sterling Technologies	Component Manufacturers	2
25	STUMPP SCHUELE AND SOMAPPA SPRINGS PRIVATE LIMITED	Component Manufacturers	3
26	AARJAY INTERNATIONAL PRIVATE LIMITED	Component Manufacturers	2
27	Aequs Private Limited	Component Manufacturers	3
28	Aero Metals Alliance	Design/ Component Manufacturing	3
29	Aeronautical Development Establishment (ADE)	Design/ Component Manufacturing	2
30	Aerocomp Precision Engineering Pvt Ltd	Component Manufacturers	3
31	AerotekSikaAviosystems Pvt. Ltd.	Component Manufacturers	2

32	All Metal Services Ltd	Component Manufacturers	3
33	ANKIT FASTENERS PVT. LTD.,	Component Manufacturers	3
34	APOLLO AEROSPACE COMPONENTS INDIA PVT LTD	Component Manufacturers	3
35	ASB GROUP	Component Manufacturers	2
36	AXISCADES Engineering Technologies Ltd	Design and Component Manufacturers	2
37	BEML LIMITED	Design and Component Manufacturers	2
38	BEVEL GEARS (INDIA) PVT LTD	Component Manufacturers	3
39	Bharat Electronics Limited	Component Manufacturers	2
40	BLISS AEROSPACE COMPONENTS PRIVATE LIMITED	Component Manufacturers	3
41	Captronic Systems	Component Manufacturers	2
42	Centre for Air Borne Systems (CABS)	Component Manufacturers	2
43	CGTech	Design and Component Manufacturers	3
44	CYIENT	Component Manufacturers	2
45	ELKAY ELECTROMECH INDIA PVT LTD	Component Manufacturers	2
46	EMSAC Engineering Pvt. Ltd.	Component Manufacturers	2
47	Enlivening Technologies Private Limited	Component Manufacturers	2
48	FERRA AEROSPACE PVT LTD	Component Manufacturers	2
49	Gardner Aerospace	Component Manufacturers	3
50	GE INDIA INDUSTRIAL PVT. LTD.	Component Manufacturers	2
51	HAPPY LANDINGS INDIA	Component Manufacturers	1

52	HINDUSTAN AERONAUTICS LTD (HAL)	Component Manufacturers	1
53	Wipro Infrastructure Engineering – Aerospace &Defence (Wipro Enterprises (P) Limited Division)	Component Manufacturers	2
54	Veer-O-Metals Pvt Ltd	Component Manufacturers	3
55	UNIVERSAL FLEXIBLES PVT. LTD.	Component Manufacturers	1
56	Unified Electro-Tech Pvt Ltd	Component Manufacturers	2
57	UCAM Pvt. Ltd.	Component Manufacturers	3
58	TW Metals Inc.	Component Manufacturers	3
59	Triveni Turbine Limited	Component Manufacturers	2
60	Thyssenkrupp Aerospace India Pvt Ltd	Component Manufacturers	3
61	Therelek Engineers Pvt Ltd	Component Manufacturers	3
62	Tata Motors Ltd	Component Manufacturers	1

Source: Aero India 2017.

6. Key Trends & Highlights:

Sl.No	Category of Tier	Frequency	Percentage
1	Tier 1	7	11.30
2	Tier 2	29	46.77
3	Tier 3	26	41.93

7. Potential for Local Partnership

Albeit aerospace industry is in existence for over six decades, India has not been able to make a global impact in both military and civil aircraft. Additionally, more than 70% of final aerospaceproducts are outsourced to tier 2 and 3 design and component manufacturers. It means they hold a significant percentage of aerospace exports.

They also share many commonalities like infrastructure, knowledge and innovation, policies and regulations, investments etc. In this milieu, the key trends using the value chain model and segment for the aerospace cluster in Bengaluru present a potential for local partnership, exclusively in tier 2 and 3 categorysections:

1. As components and parts scaleeffectively through different tiers of component manufacturing in the value chain, the value is progressively added and synergistic

interactions like earnings, information, and technical competencetake place among SMEs positioned in multiple tiers.
2. Advancement of coordinated linkages among manufacturers andsuppliers in the value chain further leads to improvement of the competitive position of individual SMEs in the marketplace and drive them towards upmarket profitable prospects. (6)
3. OEMs and LSSIs like Airbus and Boeing have instituted their R&D and simulation centers in Bengaluru. This move intensifies knowledge spillover for SMEs and provides the eco-system for diffusion of technological and market information in short expanse of time. Ex: Toulouse aerospace valley in France (6)
4. Though trade, competitiveness, and competitive position are horizontal in nature, incredible opportunities lie in the vertical integration of SMEs (dominant in the aerospace industry) especially in the areas of realizing risk intelligence and accessing onshore market opportunities. It also drives operations to become lean and competitive.
5. It should be remembered that in the past, companies competed. Now, value chains compete (defined by suppliers linked network) which provide business advantages over isolated competitors like access to more customers, customized support centers and experienced skilled labors. (7)
6. Lastly, local partnerships benefit firms beyond economics and innovation. They also embed start-ups as they encourage robust learning and network with think-tank partners. (8)

8. Discussion and Conclusion

Many static and dynamic components determine the productivity and competitiveness of an industry. According to KPMG's Global Aerospace and Defense Outlook 2016, aerospace and defense industries are intensely competitive and complex including new constraints in certain markets and growth opportunities in others. Either of the circumstances, aerospace industry will need to keenly focus on interoperability and collaborative platforms.

The intention of this paper was to identify and segment SMEs in component manufacturing based on three different tiers using Porter's model. MRO business in the Indian subcontinent is projected to grow from $ 700 million in 2015 to $ 2 billion by 2020. In the light of this report, it should be noticed that SMEs in India have the potential to garner a major share I tier 2 and tier 3 segments of the aerospace value chain. Since value chain embrace risk-sharing manufacturers/suppliers who are involved in co-development and co-production of aerospace components, the idea of developing and enhancing a local partnership holds a relevance as aerospace industry is rapidly moving from being a 'product integrator' to a 'systems integrator' where the responsibility of creating new technologies and innovations are transferred from LSSI to tier network levels in Component Manufacturing systems.

9. Future Research

Bengaluru occupies a strategic advantage of becoming an aerospace hub in the country (9). A localized cluster which comprises tier 2 and 3 component manufacturers in Bengaluru can be a stimulant for an inclusive development of the region's aerospace industry. In this regard, the researcher has taken up an exploratory research to study the geographical proximity and relationship advantages among these firms and benefits that arise from the local partnership.

Abbreviations

- SME: Small and Medium Enterprises
- PSU: Public Sector Undertaking
- ISRO: Indian Space & Research Organization
- MRO: Maintenance, Repair, and Overhaul
- FDI: Foreign Direct Investment
- CII: Confederation of Indian Industries
- HAL: Hindustan Aeronautics Limited
- NAL: National Aerospace Laboratories

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