

Examining the Antecedents of Defence Indigenization for Modernization of Armed Forces in India

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Abstract

When it comes to protecting a nation's sovereignty and national security, the role that the defence industry plays is indispensable. In recent years, there has been an increasing emphasis on indigenization, which refers to the development and manufacturing of military items within the borders of a country. It entails putting in place a robust military industrial base that can both contribute to the nation's overall security and fulfill the requirements of the country's armed forces. The modernization of the armed forces is dependent on acquiring latest military hardware, best served through developing indigenous technology. Given the importance of defence indigenization, this paper tries to examine the antecedents of defence indigenization in India using structural equation modelling. The analysis of the data reveals that government policies and private-public partnership play a vital role in defence indigenization. However, transfer of technology is yet to play a significant role in indigenization. Further, there is a strong relationship between defence indigenization and modernization of armed forces. Defence indigenization can be facilitated by fostering private-public partnerships, enhancing technology transfers, and streamlining government regulations.

Keywords: Defense Indigenization, Private-Public partnerships, Transfer of technology, Self-reliance, Atamirbharta.

1. Introduction

When it comes to protecting a nation's interests and making sure that its citizens are safe, the defense industry is essential. In recent years, there has been an increasing emphasis on indigenization, which refers to the development and manufacturing of military items within the borders of a country. This development and production take place within the country. The goal of indigenization is to increase the level of self-reliance in military manufacture while simultaneously reducing reliance on foreign suppliers. The development of an indigenous defense sector is of critical significance for a nation like India because of the strategic goals it seeks to accomplish, and the security concerns it faces. In recent years, the Indian defense sector has grown, increasing the size of its domestic defense industry a top priority to achieve strategic goals and find solutions to security concerns (Department OF Defense Production, 2011). According to Finance express (2022), the Indian government's goal is to increase the country's level of self-reliance in the manufacturing of defense goods while simultaneously decreasing its dependency on imports. Building a local defense industry that is robust and competitive, on the other hand, presents several problems, including limited infrastructure and a lack of competent labor (Karthikeyan, 2022). Despite these obstacles, the government of India has established several

programs and policies to foster research and development in the field of defense technology and to encourage the manufacturing of defense equipment on a domestic level (Karthikeyan, 2022).

India places a high priority on expanding its domestic defense industry to fulfil the country's strategic goals and address its security issues. The Indian government already spends a significant amount of money on defense, and it is anticipated that this figure would continue to rise. In addition, India has a historical tradition of producing weaponry. Due to the country's relatively small exports, it imports a significant quantity of military systems, with large platforms being the primary focus of this trend (Kumar, 2019). There have been numerous high-level commissions established in order to address the issue of indigenization in the defense industry; nevertheless, very little forward movement has been made in the direction of a workable solution. India's inability to successfully reform its defense industry can be attributed, in part, to the fact that market economics do not apply, that quality, cost, and timeliness cannot all be optimised at the same time, that defense budgets are still subject to cutbacks, that the nature of defense supply chains is shifting, and that policies to maximize technological absorption have been given little attention.

In addition, important actors have their own problems that need to be solved: There are many unrealistic requirements on the quality grounds provided by the "Indian Armed Forces," the "Ministry of Defense" does not have any specialization, the "Ministry of Finance" rejects long-term expenditure, and the political leadership does not have any expertise and is unsure whether it can make decisions due to political perceptions. According to Raghavan (2018), these characteristics make it more difficult for India's robust public defense sector. Demands over the long-term ought to be accurately projected, and there ought to be a level playing field between the public and private actors engaged. It's possible that this will help us get through all these challenges. To further motivate investment, it is vital to have a strategy that ensures regular expenditure on capital. It is imperative that these efforts be taken to ensure India's continued dominance in the defense industry. The defense industry includes a wide range of industries, such as aircraft, land systems, naval systems, electronic systems, and communication systems, among others. The defense sector is confronted with a plethora of obstacles and opportunities in today's world, which is worldwide and undergoing rapid evolution. These challenges and chances are tied to technological breakthroughs, geopolitical dynamics, and economic concerns. The idea of "indigenization" is currently serving as one of the most influential forces on the defense sector.

The procedure of becoming more indigenous is intimately connected to the process of modernizing the armed forces. The term "modernization" refers to the process of enhancing the capabilities, effectiveness, and efficiency of the armed forces through the adoption and integration of newly developed technology, pieces of equipment, and operational concepts. It involves a wide variety of domains, such as the procurement of cutting-edge weapon systems, the modernization of already existing platforms, the enhancement of training and doctrine, the improvement of command-and-control systems, and the development of cutting-edge technologies for use in asymmetric conflict and on future battlefields. Indigenization also provides substantial economic benefits, such as the creation of jobs, the transfer of technologies, and the development of a thriving military industrial base, all of which can contribute to the expansion and innovation of the wider economy. Despite this, the process of indigenizing the military industry is one that is difficult, multi-faceted, and fraught with a variety of obstacles. These obstacles include the need for collaboration between the government, the military sector, and academic institutions to address technology gaps, limited research and development skills, regulatory frameworks, budgetary restrictions, and inadequate infrastructure. Additionally, there are financial constraints and inadequate infrastructure. To be effective in overcoming these hurdles, it is necessary to have an in-depth grasp of the factors, best practices, and tactics that determine successful indigenization.

Trends in indigenization of the defense industry:

A robust military industry also provides diplomatic clout since it increases the likelihood that neighboring countries would turn to that country as a supplier rather than a competition (Lowy Institute, 2018). In addition, exports may help subsidize a country's military budget by keeping the price of new weapons down; in Israel, exports fund a significant chunk of the country's defense R&D efforts. For these reasons and more,

indigenization of a developing nation like India, with its increasing economy, diverse security challenges, and expanding international obligations, investing in the defense sector is an important and worthy national security goal. For a huge country like India, with a developing economy, a broad range of security challenges, and expanding international obligations, investing in the defense sector is an important and worthy national security goal. (Ministry of Finance, 2020). In addition, India has been working toward defense industry self-sufficiency for almost as long as the country has been independent (Chopra, 2016). Despite these obvious first-mover advantages and stated aims, India's capacity to equip its military remains woefully insufficient. Over the past five years, India has been second only to Saudi Arabia in terms of worldwide military hardware purchases (SIPRI, 2019). "Combat, transport, and reconnaissance aircraft; frigates and attack submarines; howitzers and anti-aircraft systems" and so on are only some of the major weapon platforms mostly provided by foreign providers, particularly at higher technological levels. India set a goal of 70% self-sufficiency in 1992, but as of 2011, it was only expected to be self-sufficient in 38.5% of its food needs (Behera, 2013). More so, as compared to China, India's defense exports are minuscule (about 3% of China's). Offshore patrol boats (OPVs) have been the sole major export success in recent years, with sales to Mauritius, Sri Lanka, and other potential destinations.

The essential importance of this topic for national security, economic growth, and technological breakthroughs is the impetus behind the conduct of research on the indigenization of the defense sector and its significance for the modernization of armed forces. This research intends to shed light on the various aspects of indigenization and its implications for the modernization of armed forces by conducting an in-depth examination of the relevant literature, adhering to rigorous research methodology, and conducting an extensive analysis of the available data. This study aims to provide a better understanding of the factors influencing indigenization, identify key success factors, and offer practical recommendations for nations that are looking to enhance their defense industrial base and modernize their armed forces. The study aims to achieve the following objectives:

1. Identifying the antecedents of defense indigenization in India
2. Suggest suitable policy recommendations for promoting self-reliance in defense manufacturing.

2.Review of Literature

Indigenization refers to the capability of designing and producing any type of military hardware within the nation, with the goals of achieving self-sufficiency and reducing the burden of importing goods. Creating an environment conducive to the design, development, and production of various kinds of domestic machinery is a necessary step in this process.

One of the primary goals of the Department of Defense Production is to become self-sufficient in the production of defense-related goods. The Defense Research and Development Organization (DRDO), the Defense Public Sector Undertakings (DPSUs), the Ordnance Factory Board (OFB), and commercial organizations are all contributing significantly to the process of indigenizing the defense industry. Atmanirbharta has received a significant boost across a variety of social strata and geographic regions in our country because of the energizing leadership provided by our current Prime Minister, Narendra Modi. To comply with the same, even in the defense sector, a significant amount of emphasis has been placed on atmanirbharta, which, as of late, has been the central pillar of the Indian government's policy regarding defense production. The atmanirbharta defense relies heavily on indigenization as its primary strategy.

In recent years, the Indian government has placed a strong premium on indigenization in the defense industry to achieve strategic goals and handle security concerns (Bhatnagar & Chand, 2020). This has been done to improve the country's overall level of security. The goal is to develop a powerful domestic defense industry that can meet the needs of the country's military while simultaneously decreasing dependency on imports.

There are many different forces at work in India that are driving the localization of the defense industry. First, it is vital for strategic autonomy, as depending on imports for critical defense equipment can leave a country exposed to disruptions in supply chains or geopolitical tensions (Kapur, 2021). This makes strategic autonomy an essential component of a nation's defense posture. When a nation produces its own military hardware, it can

keep tighter control over its defensive capabilities while also decreasing its reliance on the military might of other nations. Second, indigenous development fosters economic expansion and the production of new employment opportunities. The military-industrial complex has the potential to make a sizeable contribution to a nation's gross domestic product (GDP) and to be a primary driver of technical developments that can have reverberating effects in other areas of the economy. In a third and last point, the indigenization process improves technological capabilities. Countries can stimulate innovation, increase their competence in sophisticated systems, and acquire technological know-how all through the creation of their own indigenous defense technology (Singh, 2020). This not only improves the country's overall level of safety, but it also makes it possible to sell military hardware abroad, which brings in more money and raises the country's profile on the world stage.

However, realizing the goal of indigenization is not without its share of difficulties. The making of large expenditures in infrastructure, research and development, and human capital is necessary to foster the growth of a robust domestic defense industry. To cultivate a competent labor force that is capable of meeting the demands of the defense sector, governments need to initiate the development of specialized facilities, foster the growth of research institutes, and organize training programs. The sharing of knowledge and technology between academic institutions and the business world can be further facilitated by building bridges between the two. Finding the ideal equilibrium between local autonomy and global cooperation is another one of the difficulties that must be overcome. Even though it is necessary to strengthen domestic skills, it might be helpful to collaborate with foreign partners that have comparable qualities and expertise. International collaborations have the potential to open access to cutting-edge technologies, lucrative global markets, and lucrative investment opportunities. However, it is of the utmost importance to defend national interests, safeguard essential technologies, and keep tight supervision over the creation and manufacture of sensitive military hardware. Considering the new world order and taking lessons from the Ukraine-Russia dispute, there is a strong need to build stock of qualitative equipment, especially for India the only country with a land border shared by two nuclear-armed states at war with each other. India just cannot afford to have any vulnerabilities in its defenses.

In conclusion, the process of "indigenization" of the defense sector is a complex undertaking that involves strategic, economic, and technological dimensions. It presents nations with the potential to strengthen their national security, create economic growth, and encourage technological advancements. Countries can construct a powerful domestic defense industry that can serve their security demands while also contributing to overall technical growth through the implementation of government programs, the formation of partnerships, and the making of investments. Indigenization is a strategic goal with a long-term perspective that calls for ongoing efforts, collaboration, and a policy climate that is conducive to success to guarantee achievement and keep a competitive edge in the global defense market.

Determinants of indigenization of the defense industry:

Self-sufficiency, or a nation's ability to provide for its defense, is at the heart of indigenization (Stockholm International Peace Research Institute, 2018). However, in India, it is often linked to the idea that the country can provide for itself, even though it often relies on the assistance of other nations. This kind of thinking is short-sighted. No country has successfully created its defense industrial base without help from elsewhere. In the 1940s and 1960s, the Soviet Union profited significantly from German technology; China gained considerably from the Soviet Union; Israel benefited greatly from France; and so on (Siddiqi, 2019). From the German-designed original HF-24 Marut fighter aircraft to the American-made jet engines powering the Light Combat Aircraft (Tejas), even India's most successful indigenous programs have relied heavily on technology, expertise, materials, and components from outside the country. Some proposed domestic companies want to mirror this trend toward accelerating technological development via foreign inputs.

To ensure the successful adoption of new technologies, India must create favorable conditions for private investment in the country's defense sector, implement transparency and foreseeability in acquiring, and take

steps to safeguard the safety of sensitive data (Vivekananda International Foundation, 2019). On top of that, India would need to reevaluate its piecemeal procurement of various technologies that may not operate together in a networked war situation. Because of this, maintaining a diversity policy may become increasingly difficult, even though it has resulted in enormous political gains to date. Fifth-generation fighter planes are computers, just as the best anti-aircraft systems are, and they may not be able to communicate with one another. Ultimately, there will always be compromises between long-term indigenization aims and short-term modernizing impulses (which may include imports). For policymakers, defense planners, and other industry players to effectively encourage indigenization activities, it is essential for them to have a solid understanding of these variables. In the following paragraphs, we will examine some of the primary factors that determine indigenization in the military business.

- **The role of government policies**

The indigenization of the military industry is being driven, in large part, by the imperatives of national security. (Kapur, 2021) One of the most important things for governments to take into consideration is the imperative to guarantee self-sufficiency, lessen their dependency on suppliers from other countries, and protect their strategic interests. Japanese government officials and industry have worked to maintain an indigenous capability by streamlining procurement, initiating new domestic production projects, and loosening a self-imposed ban on exporting military technology to keep an indigenous capability (Hughes, 2019). Government policies should emphasize indigenizing the value chain with attractive incentives. Efforts need to be directed toward research and development in the emerging technological sphere and encouraging the participation of academia and the scientific community. (Ahuja, 2022). In addition, the preservation of critical defense technologies, intellectual property, and secret information is an essential component of maintaining national security. According to Ghosh and Nandy (2021), the primary objective of governments is to maintain control over vital military technologies and to stop the spread of those technologies to unapproved parties or possible adversaries. The strategic ambitions of India should be clearly stated in its policies related to defense. The military doctrines and defense strategy papers should clearly state the requirements and ways to enhance indigenization. The requirement to protect national security and to preserve a sovereign defense industry is a crucial factor that determines the level of indigenization that occurs.

- **Strategic Independence and Geopolitical Aspects of the Situation**

The degree to which a country indigenizes its defense industry is largely determined by several factors, including strategic autonomy and geopolitical considerations. Having the ability to independently develop, produce, and sustain vital defense technology and systems is a goal that many nations strive to achieve. According to Balasubramanian and his colleagues (2021), strategic autonomy assures that states can act in their own best interests without being unduly dependent on sources from the outside. Indigenization activities are impacted by geopolitical factors like shifting alliances and power structures around the world as well as varying views of potential threats. According to Kapur and 2021, countries strive to develop their geopolitical influence, preserve regional stability, and ensure a credible deterrence posture. Indigenization enables states to adjust their military capabilities to meet unique strategic requirements and efficiently respond to changes in the security dynamics of their regional environment.

- **Capabilities and expertise in the field of technology**

When it comes to indigenization in the defense industry, a country's technological skills and know-how are among the most important factors. According to Ghosh and Nandy (2021), developing self-reliance and lowering dependence on foreign suppliers requires the ability to create and sustain advanced defense technologies, systems, and platforms. Developing native technological capacities calls for investments in research and development, innovation, and the cultivation of skills (Pandit, 2020). In order to develop technological capabilities, it is common practice to work together with partners from other countries, transfer existing technologies, and form joint ventures. According to Bhatnagar and Chand's research from 2020, these collaborations provide access to sophisticated technology, experience, and opportunities in the industry. To

close technology gaps and improve the capabilities of their own militaries, governments place a high priority on the purchase and incorporation of essential technologies.

- **Defense Industrial Base and Supply Chain Integration**

Integrating the supply chain and ensuring the robustness of the defense industrial base are both critical factors in determining the level of indigenization achieved. (Krishnan, 2020) Developing local manufacturing capabilities, research and development facilities, and a qualified workforce are all necessary components in the construction of a strong defense industrial base. Integration throughout the whole defense supply chain guarantees that production processes are efficient, that defense equipment is delivered on schedule, and that quality control is maintained (Balasubramanian et al., 2021). The adoption of new policies and programs by the government is one of the primary factors contributing to the expansion of the nation's defense industrial base. After the Kargil War, the government decided to allow private companies to participate in the defense business. This is an encouraging development. To stimulate the growth of the country's defense industrial base toward the goals of self-reliance and indigenization, the government of India announced in May 2001 that it would allow the private sector of India to participate in a free capacity, if they obtained the necessary licenses. Encouragement of participation and collaboration from the private sector can be achieved by the implementation of policies such as offsets, preferred procurement for domestic firms, and financial incentives (Pandit, 2020). It is necessary to leverage and improve the private sector's capabilities in a country with decades of expertise in the aerospace and defense industries. The government's procurement policy, as it stands, currently favors the private sector. Defense and aerospace are capital-intensive businesses that require a more effective strategy for increasing the capacity of the private sector (**Panneerselvam, 2016**). Countries can achieve cost efficiencies, minimize vulnerabilities, and raise their level of self-sufficiency in the manufacture of defense goods when they strengthen their defense industrial base and ensure supply chain integration.

- **Collaboration & Partnerships on an International Scale**

The degree to which indigenization occurs in the military industry is influenced by the extent of international collaboration and partnership. Collaborations are formed between nations and the military industries, research institutes, and governments of other nations to have access to cutting-edge technologies, make use of specialized knowledge, and improve their capabilities (Kapur, 2021). Knowledge sharing and capacity building are both made possible through collaborative research and development projects, technology transfers, and licensing agreements (Balasubramanian et al., 2021). Additionally, international cooperation offers prospects for market access, geopolitical alliances, and export routes (Ghosh & Nandy, 2021). Countries can gain economies of scale, pool resources, and share expenses when they participate in joint military projects and international defense procurement programs (Pandit, 2020). These opportunities enable cooperative defense initiatives. The ability of countries to tap into global networks, increase the size of their client base, and improve their level of competitiveness is fostered through the formation of strategic partnerships. The absence of a practical framework for formulating policies regarding science and technology is seen as a critical barrier to the industry's progress toward sustainable growth (**Mevlutoglu, 2017**). Transfer of Technology (ToT), Memorandum of Understanding (MoU) with Original Equipment Manufacturers (OEMs) for sustainability, Capacity Requirement Planning (CRP), and Research and Development (R&D) organizations for time-bound intended outputs are essential to the realization of Atmanirbhar Bharat. The development of vendors, affiliate marketing, automation and modernization of industries, Internet of Things technology, artificial intelligence and machine learning, and efficient data analytics are all essential components of indigenization for the military. (Panda, 2021).

In conclusion, the indigenization of the defense industry is shaped by several different drivers, some of which include the imperatives of national security, strategic autonomy, technological capabilities, the strength of the defense industrial base, economic concerns, and international collaboration. The intricate interplay of political, technological, economic, and security elements that drive indigenization attempts is reflected in these determinants. These determinants need to be taken into consideration by governments, and comprehensive

strategies, policies, and initiatives need to be developed to encourage the expansion of domestic military capabilities and reduce reliance on external suppliers.

The expected outcome from the study was that the study will help the government to frame policies for indigenization of the defense industry, the study will help the government and administration understand the need for technology transfer. Further, the study will help the government and administration to understand the possibility of enhancing Public Private Partnerships in defense manufacturing. And lastly, the study will further help to understand about indigenization of defense and the modernization of the defense Industry. The following hypothesis are proposed for this research:

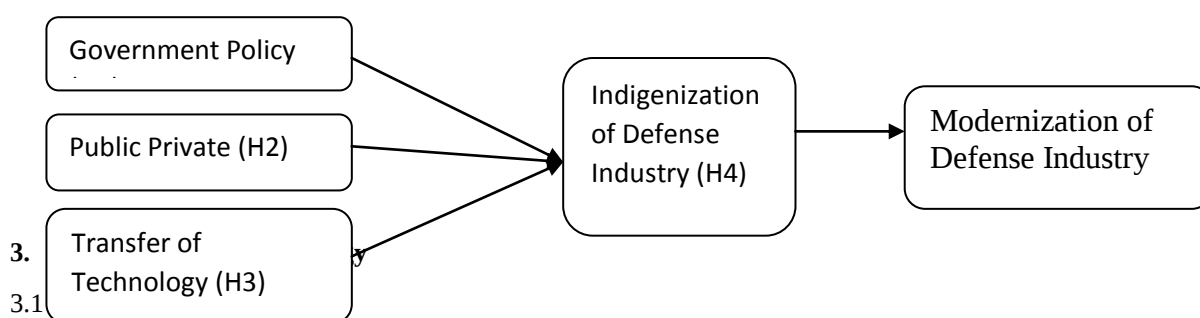
H₁- Government policy will positively influence defense indigenization in India.

H₂-Public private partnerships will positively influence indigenization of defense in India.

H₃-Transfer of technology will positively influence indigenization of the defense in India.

H₄- Indigenization of defense will enhance modernization of armed forces in India.

All hypotheses were combined to develop a conceptual model depicted below:



A quantitative survey instrument was developed based on the opinion of experts belonging to armed forces, defense industries and DRDO. The variables listed were corroborated through articles and opinions published by the defense personnel at various platforms. The final variables include:

1. Government Policies
2. Public private partnerships
3. Transfer of technology

We have used 5-point Likert scale to capture the responses on various statements pertaining to each variable where 5 stands for strongly agree to 1 as strongly disagree. The pilot testing of the survey questionnaire consisting of 30 responses resulted in satisfactory value of reliability (Cronbach alpha 0.7).

We used snowball sampling for the study and respondents were the personnel actively involved in policy formulation and manufacturing of defense equipment from MoD, DPSUs, OFs, DRDO, Armed Forces and Private defense industries etc. and the defense analysts involved in studying this subject. The questionnaire was sent to 150 respondents. Out of 130 responses (86% response rate), 124 were valid responses. We have structured equation modelling for data analysis.

3.2 Empirical Analysis

As stated above the objective of the research is to identify the antecedents of defense indigenization in India. For this purpose, the data of 124 responses was analyzed using Structure Equation Modelling through SPSS AMOS 28 software. The demographic characteristics of the respondents is discussed below:

Age group of Respondents:

From Table 1, it was concluded from the data collected that out of 124 survey participants who participated in the survey, 2% of them were in between 18 to 35 years, 56.1% of them were between 36 to 50 years, 35.7% of survey participants were off between 51 to 65 years, and 6.1 % of respondent were above 66 years of age.

Table 1: Age group of Army Officers					
Age		Frequency	%	Valid %	Cumulative %
Validity	18-35 yrs.	2	2.0	2.0	2.0
	36-50 yrs.	70	56.1	56.1	58.2
	51-65 yrs.	45	35.7	35.7	93.9
	Above 66 yrs.	7	6.1	6.1	100.0
	Total	124	100.0	100.0	

Source: Calculated with the help of Microsoft office excel 2019

Associated Category:

From the below table 2, revealed that 68.4 % respondents were belongs to armed forces, followed by 19.4 % of the respondents were from defence industry, 9.2 % respondents were govt officials and 3.1 % respondents were from DPSU or ordinance factories.

Table 2. Associated Category

Associated Category		Frequency	Percent	Valid Percent	Cumulative Percent
Associated Category	Armed Forces of India -Army, Navy or Air Force	85	68.4	68.4	68.4
	DPSU or Ordinance Factories	4	3.1	3.1	71.4
	Government official from Department of Defense	11	9.2	9.2	80.6
	Defense Industry-Private	24	19.4	19.4	100.0
	Total	124	100.0	100.0	

External factors drive the importance of defense Indigenization in India:

From Table 3, it was found that 70.4 % of the individuals voted for competitive advantage/business opportunities as the important external factors in defense indigenisation followed by 59 % who said advanced foreign technology, 46 % said globalisation, 30 % said licensed production, 23.5% said low cost of procurement from foreign players, 22.4% said defense production by other developing countries and a 2 % said high cost of buying.

Table 3. External factors drive the importance of defense Indigenization in India	
External factor	Percentage
Less restrictions on imports of defense products	2.04
Defense production by other developing countries	22.4

Low cost of procurement from a foreign player	23.5
Licensed Production	29.5
Globalisation	45.9
Advance foreign technology	59.2
Collaboration with foreign players	61.2
Competitive advantage/business opportunities	70.4

Source: Calculated with the help of Microsoft office excel 2019

Internal factors drive the importance of defenseIndigenization in India:

From the below table 4, it showed about internal factors drive the importance of defenseindigenization in India and concluded that 10.2 % of non-availability of equipment 13.3 % of budget constraints, 36.7 % of the emergence of defense start-ups, 47.9 % of a reduced burden on imports, 51 % of funding by government, 56.1 % of economic benefits and profitability, 57.1 % of ease of government regulations in defense procurement, 58.1 % of opportunities for co-production and co-development with private players, 65.3 % of the possibility of export and 70.4 % of make in India initiative are the internal factors that drive the importance of defenseindigenization.

Table 4. Internal factors drive the importance of defenseIndigenization in India	
Internal factor	Percentage
Non-availability of equipment	10.2
Budget constraints	13.3
The emergence of defense start-ups	36.7
Reduced burden on imports	47.9
Funding by government	51
Economic benefits and profitability	56.1
Ease of government regulations in defense procurement	57.1
Opportunities for co-production and co-development with private players	58.1
Possibility of export	65.3
Make in India initiative	70.4

Source: Calculated with the help of Microsoft office excel 2019

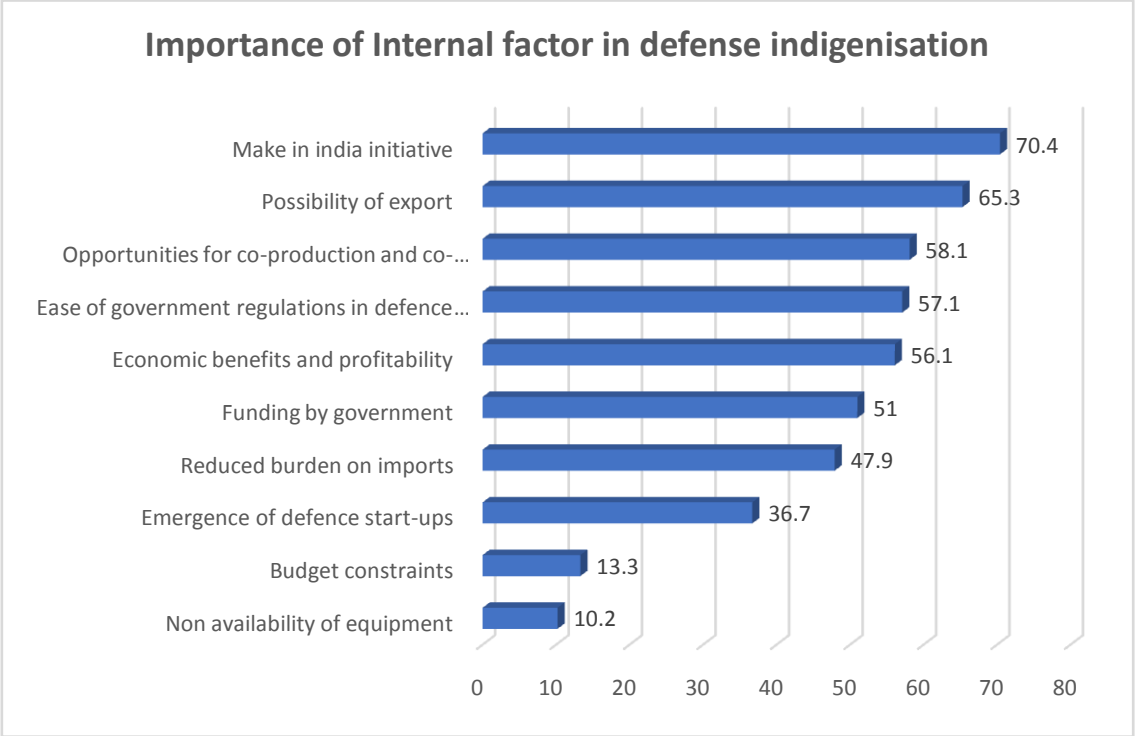


Figure 1: Internal factors drive the importance of defenseIndigenization in India

Table5 below found that the value for “Cronbach alpha”, in this case, is 0.897 and highlights that the measuring instruments are highly reliable. Further, the instruments indicate a more significant internal consistency within the individual samples.

Table 5 Reliability Statistics		
“Cronbach’s alpha”	“Cronbach’s alpha” based on the Standardised Items	Number of Items
0.897	0.906	28

From the below Table6 Kaiser-Meyer-Olkin (KMO) scores above 0.70 are considered satisfactory, while those below.50 are deemed insufficient. Use the KMO test to see whether sufficient data points can be attributed to each predictor. Here, it's 0.812, which is excellent. Suppose the variables are substantially linked as they should be to give a good foundation for component analysis. In that case, the “Bartlett test” will be crucial (i.e., have a significance value of less than.05).

Table 6. KMO and Bartlett's Test		
“Kaiser-Meyer-Olkin Measure of Sampling Adequacy”.		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	1124.299
	Df	300
	Sig.	0.000

Table 7. Descriptive Statistics

Variable	Average	Standard Deviation	N
GP	3.925	0.608	124
PPP	4.109	0.562	124
TOT	3.626	0.689	124
DI	4.167	0.498	124
MAF	3.984	0.528	124

From Table8, a significant and positive correlation has been found among variables GP, PPP and TOT. There is a substantial positive connection between DI and MAF and there is a significant impact of variable GP, PPP and TOT found on DI and MAF. This table represents the correlations, composite reliability (CR) and average variance extracted (AVE) which exhibits that there is no cross loading among the variables, the AVE square roots exceeded the correlations which indicates satisfactory discriminant validity.

Table8: Correlation, Composite Reliability and Average Variance Extracted

Measure	Government Policy	Private-public partnership	Transfer of technology	Defense Indigenization	Modernization of armed forces	CR	AVE
Government Policy	1					0.75	0.58
Private-public partnership	0.511	1				0.74	0.52
Transfer of technology	0.451	0.347	1			0.81	0.53
Defense Indigenization	0.5	0.654	0.275	1		0.85	0.60
Modernization of armed forces	0.365	0.687	0.385	0.684	1	0.76	0.54

Structural Model

The structural model was analyzed using maximum likelihood estimation method for testing of the proposed model. Table 9 represents the results of the structural model. The values of fit indices ($p < 0.05$; RMSEA=0.09; CFI=.82) indicate overall satisfactory model fit. The model is represented through Figure 2.

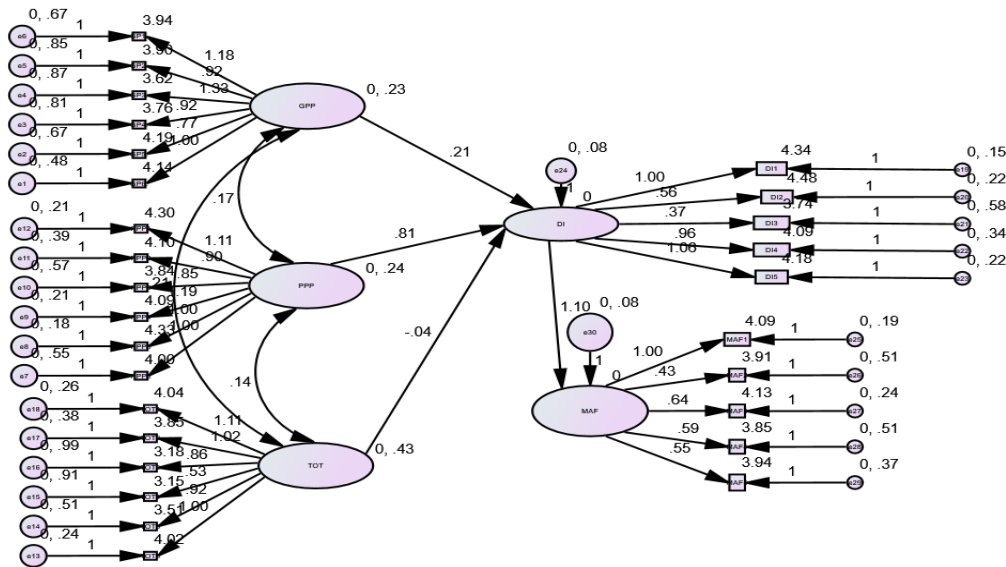


Figure 2: SEM model representing the relation between defense indigenization and other variables.

Table 9RMSEA and CFI Values			
Model Name	RMSEA	P	CFI
Default model value	0.097	.000	0.824
Saturated model value			1.000
Independent model value	0.176	.000	0.00

As evident from the table 10, the association between government policy and defense indigenization was significant with coefficient 0.25 and $p < 0.001$, and at the same time, the relationship between public-private partnership and defense indigenization was also significant with coefficient 0.50 and $p < 0.001$; thus, supporting H1 and H2. Further, the relationship between defense indigenization and modernization of armed forces with coefficient 0.624 and $p < 0.001$ was significant, supporting H4 as shown in Table 11. However, the relationship between transfer of technology and defense indigenization with coefficient -0.011 and $p = 0.902$, was insignificant; hence, H3 was rejected.

Table 10: Summary of hypotheses testing

Hypothesis	Paths	Coefficients	t-values	Results
H1	GP $\longrightarrow$ DI	0.25	2.604***	Accepted
H2	PPP $\longrightarrow$ DI	0.50	5.476***	Accepted
H3	TOT $\longrightarrow$ DI	-0.011	-0.124	Rejected
H4	DI $\longrightarrow$ MAF	0.624	7.825***	Accepted

It is further evident that defense indigenization positively influences the modernization of armed forces with significant beta value of 0.624 ($p < 0.001$). The results revealed that favorable government policies and greater public-private partnerships in defense manufacturing will help in attaining self-reliance in defense manufacturing. However, transfer of technology is yet to play a significant role due to a lot of legal formalities involved in the process. If foreign companies set up their manufacturing unit in India, then it can directly impact defense indigenization. Added further, defense indigenization will in turn, lead to modernization of armed forces.

4. Conclusion and policy implications

Based on the analysis of data it is evident that government policies, public private partnership lead to defense indigenization in India. It has also been discovered that there is a considerable positive correlation between DI and MAF, in addition to a significant impact that the variables GP, PPP, and TOT have on DI and MAF. The results corroborate the findings of the study by Chakrabarti et al. (2014) and Chaudhary and Jain (2015) who investigated the impact of government policies on indigenization of the Indian defense industry and found that government policies have a positive impact on indigenization, particularly in terms of research and development initiatives, defense offsets, and technology transfer. The study also revealed that public-private partnerships play a critical role in promoting indigenization in the defense industry. the study suggests that increasing public-private partnerships in defense manufacture in India could help in the development of dual-use indigenous technologies, reduce the cost of manufacturing defense equipment, and bring technologies like artificial intelligence and cybersecurity. Furthermore, the study highlights the necessity of fostering indigenous defense capabilities in India to become less reliant on imports from other countries and improve the country's national security. In a similar study by (Cox 2016) it was found that PPPs can also help to improve efficiency and reduce costs in the defense industry. Private companies are often able to operate more efficiently than government entities, which can lead to cost savings and improved performance. To accomplish indigenization and self-reliance in weapon manufacture, the public sector should work as a catalyst in improving the capacities of the private sector and should be seen as a collaborator, rather than a competitor, in the field of defense.

These findings, taken together, imply that government policy and public-private collaboration are essential variables in encouraging defense indigenization, which in turn has a favourable effect on the modernization of the defense industry. The findings also suggest that the transfer of technology might not be as important of a part in the process of encouraging indigenous development. The increasing negative list is limiting the option of technology transfer. The foreign manufactures are now required to collaborate with Indian companies to manufacture in India with a mutually acceptable technology transfer mode (Ashok Kumar, 2022). Even though the government of India has implemented numerous reforms to its FDI policy and procedures, significant further work is still required to close the gaps that prevent a continuous flow of FDI into the defense industry (Srivastava, 2015). While India's vast market size makes it possible to transfer technologies, its internal issues fundamentally make it more difficult for these technologies to be effectively utilized. (Weiss, 2018).

Based on the facts presented earlier, the following are some recommendations that can be made to encourage localization within the defense industry:

- Increase funding from the government for research and development efforts:

The policies of the government should be geared towards increasing financing for research and development activities in the defense industry. This will assist in the promotion of innovation and will enhance the capabilities of the domestic sector.

- Support the Transfer of Technology:

The government ought to support the transfer of technology from international partners to domestic enterprises operating in the defense industry. This will assist in the development of technological capabilities within domestic industries and will foster increased levels of self-reliance.

- Foster public-private partnerships:

It is important to foster public-private partnerships in order to foster indigenization in the defense industry. The government's financial resources and the technical competence of private enterprises can be brought together through the formation of such partnerships in order to create new technologies and products.

- Create an all-encompassing defense offset strategy:

It is important to create an all-encompassing defense offset policy in order to encourage investment in the local defense sector, strengthen technological capabilities, and promote technology transfer.

- Encourage participation from the private sector:

The government ought to encourage participation from the business sector in the military manufacturing industry. This can be accomplished through the provision of tax breaks, the lowering of regulatory hurdles, and the promotion of business partnerships between domestic and international corporations.

- Create a Long-Term Vision:

The government should create a long-term vision for the defense sector that focuses on self-reliance and indigenous growth. This vision should be created on a long-term basis. This will assist in developing a sustainable environment for the defense sector and lessen reliance on partners from other countries.

- Encourage collaboration between the government, industry, and academia:

The government should establish partnerships with industry and academia to promote innovation and R&D in the defense industry. Collaboration can also help address skill gaps and promote knowledge sharing.

- Focus on building critical infrastructure:

The government should invest in building critical infrastructure such as testing facilities, manufacturing capabilities, and logistics support to enable the development of indigenous defense products.

- Promote innovation and entrepreneurship:

The government should create a favorable environment for innovation and entrepreneurship by providing incentives, funding, and mentorship programs to encourage startups and small businesses to enter the defense industry.

- Develop a skilled workforce:

The government should invest in training programs to develop a skilled workforce in the defense industry. This can include technical training, apprenticeships, and education programs focused on the needs of the industry.

- Encourage the use of indigenous products:

The government should encourage the use of indigenous defense products by its own armed forces. This will create a market for domestic products, promote self-reliance, and build confidence in the capabilities of the domestic industry.

- Streamline regulations:

The government should streamline regulations and procedures related to defense procurement and manufacturing to reduce bureaucratic hurdles and improve efficiency. This can include simplifying licensing procedures, reducing paperwork, and improving communication channels between stakeholders.

The government will be able to improve the capabilities of the domestic industry and encourage increased indigenous production in the defense sector if it puts these recommendations into action

In conclusion, as the defense sector continues to develop, policymakers should continue to pay attention to the ways in which the industry's landscape is shifting and adapt regulations accordingly. Investing in developing

technologies such as artificial intelligence and cybersecurity, which are anticipated to play an ever-increasingly significant role in the defense industry over the course of the next few years, may be one way to accomplish this goal.

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