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PUBLIC PROCUREMENT AS A TOOL TO BOOST INNOVATION AND ENTREPRENEURSHIP: CASE OF INDIAN DEFENSE SECTOR

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I hereby declare that I have compiled the thesis independently and all works, important standpoints and data by other authors have been properly referenced and the same paper has not been previously presented for grading. The document length is 13679 words from the introduction to the end of conclusion.

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TABLE OF CONTENTS

Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AGNii	Accelerating Growth of New India's Innovations
AI	Artificial Intelligence
AIC	Atal Incubation Centres
AIM	Atal Innovation Mission
ATL	Atal Tinkering Labs
CCI	Competition Commission of India
CIIE	Centre for Innovation Incubation and Entrepreneurship
CPPP	Central Public Procurement Portal
CPSE	Central Public Sector Enterprises
CVC	Central Vigilance Commission
DAP	Defense Acquisition Procedure
DIO	Defence Innovation Organization
DISC	Defence India Start-up Challenge
DPEPP	Defense Production and Export Promotion Policy
DPP	Defence Procurement Procedure
DRDO	Defence Research and Development Organization
ESDM	Electronics System Design & Manufacturing
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GeM	Government e-Marketplace
GePNIC	Government eProcurement System of National Informatics Centre
GFR	General Financial Rules
GoI	Government of India
IC	Indigenous Content
ICT	Information and communications technology
IDDM	Indigenously Designed, Developed &Manufactured
iDEX	Innovation for Defence Excellence
IoT	Internet of Things
IPR	Intellectual Property Rights
IREPS	Indian Railway e-Procurement System
LAC	Line of Actual Control
LAN	Local Area Network
LRU	Line Replaceable Unit
LTE	Limited Tender Enquiry
MeitY	Ministry of Electronics and Information Technology
MIS	Management Information System
MMRCA	Medium Multi-Role Combat Aircraft

MoD	Ministry of Defense
MSME	Micro, Small and Medium Enterprises
NIF	National Innovation Foundation
NIT	Notice Inviting Tenders
OECD	Organisation for Economic Co-operation and Development
OEM	original equipment manufacturer
OTE	Open Tender Enquiry
PCP	Pre-commercial Procurement
PIB	Press Information Bureau
PLI	Product Linked Incentive
PMU	Project Management Unit
PPI	Public Procurement of Innovation
PSU	Public sector undertakings
PwC	PricewaterhouseCoopers
PWD	Public Works Department
RDSO	Research Design & Standards Organization
SEBI	Security and Exchange Board of India
SINE	Society for Innovation and Entrepreneurship
SME	Small, Medium Enterprise
SPM	Strategic Partnership Model
STB	Strategic Technology Board
STF	Strategic Technology Fund
STIP	Science & Technology Policy
TAC	Technology Assessment Cells
TDF	Technology Development Fund
ToT	Transfer of Technology
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicle
UDISE	Unified District Information System for Education

ABSTRACT

Public procurement of innovation has emerged as a policy tool that can be utilized in order to boost innovation and entrepreneurship opportunities. The thesis is about public procurement of innovation in India and how it has played a role in providing an impetus to the innovation ecosystem and encouraging entrepreneurship. A special focus is on the defense sector to see how it has adapted public procurement of innovation by designing special initiatives that bring to light various scenarios and challenges which can be solved by innovative solutions and products. As there is a lack of feedback mechanism for the overall structure and schemes, the research for this thesis provides a starting point. The analysis is conducted using the system failures framework for innovation policy design to see how public procurement initiatives in India play a role in overcoming these failures; along with a questionnaire based study to gauge the overall effectiveness of the initiatives and collect feedback. The findings show that public procurement of innovation initiatives in India are heavily focused on innovation and entrepreneurship and have a potential to be devised as a holistic innovation policy tool. These can be made more robust by taking into account the issues being faced by the end-users (entrepreneurs in this case) and by working on making a more inclusive policy for public procurement.

Keywords: public procurement; innovation; entrepreneurship; defense procurement

1. INTRODUCTION

"Public Procurement of Innovative solutions (PPI) happen when the public sector uses its purchasing power to act as early adopters of innovative solutions which are not yet available on a large scale commercial basis." – **(European Commission, n.d.)**

1.1 Relevance

Policymakers in India have used public procurement in order to aid a variety of Small and Medium Enterprise, Startups and support socio-economic goals. Introduction of portals like Government e-Marketplace (GeM) has made it easier for Indian Firms and startups to access government tenders and projects. This has helped to widen the sphere of opportunities and serve both the government, in terms of the available options and, the firms to come up with innovative products and expand their business. Also, the Central Public Procurement Portal (CPPP) has provided tremendous opportunities to companies by facilitating all Central Government departments, organizations and Central Public Sector Enterprises (CPSE) to publish their Tender inquiries and Notice Inviting Tenders (NIT) (CPPP, 2020). The agenda for this is to provide a single point of contact leading to economies of scale. If we look back a little, the credit to the existence of such progressive measures can be given to the start of Liberalization in India at the beginning of 1991. Huge reforms were made to the industrial and trade policies paving way for wider macroeconomic stabilization by allowing private investment, de-licensing, industrial deregulation etc. Various sectors such as Agriculture, Pharmaceutical, Telecommunication, Banking, Finance etc. saw great reformations. The Indian market opened up to more foreign investments, FDI increased from $129 million in the year 1991 to approximately $41,000 million around 2005 (Dutta and Sarma, 2008). Post-liberalization, the market also adapted technology. Foreign companies were allowed to bring their technology via automatic approval for technology agreement and giving freewill to Indian companies to negotiate terms of technology transfer. FDI in India increased drastically starting from $97 million in the year 1991 and reaching $82 billion in the year 2021 owing to the policy reforms undertaken over the years. In the defense sector, for example, the FDI opened for the private sector in 2001 leading to an increase in FDI from 26% (year 2001) to 74% (year 2020) under the automatic route (Nayak and Sahoo, 2021).

In order to strengthen technological competence and quality manufacturing, the national manufacturing policy was formed in India in the year 2011. Also, in the arena of defense, the Defense Production Policy (DPP) was formed in the year 2013 and Defense Production and Export Promotion Policy (DPEPP) in 2020. These policies explicitly defined procurement as an imperative parameter to achieve socio-economic goals. The Government of India also launched the 'Make in India' campaign in order to encourage government procurement as it forms an integral part of the industrial strategy and to increase the share of manufacturing in the GDP. The percentage contribution of public procurement to India's GDP is estimated in-between 20% to 22%. Over the years, the GDP steadily increased - $266 billion in 1991 to $2.7 trillion in 2020. If we look at it in terms of monetary figures – If India's economy is sized at USD 2.7 trillion, public procurement amounts to approximately USD 500 billion on an annual basis (Kavitha, 2019).

1.2 Research Objective

Innovative Entrepreneurship as a concept has become increasingly significant when we look at a policy approach towards achieving a holistic Innovation. There is also the concept of Knowledge Intensive Entrepreneurship (KIE). The literature defines KIE firms as those which take inspiration from existing information in their fields and then use this information to form new ideas thereby giving rise to innovation (Malerba and McKelvey, 2019). It is clear that entrepreneurship and innovation go hand in hand. The goal is to understand the role that public procurement of innovation plays in this ecosystem – the ways in which the process of procurement leads to innovation and entrepreneurship. The induction of entrepreneurs and suppliers into the PPI system has been imperative in giving rise to a co-created innovative product or service (De Silva & Wright, 2019). With this as the central idea, the research will revolve around studying the effectiveness of Public procurement in terms of a tool to boost Innovation and giving entrepreneurial organizations a center stage in the innovation process and what is the genesis of this approach from a policy standpoint. The thesis will majorly focus on measures undertaken in Indian Defense sector, as the subject area is very broad in terms of a gamut of sectors involved in it. The study will encapsulate the following research question:

1. **How has the Indian defense sector devised the public procurement of innovation approach in paving a way for knowledge intensive entrepreneurship?**

The remainder of the thesis is in the following order. Chapter 2 is dedicated to introducing the idea of public procurement of innovation; exploring its relevance; its relationship to entrepreneurship; a brief overview of what is public procurement and its relation to Innovation; the theoretical evidence connecting both the concepts and the relevance of public procurement of innovation with entrepreneurship and explain the theoretical framework deployed. Chapter 3 is dedicated to exploring the failures that exist in the Indian Innovation system Chapter 4 will highlight some initiatives that government of India has taken in order to curb the failures. Chapter 5 of the study will explain the methodology used to approach the research question. Chapter 6 will display the results of the applied framework and questionnaire. Chapter 7 will be dedicated to the discussion on the application of framework to the public procurement of innovation scenario in India and discuss the implication of the study. Chapter 8 will be to draw conclusions.

2. UNDERSTANDING PUBLIC PROCUREMENT OF INNOVATION

This chapter will explain in details all concepts related to public procurement and innovation.

2.1 Public Procurement and Innovation

As per OECD, “Public procurement refers to the purchase by governments and state-owned enterprises of goods, services and works’. In contrast to 'public technology procurement', regular 'public procurement' occurs when public agencies buy ready-made 'simple' products such as pens and paper where no R&D is involved. Only price and performance of the (existing) product is taken into consideration when the supplier is selected” (OECD, n.d.). Public procurement of innovation, earlier referred to as public technology procurement, happens when the government places an order for a product to service that is currently non-existent but which perhaps could be developed in a reasonable amount of time. Any radical technological development should fulfill the demand raised by the buyer. This is the ‘ideal’ scenario for technology procurement (Edquist and Hommen, 2000).

From the above definition, it seems like public procurement gives rise only to radical innovation. However, many authors beg to differ. Geroski (1990; p.192) stated that devising public procurement policies to push firms to garner new capabilities does not in any way mean that they should be expected to deliver something entirely new. Public procurement does not necessarily lead to a ‘non-existent’ product but could also be incremental in nature. The right way to examine public procurement of innovation would be, a procurement done by the public sector in order to cater to a public requirement or need which devices innovation as a tool. So, public procurement of innovation in layman terms could be defined as a concept where the public sector specifically buys innovative goods and services which do not exist yet or are the upgraded alternate version. This gives rise to innovation – which could be radical, disruptive, architectural or Incremental.

Due to the nature of the whole procuring process that requires research and development activities in order to obtain the end product, it ultimately acts as a genesis of Innovation. We can safely assume that there is a correlation between both the terms. Literature has also defined Public procurement as a widely accepted demand-side tool which stimulates innovation. If we look at it pragmatically, procurement could be seen as a research and development contract given to a

supplier through multiple stages – exploration, feasibility analysis, R&D, prototyping, field testing and finally commercialization (Edler and Georghiou, 2007). Throughout the process we see that the user plays a very critical role. We already know that public procurement acts as a demand-side tool, this means it is the user who desires a certain product and kick starts the process. In his paper, 'Product Innovation and User-Producer Interaction', Bengt Lundvall (1985) suggests that the user who interacts actively with progressive technology would generally be involved in the process of 'learning by doing'. This know-how further helps the producer to envisage the future product through the user's perspective. The user, for example, in this case the public procurement agency (government) will be engaged in gathering information about new technological opportunities as they want to grow and stay competitive. Apart from the information on new product requirements, the agency will also need to assess the internal impact and compatibility in terms of its own capacity, competence and knowledge within its unit. This information is very critical especially in the initial phases to judge the feasibility. The user then shares the information and specific new product related requirements with the producer and the producer then can start with the further process of developing the product. Once the product is ready, the producer will prepare a user-manual for the user to explain product functionality. At this stage, the user becomes dependent on the producer, as it is the producer who will provide training in using the product. Therefore we can assume that there is some level of dependencies on both the sides and cooperation is imperative. The user however has an incentive to monitor the producer's competency and reliability and always has a choice to choose from a varied number of producers (Lundvall, 1985).

Staffan Linder (1961) in his trade theory also places the user/demand side as the starting point of the innovation process. He states that first there arises a need which cannot be sufficiently satisfied by the existing products. Also, there is an assumption that the entrepreneurs are better informed about the development resources in the market and are generally the first ones to react to a demand for new or improved products. The demand side will then further provide the development opportunity and the outcome of this activity will be defined as an innovation. He argues that in terms of creating comparative advantage, it is the demand induced innovation; not supply factors that act as the determinant (Linder, 1961). This reinforces the fact that public

procurement is in fact a demand dominated activity that is acting as a starting point of innovation and consequently increasing entrepreneurial opportunities.

2.2 Public procurement of Innovation and its relation to Entrepreneurship

Innovation has always been interrelated with entrepreneurship in literature time and again. As put by Drucker, “Innovation is a tool used by entrepreneurs using which they can bring about some changes and look at it as an opportunity for an alternate business or an alternate service. It is something that can be presented as a discipline, capable of being learned, and can be put to practice. Entrepreneurs need to proactively search for the sources that lead them to innovation, the related changes and the indications that show opportunities for successful innovation. Also, they should know and learn to apply the principles of successful innovation” (Drucker, 1985, cited in CourseHero, 2022). There have been many examples where Innovation stemmed from a novel idea from a small start-up firm and went on to become revolutionary.

Public procurement, innovation and entrepreneurship in tandem can be considered as methodological steps towards a holistic economic development. The process starts with a well-proposed public procurement plan/tender which states the functional requirements or specifications. The requirements could be to create a completely new product which would help overcome a limitation or a wider public issue or perhaps upgrading an existing product with a completely new approach or using a new technology. In order to achieve this, a lot of R&D will be required, a lot of brainstorming and formation of new ideas which ultimately forms the process of innovation and the fact that this would a publicly procured product, it means it will be sourced from entrepreneurs who are looking for opportunities (Drucker, 1985, cited in CourseHero, 2022) and possess technical capabilities to implement the idea from paper to an actual product. If we look at the core, the need or demand for a product plays a significant role in triggering the process of innovation.

When we think about the process of public procurement, the one thing that stands out is the interaction that happens between the firms. The interaction and interactive learning between the organizations are considered as a pillar upon which innovation is based according to the innovation systems approach. (Edquist, 2015) These innovations could be new or improved processes or goods. When users in addition to the innovator have an interest in the innovation, it can trigger an open collaborative user innovation process (Baldwin and von Hippel, 2011). Such processes involve open

access to the works of contributors developing a new product or service and the outputs from their individual and collective design efforts are available for anyone to use. This is termed free diffusion of innovation-related information to non-innovators (Gambardella, Raasch and von Hippel, 2017). This diffusion of information can form a part of developmental research which may or may not lead to innovation. However, when the outcome of this research is made viable and commercially available through procurement, it then takes the form of innovation, going by the guidelines mentioned in the OECD Oslo Manual - In order to qualify as an innovation, the product must be commercialized and implemented (OECD, 2005, p.47). Therefore, a new product is considered as implemented when it has been introduced to the market.

There are five types of procurements related to innovation (Edquist, 2015) – Innovation –friendly procurements, transforming regular procurement to innovation procurement, direct procurement, catalytic procurement and pre-commercial procurement:

a) **Innovation-friendly procurement** – An innovation-friendly procurement is the one where regular procurement is conducted in a way that encourages use of innovative solutions.
b) **Regular public procurement** – Under this type of procurement, an already existing product is procured according to standard bidding format where economically most advantageous or low priced bids.
c) **Direct Procurement** – A direct procurement could be both radical and incremental. Direct procurement by the government could include purchase of defense or infrastructural goods. This type of procurement has a potential to create a good amount of employment/entrepreneurship opportunities.
d) **Catalytic Procurement** – This type of innovation occurs when the procuring firm is procuring on behalf of other actors. It acts as a catalyst, coordinator, knowledge-partner and partial financier but not the end-user. The beginning of catalytic procurement is often triggered by a social need or an issue that requires attention but is unable to generate an effective demand.
e) **Pre-commercial Procurement (PCP)** – PCP occurs when the public sector buys the developmental solutions rather than a product and directs it to a relevant area where it is required. This includes public procurement of research and development services.

It is also worth noticing that public procurers could influence the degree to which a demand would be generic or dedicated. The public sector could demand products with complex specifications, hence, imposing quality standards and technologically advanced goods. Uyarra and Flanagan (2009) gave a typology based on the interaction between the procurers and suppliers segmenting different types of procurements – efficient procurement where standardized goods are procured to serve a generic market; adapted procurement where specific/niche functionality is fulfilled using known production methods; technological procurement where use of new technological solutions is encouraged to solve generic demands and experimental procurement where use of specialized technical solutions is made. Procurers hence keep moving from one segment to another based on different scenarios. (Uyarra and Flanagan, 2009, p.27)

2.3 The System Failure Framework for Innovation Policy Design

When we talk about policy design, it is imperative to first know the purpose of why the policy is being designed, what are the limitations that the policy will help overcome, which are the failures that the policy will help to improve upon. In order to achieve policy coherence in the policy we will go with the idea of market and system failures which frame and validate current innovation policies. The benchmark for rationale behind policy intervention in innovation activities is based upon the market failure argument developed by Kenneth Arrow (Weber and Rohracher, 2012). He argues that market-based failures lead to underinvestment in knowledge development and research. There are many other market failures which lead to weak performance of the system. As an extension to the existing market failures, Woolthuis et. al. (2005) categorized the failures into four broad categories:

a) **Infrastructural failure** – Infrastructure is considered a very important factor in long-term development. Having a stable infrastructure in terms of ICT infrastructure, skills, technology, training, education, electricity, transportation etc. is imperative and plays a supportive role in overall development. Infrastructure failures therefore need to be identified and prevented.
b) **Institutional failure** – Institutions are external and internal environments in which the actors are embedded like the laws, rules and regulations, macroeconomic policy environment, social values and culture etc. In case these environments are not conducive, it might lead to institutional failures and cause hindrance in innovation. The institutional failures can be further defined as hard institutional failure and soft institutional failures.

Hard institutional failures can be with regards to rules and regulations, IPR, general legalities, contracts etc. Soft institutional failures occur related to the environment particularly in a macroeconomic sense. Soft institutional failures also include social norms and values and entrepreneurial spirit in the organization.

c) **Interaction failure** – The interaction defines the relationship between the various actors, which includes relationships with other firms along with the government, knowledge institutions and third party consultants. Interaction failures are of two types – one where there is a lot of interaction which could lead to lock-in into a bounded structure where the interaction happens only between long established relationships leaving no space for new entrants. This could also be explained in terms of 'being too comfortable' in the current set-up and unwillingness to change. There could also be a scenario where someone from the strong interaction group is unable to form a group with other parties with different expertise or interest. Weak interaction failure occurs when one firm is unable to interact with another firm due to overlapping technological know-how and there is a lack of shared vision. This could severely hinder coordination and consequently innovation.

d) **Capabilities failure** – Capability failure simply points towards the lack of competencies, capacity/resources, knowledge etc. Keith Smith pointed out that the firms lack the ability to adapt to new technologies and prefer to focus only on what they know. Also, Franco Malerba discussed the same failure under the heading 'learning failure'. The main argument of this failure is that the organizations or firms are unable to transition from the old system to a new technology or paradigm. In order to take a leap from old to new technology the "firms need capabilities such as flexibility, adaptability, potential to learn, and resources to be able to adapt to new technologies and dynamic market demands" (Woolthuis et. al., 2005). Hence, it is important that such failures do not occur to avoid a situation of lock-ins.

The framework provides policy makers with an idea to design, evaluate and 'analyze policy measures in the field of innovation'. As per the System of Innovation approach, innovation is interactive in nature and follows a non-linear process where actors/firms interact with various organizations and institutions. Interaction encourages feedback and exchange of information which leads to innovation. The approach helps in understanding the interaction between the actors and

institutions and gives a holistic picture from both ends. By identifying the gaps, it helps to decide how and where the resources should be spent, where intervention is required and what the failures that needs to be addressed. (Woolthuis et. al., 2005)

The framework is structured as follows:

Figure 1: System Failure Framework for Innovation Policy Design (Woolthuis et. al., 2005)

Actors (missing actors) / *Rules (system failures)*	**Demand** •Consumers •Large buyers	**Companies** •Large firms •MNCs •SMEs •Start-ups	**Knowledge institutes** •Universities •Technology institutes	**'Third parties'** •Banks, VCs •Intermediaries, consultants •Sector organisations, employers
Infrastructural failure: ICT, roads, railroads, telecom, ..				
Institutional failure: • Hard: laws, regulations, ...				
• Soft: norms, values, ...				
Interaction failure • Weak network failure				
• Strong network failure				
Capabilities failure				

The broad categories given in the above framework can be explained as follows (Woolthuis et. al., 2005):

a. **Actors** – Actors are basically any stakeholder who supports the system by co-creating product, technology and institutional framework within which they work. These can be customers, firms, policy departments, research institutes, consultants etc. Policy makers generally take the central role while other actors interact with different processes such as design, implementing and evaluating innovation policies.

b. **Rules/system failures** – These are the conditions which act as externalities. These have either been created by the actors or have spontaneously emerged, and influence the functioning of each of the actors and the system as a whole.

The framework could be used to study the interaction between the actors and rules closely and can be used as a starting point to approach an innovation policy from a critical point of view.

2.3.1 Framework Assumptions

It is important to understand that the re-defined framework given by Woolthuis does not make use of lock-ins or path dependencies. Lock-ins is considered as situations which hinder the process of innovation. The aim of the innovation policy is thus to identify such situations and failures and work on eliminating the hindrances in order to make way for innovation and economic development. The framework identifies actors as both the cause and remedy for the failures. This might sound a bit complex, however, the assumption that the environment in which the actors and failures exist is interconnected helps to put into perspective that any one failure is not caused by any one actor and similarly any one failure will be required to be solved by a combination of actors. For example – "weak network failure may occur when companies do not interact efficiently; this may be a lack of cooperation with market parties, with technologically complementary firms or e.g. with the knowledge infrastructure (the actors)." (Woolthuis et. al., 2005; p.611)

As we are talking about an innovation system, the assumption that nothing happens in isolation and there is a constant interaction between the elements and surrounding environment holds true. Christopher Freeman stated that "national system of innovation is a network of organizations and individuals representing both public and private sector, which interact under constraints of nationally-specific institutions, in order to import, introduce and disseminate new technologies with an intention to improve performance of an enterprise or an economy." (Freeman, 1987 cited in Manzini, 2012) It is imperative to note that in this framework or innovation environment, policy makers play a central role while the other actors play a supportive role. Therefore, while trying to analyze the policy, the assumption is that the policy or scheme devised by the government has the main role of aligning the actors in such a way that they are able to fix the failures.

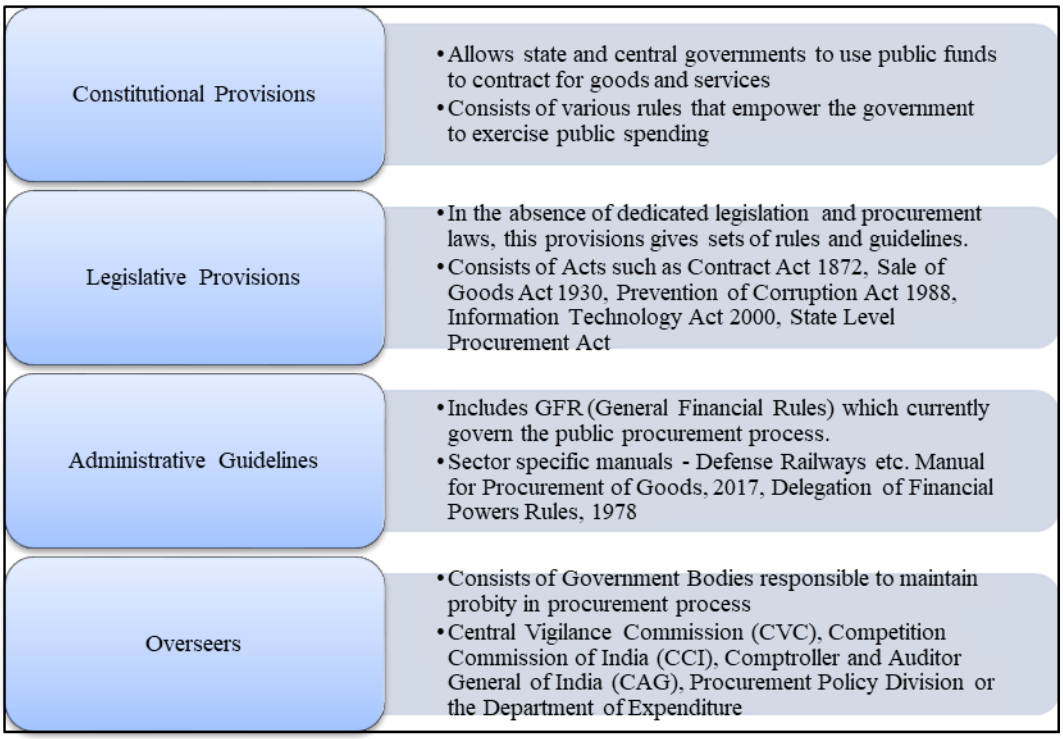
2.4 Public procurement of Innovation in India

India being a developing country understands the importance of Innovation and treats the agenda as a priority. OECD's India policy brief explains why Innovation is important in India, "As a global hub of offshore knowledge-intensive IT services and industry, India is a leading example of the economic possibilities innovation can bring. But India's growth rate has slowed in recent

years and poverty continues to be a major challenge. Investing in innovation and upgrading to higher value-added activities can boost productivity, create better paid jobs and strengthen growth*"* (OECD, 2014)

The public procurement framework in India has the following elements (Panda, Sahu and Gupta, 2016) (Mara and Deshpande, 2020): Constitutional provisions, Legislative provisions, Administrative guidelines and Overseers.

Figure 2: Public Procurement Framework in India (Source: Panda, Sahu and Gupta, 2016)



There is also some area/sector specific procurement rules, for example – Defense Procurement Manual 2009 and Defense Procurement Procedure (DPP) 2016, Indian Railway e-Procurement System (IREPS), Pharmaceutical Purchase Policy 2013 etc. The data on the research question will provide a glimpse of the procurement process in the Defense sector.

The institutional and regulatory framework in India aims to make sure that the public procurement process is transparent, is accountable and efficient. Some of the institutions and

policies that have been created by the government of India which indirectly plays the role of public procurement of innovation are:

a) **National Innovation Foundation** – NIF was founded in the year 2000 under the guidance of Department of Science and Technology, GOI, with a mission to cultivate grass root technological innovation and to foster knowledge based society. NIF supports firms working on technological innovation at a grass root level and gives them a commercial platform and enables them to become a part of the value-chain. However, this does not directly fall into the sphere of public procurement policy on paper, but in essence is an initiative by the GoI which works like public procurement of innovation.

b) **Science, Technology and Innovation policy** – The STIP was initiated with an objective of identifying the strengths and shortcomings of the Science, Technology and Innovation ecosystem in India in order to mobilize socio-economic development and make the Indian STI ecosystem globally competitive (DST, 2013). The STIP provides varied support ranging from financing, giving incentives, promoting research and development through Research and Innovation Excellence framework, devising mission mode programs which will deliver technology and innovation in various priority sectors such as Agriculture, Health, Energy, etc., enhancing public procurement programs to incentivize innovation from a wider perspective, providing flexible mechanism for supplier development programs for public procurement.

2.4.1 Public Procurement in Defense sector in India

The procurement process in all sectors in India is governed by the General Financial Rules 2017. There is no separate entity governing procurement in the defense sector. The Ministry of Defense (MoD) has devised two regulations for defense and security procurements – Defense Procurement Procedures (DPP) and Defense Procurement Model (DPM). Defense Procurement Procedures are meant to streamline the military procurement process meanwhile providing probity and transparency. Also, DPP provides guidelines for all capital acquisitions to be made by the Ministry of Defense inclusive of Armed forces. Under the Defense Procurement Procedure (DPP) 2016, a new scheme by the name “Buy Indian-IDDM (Indigenously Designed, Developed and Manufactured)” was launched with a view to promote indigenous designs and development of

equipment for the defense sector. This capital procurement scheme is considered the top most priority for procurement of defense equipment. Defense Procurement Model on the other hand takes care of the revenue procurements such as non-strategic and bulk procurements.

In April, 2018, an ecosystem for defense innovation was formed by Defense Innovation Organization (DIO) which is a non-profit company established with the purpose to act as managing and funding body for iDEX - The ecosystem referred to as Innovations for Defense Excellence. iDEX was created with a vision to foster innovation and technology development in Defense and Aerospace. iDEX also engages Start-ups, MSMEs, Independent Innovators and R&D institutions. It gives grants to such organizations to carry out research and development directed towards technological enhancements in the Indian Defense and Aerospace industry.

iDEX scheme incentivizes participant firms that participate in development of a prototype by funding them with INR 1.5 Million. Approximately **700 start-ups** participated in the Defense India Start-up challenge (DISC) which released 18 problem statements under 3 rounds. 58 start-ups were funded for challenges like 4G/LTE Tactical, See Through Armor which was required to provide 360º view from inside tanks using cameras, sensors and digital mapping systems, Individual protection systems with built-in sensors to monitor and transmit vital data in real time, Secure hardware based offline encryption device to help secure communication of sensitive data, Autonomous underwater swarm drones, Foliage penetration radar etc. (iDEX, n.d.)

The Defense Innovation Organization (DIO) has selected some incubators which support the iDEX scheme as partners. The role of these partners is to mentor the entrepreneurs and MSMEs to create technological products for Indian military and Public Sector Enterprises (PSU). Knowledge institutions and special incubation centers perform the role of partners – These include institutes such as Indian Institute of Technology, Hyderabad; Indian Institute of Science, Bangalore; Maker Village, Kochi which is the largest electronic hardware incubator and ESDM facility, Society for Innovation and Entrepreneurship (SINE) – Indian Institute of Technology, Mumbai; Centre for Innovation Incubation and Entrepreneurship (CIIE), Indian Institute of Management, Ahmedabad; t-Hub, Hyderabad, etc. (iDEX, n.d.).

Defense Acquisition Procedures (DAP) was introduced in 2020, in the form of an upgraded and reformed version of Defense Procurement Procedures (DPP). The reforms provide more transparency, probity, accountability, unbiased competition in the procurement procedures. DAP came into force with the vision of making India a global hub for defense manufacturing. DAP encourages procurement on the lines of mandate released by the Ministry of Defense which has banned import of certain products in order to encourage indigenization aligning with the achievement of 'Self Reliance Mission - Atma Nirbhar Bharat Abhiyan' of Government of India. DAP devises six Capital Acquisition Schemes - Buy, Buy & Make, Make, Leasing, Design & Develop and Strategic Partnership Model (SPM). The Buy scheme has further defined procurement categories which are - Buy (Indian - IDDM), Buy (Indian), and Buy (Global). The Buy and Make scheme is further classified into Buy and Make Indian and Buy (Global - Manufacture in India) procurement categories.

DAP emphasizes higher priority to the Buy IDDM procurement category. Let us further understand these procedures: (MoD, 2020)

- Buy (Indian - IDDM Indigenously Designed, Developed and Manufactured) - Acquisition of indigenously designed, developed and manufactured products by Indian vendors which has a minimum 50% Indigenous Content (IC) on the cost basis of the base contract price.
- Buy Indian - Acquisition of products from Indian vendors who may not have indigenously designed or manufactured the product and have a 60% IC on the cost basis of the base contract price.
- Buy Global - Direct purchase of complete product from foreign or Indian vendor. The Indian vendor in this case must have 30% IC at the least.
- Buy & Make Indian - Acquisition of products from Indian vendors who work in tie-up with foreign Original Equipment Manufacturers (OEM) followed by indigenous production with Transfer of Technology (ToT) as per range specified by the OEM. 50% IC is required here.
- Buy Global & Manufacture in India - Direct purchase from foreign vendor followed by indigenous manufacturing and maintenance through its subsidies in India or a joint venture or via an Indian Production Agency meeting a minimum of 50% IC.

Defense Production and Export Promotion Policy (DPEPP) brings along with itself some more lucrative reforms which are based around providing a boost to indigenous procurement and developing a dynamic, competitive defense industry. It provides an environment that encourages R&D, rewards innovation & promotes self-reliance. The provisions are intended to help reduce the dependency on import of defense equipment. The Ministry of Defense aims to promote export of defense products and achieve $5Billion in export of Aerospace and Defense goods and services by the year 2025. They aim to also achieve a turnover of about $25Billion (MoD, 2020).

Some of the notable steps in this direction are listed below:

- To boost indigenous procurement and provide impetus to innovation, a negative list of defense items have been created which places import embargo on the listed items. The list was first released in 2020 with 101 items which has now gone up to 310.
- Project Management Unit (PMU) set up to provide support during the acquisition process which will help estimate correct lead times, life cycle cost, facilitate contract management etc.
- Technology Assessment Cells (TAC) set up to assess Technology Readiness Levels (TRL) available in the country for all major systems and platforms and provide reports on industrial capability for design, re-design, development and production (PIB, 2020).

3. BRIEF OVERVIEW OF SYSTEMIC FAILURES OF INDIAN INNOVATION SYSTEM

The following section discusses the systemic failures that exist in the Indian economy that give context to the existence of a robust public procurement of innovation policy. One policy alone cannot definitely fill all gaps, however, in order to understand what the aim of the policy should be, it is imperative to first understand what failures it should try to bridge.

3.1 Infrastructure failures

The infrastructure failures as we know, define issues pertaining to the physical infrastructure such as roads, railways, electricity, internet etc. and knowledge/science infrastructure such as testing facilities, training etc. This failure could occur in two ways - in the form of unavailable infrastructure and the second way where infrastructure is available but not freely accessible (Negro, Alkemade & Hekkert, 2012). When it comes to infrastructure, there are issues due to the following factors: mismanagement of public funds, cartelization and bid-rigging, unavailability of MIS, time consuming and cumbersome process, manual rate negotiations and inefficient offline payment processing (CPI, n.d.), complex policy structure in the presence of multiple purchase preference policies making it confusing for buyers. Another phase to these failures is due to the inability to identify change resisting digital transformation and limited competition.

India lags behind on having basic infrastructure let alone modernized infrastructure. Though the road network in India is 5.98 million kms (IBEF, 2022), it is of lower quality in majority of places and congested. Road construction is inflicted with delays and cost overruns. As per a report from Mckinsey (2009), 70-90% of road construction projects are delayed due to land acquisition issues. The effect of this delay trickles down and causes cost overruns due to underutilized resources and labor costs. The nature and size of projects are also directly proportional to the cost overruns and delays. Larger projects have higher chances of delays (Singh, 2010). The Ministry of Statistics and Program Implementation in their Annual Report (2020-21) indicated that there was a 19% cost overrun and time delays ranging from 1-19 years in the 1687 Infrastructure projects in that period. The reason behind the time delays as indicated in the report was due to delay in getting permissions and clearances from various Union Ministries. Land acquisition, removal of encroachment, power

supply, water supply was among the issues faced from the State Governments' end. Railway network in India is overcrowded and managing beyond actual capacity. There is a rising need for railways to support freight capacity (MOSPI, 2021). As per PwC, 65% of freight is still carried by road which is already suffering from congestion (PwC, 2013). There seems to be mismanagement of funds or under-estimation of the required funds which can be utilized in modernizing the railway network.

Next widespread issue is that of Cartelization and bid-rigging which occurs when vendors deliberately collaborate and mutually decide the price and terms of the bid. This mutual submission of tender fails the whole procurement process, there is no space for fair competition, forbade new entrants in the market and may result in loss of quality and funds. Competition Commission in India (CCI) is the body which has been assigned with the task of investigating cases of bid rigging and cartel formation. One example can be taken from a case reviewed by CCI wherein a tender was released by Indian Railways to purchase feed valves for diesel locomotives. Only three bidders submitted proposals quoting identical prices. Out of the three, two firms tweaked their bids in such a manner that the third party received the final contract (Regional Training Institute, 2013)

The defense procurement is also not immune to infrastructure failures. There are several examples which showcase that many defense projects are marred with delays and instances of bid-rigging. A very prominent example is the procurement of Mirage 2000 fighter jets from France which was initiated in 2001 by the Indian Air Force. This later transformed into a tender for procuring 126 Medium Multi Role Combat Aircraft (MMRCA) in 2004 (ORF, 2021). No Request For Proposal was released until the year 2007. In the year 2015, India agreed to purchase 36 Rafale jets from France scrapping the original requirement of 126 fighter aircrafts (Deccan Herald, 2015). 35 out of 36 Rafales were delivered to India so far, the latest ones in the year 2022 (Hindustan Times, 2022). The issues with such delays are that it not only causes severe deficit of the required products but also loss of technological advancements over the years. It hampers the operational readiness of the forces (Kundu O., 2019).

3.2 Institutional failures

Moving on to the institutional failures – this failure refers to shortcomings caused due to the external environment including unfavorable laws and regulations and internal environment including values and culture which hinder growth. Institutional failures are further divided into hard institutional failures and soft institutional failures. Hard institutional failures occur when institutional mechanisms come in the way of innovation. Some of the laws and regulations such as labor laws, Intellectual Property Rights (IPR) if not designed taking into consideration the ease of business can halt the progress of innovative processes. IPRs are "particularly important for innovation, since they enable actors to appropriate the benefits of innovation, and the system of corporate governance" (Woothuis et. al., 2005) and its protection is imperative (Ezzeddine and Hammami, 2018). Keeping in mind the importance of IPR, Franco Malerba refers to hard institutional failures creating an appropriability trap, meaning that if there are very stringent regimes and laws, it is highly possible that it may limit the technological diffusion and as a result block differentiated technological abilities within an industry. Soft Institutional failures on the other hand are caused due to political values and culture which do not create a favorable environment for innovation. The soft institutional failures have an immense impact on innovation and could be a major hindrance.

In India's perspective, the main institutional drawback is that there is no law governing the public procurement process. Public procurement framework in India currently lacks a dedicated legislation. It is governed by various rules such as the General Financial Rules (GFR), ministry/department specific guidelines and procedures. There is a very complex federal framework for public service delivery (Hazarika and Jena, 2017). There are various rules and regulations which are clearly mentioned in the GFR regarding the process of procurement that needs to be followed while keeping corruption and allowing probity in the entire process. However, it is not backed by a comprehensive policy. Anti-competition is also a major institutional issue which is achieved via favoritism, bribery or simply because of bureaucracy in the system. For example: Departments/Ministries often maintain a list of short-listed suppliers who are eligible to participate in the procurement process via Limited Tender Enquiry (LTE). Open Tender Enquiries are generally avoided in order to limit competition. The Central Vigilance Commission (CVC) reports that often, the authorities responsible for approving the vendors deliberately impose strict regimens and procedures that discourage participation from potential bidders. An example can be taken from Indian Railways that

emphasizes that only the vendors pre-approved by the Research Design & Standards Organization (RDSO) will be allowed to participate in the procurement process. This process is unnecessarily difficult, time consuming and restrictive and discourages fair competition (Malhotra D., 2012).

A very apt example of hindrance caused due to unfavorable laws can be taken from the defense sector. Sikkim State Government declared areas near the Line of Actual Control (LAC) which marks the India-China border as sanctuaries/national park/reserves without approval from the Ministry of Defense, whereas it is mandatory. As the areas became sanctuaries, no construction work could be carried out without taking clearance from the Environment Ministry, state government and in some cases even the Supreme Court. As the areas consist of harsh terrains, it is imperative to have smoother roads and infrastructure to enable the defense units to keep the area safe. On the other hand, the concern of environmental damage gave rise to the requirement of environmental clearance. Thus, such rules and regulations created a precarious situation for the defense units impinging their preparedness (Kapoor Gen. D., 2013). The above example also showcases Infrastructural failure.

In terms of Innovation culture in India, it could be looked at two ways - on one hand, people are very skeptical to adapt to change and often are very comfortable with the way of things. On the other hand the ‘Jugaad’ culture is second nature among people. Jugaad is a hindi word which means a flexible, innovative and easy way to get things done. Navi Radjou terms Jugaad as an improvisational skill (Radjou and Euchner, 2016) which is common in developing countries which have enormous problems but very limited resources. Though it is creative, the jugaad culture will not lead India to achieve a higher innovation index. What is required is the need to nurture innovation at the roots i.e. knowledge institutions, which are currently lacking.

3.3 Interaction failures

Interaction failures are one of the most critical failures that need to be addressed especially when we are talking about innovation. As Innovation as a phenomenon does not take place in isolation, it is important that parties involved in the innovation process interact in an efficient manner. Some of the reasons behind the strong interaction failures in the Indian scenario are: Government bureaucracy, lack of accountability, favoritism, bribery and discrimination, culture of using influence to get things done, weak monitoring.

Bribery has long been part of the Indian economic system since the time of ‘License Raj - Permit Era’ which started just after the end of British rule in India and continued up till the early 1990s. The License Raj was the time of severe red-tapism (Majumdar, 1998) wherein the government had very strong control on the process of setting up business in India. Series of licenses were made mandatory before one could start a business; which meant obtaining licenses from various different authorities. In order to make the process a bit less cumbersome, people started to bribe officials so that they obtain licenses much faster, without the need to go through hassles. According to a recent survey conducted by Transparency International, India had the highest bribery rate (39%) as compared to 16 other Asian countries which participated in the survey. Also, it has the highest rate of people using influence and personal connection while using a public service (Transparency International, 2020).

Another strong interaction failure can be seen in the defense offset policy. According to this policy, as India imported a lot of defense goods which are expensive, the partnering countries had to invest some percentage of the total expense inside India either in the form of investment in Research and Development, Transfer of Technology, manufacture and maintenance of products etc. However, the offset policy did not have the desired result. There were no significant technology transfers or FDI as suppliers hesitated to commit technology (Kumar Behera, 2009), the vendors started to overquote in order to minimize the impact of offsets, some offsets were never recovered (Samunnatha, 2021).

A weak interaction failure can be seen in the slow pace of technology adoption in the Government departments. A lot of e-governance initiatives face strong resistance from the current bureaucratic system as it requires major restructuring of administrative processes and ways of working. Also, English language is considered as a major barrier in case of fast technology adoption given the diversity of Indian languages (Paramashivaiah and Suresh, 2016).

3.4 Capabilities failures

Capability failure occurs when firms are unable to interact with other actors or environments due to lack of knowledge, skills and resources or capacity to adapt a new technology. The lack of vision and innovative mindset due to limited exposure could also be one of the reasons for under-developed capabilities. Limited reachability to knowledge resources, inefficient educational structure, and lack of monetary resources for skill development could all sum up to become a capability failure. An example can be taken from challenges faced in the SMEs and MSMEs sector in India in terms of lack of know-how about latest technologies, managerial skills, benchmark global practices etc. As per a study conducted by Asian Development Bank Institute, 75 and 86% of SMEs and MSMEs are unaware of latest technological and market information (Pachouri and Sharma, 2016).

There is also a huge gap in effective policy implementation and execution. This is also coupled with the lack of funds to improve infrastructure such as availability of internet, technological and research resources, knowledge resources, labs etc. (Carnegie Endowment for International Peace, 2016). Education attracts only 3.1 % of GDP in India, resulting in low levels of learning and uncreative knowledge-society. If we look at a very granular level such as availability of basic infrastructure in schools; Unified District Information System for Education (UDISE+) report from 2019-2020 shows that approximately 23% of government schools do not have functional electricity, another 16%-30% schools lack facilities such as libraries, computer labs; 88% schools do not have internet facility (UDISE+, 2022).

Looking at the systemic failures that plague India, we can see that corruption is one of the major causes of disruption. In case of a developing economy like India, corruption majorly hinders growth and development (Tabish and Jha, 2011). Transparency, awareness, and accountability are some of the virtues that have been identified as remedies for curtailing corruption in public procurement (Cavill and Sohail, 2007, p.36).

4. EXISTING DRIVERS IN THE DIRECTION OF PPI POLICY

We briefly discussed the failures that exist in the Indian economy. Understanding the failures that inflict the economy is an important step in the direction of holistic policy design and helps form the idea of what the policy must work to improve. This chapter describes some initiatives and policy steps that have already been taken in this direction. The concepts are very closely linked to the public procurement framework and may be considered as the actions that the Actors in the innovation system undertake in order to fill the failure gaps. A special focus in this chapter will be on the initiatives taken in the defense sector.

4.1 Institutional Support

The role of Institutions is imperative in forming a strong basis for innovation. These form the fundamental building blocks of society and can also take the form "rules, norms and laws" (Johnson, 1992 cited in Rolfstam, 2009). As discussed previously, there is no particular law or legislation governing the public procurement process. For this purpose, the General Financial Rules (GFR) exist which consists of rules and orders that are required to be followed when undertaking any sort of public buying. GFRs have evolved over the years and include many innovation provisions. Currently, GFR governs the administrative guidelines of the public procurement framework. It facilitates smooth working and efficiency instead of creating impediments. These ensure proper implementation of financial procedures while maintaining accountability and due diligence. As per guidelines given in the General Financial Rules, transparency in the procurement process is of foremost importance. Rule 144 of GFR states that the procurement bodies need to ensure that all offers or bids should be invited in a fair and transparent manner and also that all relevant documents are published on the Central Public Procurement Portal (CPPP). The portal has been designed with the motive of providing a single information source for procurement related details. As per Rules 159 and 160 of the GFR, it is mandatory for all ministries and departments to publish and accept all bids respectively through the Central Public Procurement Portal (DOE, 2019). The portal also has a provision to give preference to MSMEs and Start-up vendors. The MSMEs and startups can enroll under the purchase preference category, hence paving the way for entrepreneurship. The CPPP portal also has an app which makes it all the more accessible.

Figure 3: eTenders processed through GePNIC on CPPP (CPPP, 2020)

Financial Year	eTenders	Value (in Crores)
2018-19	1367149	1807951.49
2017-18	1111230	1958787.38
2016-17	681971	890968.84
2015-16	513842	692177.78
2014-15	308854	477517.24

The National Association of Software and Service Companies (NASSCOM), a non-government trade association along with Center for Development of Advanced Computing (C-DAC), MeitY conduct ICT Grand challenges such as building 'Smart water supply measurement and monitoring system' which invites innovative ideas to address the water management issues in Rural, Semi-Urban and Urban areas.

As stated earlier, the procurement framework encapsulates overseers and legislative provisions which are supported by organizations such as Central Vigilance Commission (CVC), Competition Commission of India (CCI) and various other anti-corruption acts respectively; which help curb the issue of unfair practices. The CVC also acts as the nodal body for grievance redressal under the public procurement framework. The aggrieved bidders can approach CVC to report any discrepancy in the procurement process. CVC ensures that the procurement process is free of bias and undue influence. The Chief Technical Examiner's Organization (CTEO) that is a technical wing of CVC undertook intensive examination of 77 procurement cases covering over 41 organizations including Ministry of Defense, Indian Railways, Public Works Department (PWD) etc. The value of the procurement cases amounted to approximately INR 208 billion. Also, under the supervision of Chief Vigilance Officers, in the year 2019, 122 organizations conducted 2677 inspections of large contracts and major purchases leading to recovery of INR 330 million and 90 vigilance cases/system improvements (CVC, 2019). The CVC also acts as the nodal body for grievance redressal under the public procurement framework. The aggrieved bidders can approach CVC to report any discrepancy in the procurement process.

The public procurement framework too with its governing bodies like Central Vigilance Commission (CVC), Competition Commission of India (CCI) etc. provides a nurturing environment

for innovation and entrepreneurship to thrive. A lot of educational institutions such as Indian Institute of Technology (IIT) are part of such schemes and act as knowledge source and mentoring body.

4.2 Existence of e-portals

Portals like the Government e-Marketplace (GeM) help a great deal to achieve transparency in the system. The Government e-Marketplace (GeM) was designed with the aim of making it the national public procurement portal. The platform provided a transparent procurement system which was effective in encouraging greater participation and increased the geographic coverage. The portal works as an e-marketplace for procuring both goods and services for various government ministries and agencies. Rich repository of products, updated MIS data dashboard, vendor rating system by Security and Exchange Board of India (SEBI), dynamic pricing, uniform purchase procedures are some of the benefits of the portal. For large projects, national competitive biddings are used so that smaller firms are able to participate as well. GeM provides features like e-bidding, reverse e-auction, demand aggregation etc. that helps the government make good use of funds.

Similarly, platforms like eProcure which is a central public procurement portal and Government e-Procurement system (GePNIC) developed by National Informatics Center (NIC), Ministry of Electronics and Information Technology (MeitY) have given a platform which cater to procurement/tendering requirements in a an easy, accessible and transparent manner. These portals have been able to generate and fulfill a decent amount of tenders for various sectors like civil works, roads, electrical works, manpower supply, Laboratory and scientific equipment, miscellaneous goods and services etc., by means of competitive bidding and efficient allocation of resources. The sellers have direct access to the government departments through this portal. There are several other such portals developed by state governments and departments which help promote procurement requirements.

4.3 Monetary Incentives

The Government of India realizes the importance of improvement of infrastructure for overall economic growth and has allocated close to INR 7.5 lakh crore towards infrastructure development in the latest Union Budget 2022 (Kanabar, 2022). Some of the areas which would stimulate the

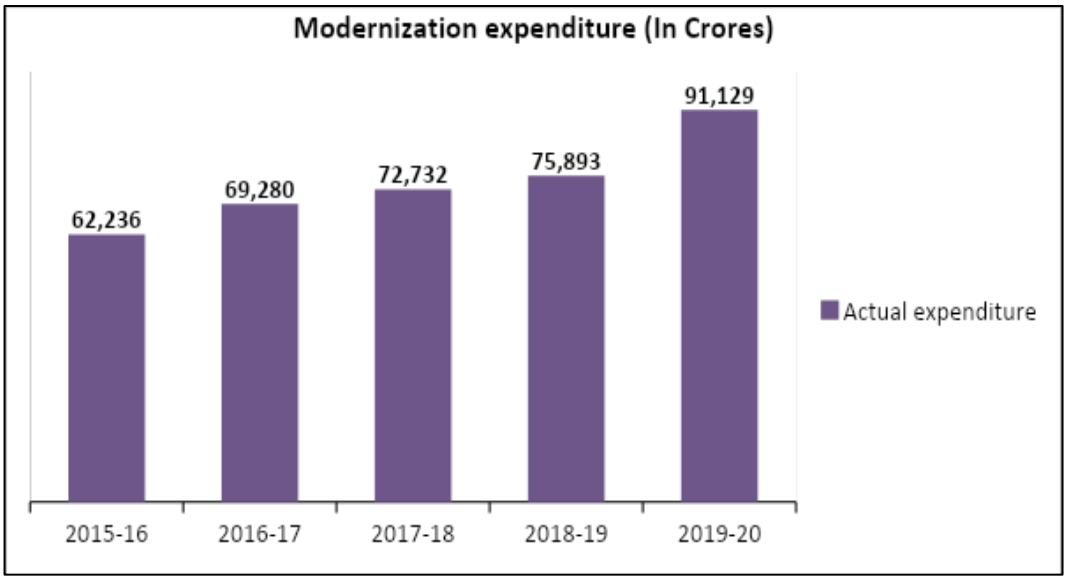
infrastructural development are: improved railway, roads, metros and highway construction, smart water supply systems, universal household electricity system, MSMEs, solar and wind power projects etc.

The iDEX initiative has been launched in partnership with Atal Innovation Mission. Under iDEX, Support for Prototype and Research Kickstart (SPARK) framework has been designed in order to provide entrepreneurs with support in prototyping and commercialization of functional prototypes. SPARK program ensures that a startup that has applied to a DISC iDEX challenge and has been selected; has at least an equivalent amount of financial or in-kind contribution for developing the product. The grants are provided on the basis three stages – Seed stage support, Series A investments and Follow-on investment. Under Seed stage support up to INR 25 million per startup is provided as a grant/debt/equity to startups that have working proof of concept and have the future potential to develop products for the defense sector. Series A investments grant INR 100 million per startup whose technology has been accepted by army, navy or air force, however, need further resources to scale up business. Follow-on investments are reserved for higher investments as and when required. In order to qualify for investment, a startup is thoroughly evaluated on various parameters such as: Technology advantage, Product advantage, Commercial advantage, and Integration advantage. Also the risk factors are assessed for each startup – Technology Risk, Market and financial risk, Operational Risk, and People risk (PIB, 2020).

Providing further impetus to investment schemes is a program by the name 'AGNii –Accelerating Growth of New India's Innovations' under Invest India initiative. AGNii helps startups and entrepreneurial organizations to commercialize technological innovations. The initiative gives a platform to new startups to showcase their idea and technology to a wider market through hackathons, online training modules, and gives opportunities to expand networks etc. Also, recently a Product Linked Incentive (PLI) scheme was launched in association with Drone Rules 2021 that incentivizes drone manufacturers. This has been done to promote indigenization capacity. The total pledged amount towards this scheme is INR 120 Crore (PIB, 2021).

The fact that the government realizes the importance of adapting technological advancements reflects from the growing expenditure on modernization of Armed Forces.

Figure 4: Expenditure on Capital Acquisition by the Ministry of Defense. Source: (PIB, 2020)



The overall budget allocated to the Ministry of Defense was about 15.5% of the total Central Government expenditure in the latest budget allocation. This amounts to approximately INR 6200 crores (MakeinIndia, n.d.). Under the Defense Procurement Procedure, during the years 2014-2019, the government has spent approximately INR 404880 crores towards categories of procurement (Ministry of Defense, 2019-20). The expenditure on defense research and development also is growing at a steady rate. For the year 2017-18, the Defense Research and Development Organization (DRDO) accounted for the maximum share of 31.6% of R&D expenditure (PIB, 2020). The Defense eProcurement published approximately 4,228 e-tenders in the financial year 2018-19 with more than 14,000 bids received (CPPP, 2020).

The iDEX initiative also was a huge success as more than 600 startups participated in DISC 1 and DISC 2 challenges alone. As discussed earlier, programs like iDEX provide incentives. For example: the category of ‘Make’ scheme under Defense Procurement Procedure (DPP) provides financial support of 70% of cost incurred on prototype development.

4.4 Innovation Programs/Initiatives

Improving infrastructure and making it more viable for innovation has been on the core target of the government. An example towards this commitment would be 'Smart Cities' initiative which is a promising initiative towards building a technology based society. The objective of this scheme will be to first ensure availability of core infrastructure such as water, electricity, health, education etc. and then also induce digitalization, e-governance etc. (Aijaz, 2021).

An environment for innovation is being achieved through programs like Start-up India, T-Hub, iDEX, etc. that provides one-stop solutions and nurturing environments to the entrepreneurs. Start-up provides young entrepreneurs with all the guidance related to legal regulations, financial nitty-gritties, feasibility testing, marketing solutions, commercialization etc. Through the Start-up India portal, the users have an option to connect with the startups, incubators, corporates/accelerators, mentors, investors and government ministries and departments. Also, there is an option to participate in cross country programs through the Startup India International Bridges forum with connections with Brazil, Finland, Japan, Korea, Russia, Sweden, Portugal and Singapore (Joshi, 2021). The bridge enables India and other countries to collaborate, connect and share resources with each other. On similar lines, such incubation hubs exist on a state level as well, for example: t-hub is an innovation ecosystem based in Hyderabad, Telangana. It has synergized start-ups, government, academic institutions and private sector. It functions in tandem with the Government e-Marketplace, MeitY and Digital India initiative. Another interesting step from the Ministry of Defense was to engage military and army personnel with immense on-the-field first-hand experience in 'iDEX 4 Fauji' program to support innovation. The objective of the program is to harness the knowledge from members of Indian Armed forces to improve existing platforms and also work on futuristic ideas for innovation in the defense sector.

Disruptive technologies, changing work and economic environments means that adaptability is the key to sustain. Adaptability would require learning and know-how of the internal and external environment. A lot of stress has been put into making the initiatives taken in the direction of innovation, knowledge supported initiatives that aim to enhance the capabilities and learning horizon. The procurement schemes devised have one feature that is very prominent and that is partnership with knowledge institutions. For instance, the mandate of Startup-India scheme is to

assist the firms throughout the innovation process by providing mentorship in collaboration with incubation organizations, hand-holding through legal and technical procedures. Anyone who is a part of startup India platform has access to market research reports for various topics such as Internet of Things, Fintech, Artificial Intelligence, Regulation and Taxation, Ecommerce, Healthcare, Finance etc.; various startups from technology sector; incubators; marketing professionals etc.

A very unique initiative in the direction of knowledge based innovation is the Atal Innovation Mission which is also part of the defense procurement ecosystem. Atal Innovation Mission (AIM) has been designed with the purpose of creating and promoting a culture of innovation and entrepreneurship in the country. AIM is given the responsibility of developing programs and policies to foster innovation, provide the stakeholders with platforms and collaboration opportunities and create an umbrella structure to manage innovation and entrepreneurship ecosystem (NITI Aayog, 2016). AIM follows the approach of cultivating innovation from the grass-root level i.e. encouraging a culture of problem-solving and innovative mindset starting from schools, universities, research institutes, private sectors, MSMEs and so on. Under the initiatives, 'Atal Tinkering Labs (ATLs)' have been opened across various schools in the country; 'Atal Incubation Centers (AICs)' have been established in universities, research organizations and corporates. Till date, AIM has established more than 10000 ATLs across the country and has a reach to about 2 million school students. The students are engaged in projects related to robotics, 3D printing, prototyping, Artificial Intelligence etc. There are approximately 68 Atal Incubation Centers in India that have incubated nearly 2200 start-ups till now (NITI Aayog, 2016). The government also finances the establishment of these centers for a period of 5 years.

Towards building resource and monetary capabilities, the Science, Technology and Innovation Policy provide an impetus to the overall procurement and innovation process. Due to the onset of public procurement of innovation initiatives across various sectors and on a central level, it has been able to garner special focus in the 5th STIP policy which is aimed at improving the policy implementation strategy, strengthening the financial structure, encouraging decentralization and inclusion. The policy makers identified the issue of low investments and inadequate direct finance support to public procurement strategies and therefore keeping this in mind, revised the policy. The

5th Science, Technology and Innovation Policy, 2020 has the following provisions which strengthens the innovation procurement and entrepreneurship (DST, 2013):

- Attempt indigenization of technology and indigenous technology. Under the policy, a Strategic Technology Board (STB) and Strategic Technology Fund (STF) will be created to form strategic conjunction between departments and incentivize relevant sectors respectively.
- Special programs for supplier development for public procurement in various sectors especially SMEs and Start-ups.
- States to strengthen participation in Science, Technology and Innovation by providing financial enhancements. States will keep an earmarked budget from state-allocation to this effect.
- Inculcation of well integrated Science and Technology support programs to help entrepreneurs.
- Improving speed, transparency, clarity in the program delivery - streamlining overlapping schemes, reducing bureaucratic hindrances and having a centralized database.

5. METHODOLOGY

The aim of the thesis is to establish if public procurement can boost innovation and entrepreneurship and see how this concept has worked in the context of India. The initial approach was to use Woolthuis's System failure framework for innovation policy design and evaluation of the gaps that public procurement of innovation as an initiative has been able to fulfill. This framework was helpful for an ex-post policy analysis to explore whether or not the application of public procurement has led to innovation and surge in entrepreneurship in the defense sector. Using the failure framework, the author tried to plot the areas where public procurement as a measure has enabled to overcome the failure. This helped to form a structured approach to the research question.

The study used mixed-methods employing both theoretical and empirical interpretations. The research is primarily, explanatory in nature wherein the aim was to find a cause-effect relationship between public procurement, innovation and entrepreneurship. A web-based qualitative questionnaire was administered in the month of April, 2021, to the startups which took part in defense procurement challenges with the aim of gaining an overall feedback about the experience in participating in schemes and competitions organized by the defense sector, understanding the impact in terms of monetary and knowledge-gaining that the defense procurement schemes have on such entrepreneurial organizations, nature of procurement, what percentage contribution do such schemes have on their turnovers and what do they consider as a barrier to innovation in current set-up.

The information on such organizations also required a desk research using which the participants had been chosen. The objective of the questionnaire was to gather feedback from the participants related to their experience of engaging with the public procurement process, what kind of innovative products are being created and what they think about innovation and knowledge-intensive entrepreneurship.

The following gives an example of the kind of organizations chosen as these have participated in various programs organized by the Ministry of Defense under defense procurement programs primarily focused on technology based solutions:

a) **Morphedo Technologies Pvt. Ltd.** – Development Agency chosen under Technology Development Fund (TDF) scheme by Defense R&D Organization (DRDO), Ministry of Defense, India. Provides research, design and manufacturing AI/IOT solutions.
b) **Astrome** – A very successful start-up which has won various awards and challenges such as NASSCOM's Most Promising Aerospace and Defense startup, National award in 'Technology Startup' category in the year 2018. Specializes in Satellite communication, wireless communication etc.
c) **ideaForge Technology Pvt. Ltd.** – Licensed Manufacturer of UAVs approved by the Ministry of Defense (MoD). They bagged a $20million deal from the Indian Army. Their drones are used by Indian Armed Forces and police forces. Also used for geospatial surveillance
d) **iSenses** – A machine intelligence company specializing in AI, machine learning, automatic system recognition etc.
e) **Tonbo Imaging** – Winner of the "See through Armor" DISC challenge. Specializes in micro-optics, sensors for military applications

Additionally, a small study was carried out on some more defense sector start-ups to find out the type of innovation and procurement that is happening. This was important in order to understand the background of the startups and the steps taken by the government which provided a push to the startups in the direction of innovation.

6. RESULT

This chapter is dedicated to state out the results of the research. The following summarizes the findings:

- Under the iDEX program, so far 117 challenges have been released and 114 startups/individual entrepreneurs/MSMEs won the challenges. The funding earmarked for these challenges range from INR 1.5-10 crores.

Table 1: Overview of iDEX Challenges (Source: iDEX, n.d.)

iDEX Challenge	No. of Problem Statements	No. of Winners
DISC 1	10	35
DISC 2	3	9
DISC 3	3	14
DISC 4	11	21
DISC 5	35	12
DISC 6	38	Ongoing
Open Challenge 1	10	13
Open Challenge 2	5	8
Open Challenge 3	2	2
Total	**117**	**114**

- The kind of defense projects the companies were involved with include Developing Indigenised LRU(Line Replacement Unit) for LCA (Light Combat Aircraft), Design and fabrication of Acoustic sensor enclosure by Morphedo; Indian Army Northern Command UAV (Unmanned Aerial Vehicle) by iSenses; High Altitude Mini Drone undertaken by iForge; Thermal Imaging Scopes, Thermal Imaging Binoculars, Vehicle Upgrades, Border, Coastal Surveillance Systems by Tonbo Imaging; SpaceNet satellite communication providing wireless internet to ships and remote areas, Gigamesh – multi Gbps wireless communication device by Astrome.

- The nature of procurement primarily is direct procurement as it is related to the defense sector.

- The average time period invested in these defense projects are somewhere between 2-5 years.

- It is seen that the percentage contribution of these procurement schemes/challenges to the turnovers of these entrepreneurial firms in some cases is quite significant – for example, ideaForge indicated that the contribution is about 90%; while the other firms mentioned it to be around 10%.

Next part of the questionnaire used Likert scale to assess the sentiment and opinion around public procurement of innovation; whether the schemes are able to deliver the desired outcome and perceived in the intended way i.e. to boost entrepreneurship; to help startups to scale up and commercialize their product; to eliminate the hindrances and to encourage an environment of innovation leading to a digitally equipped society.

Figure 5: Response on the advantage of public procurement schemes by defense sector

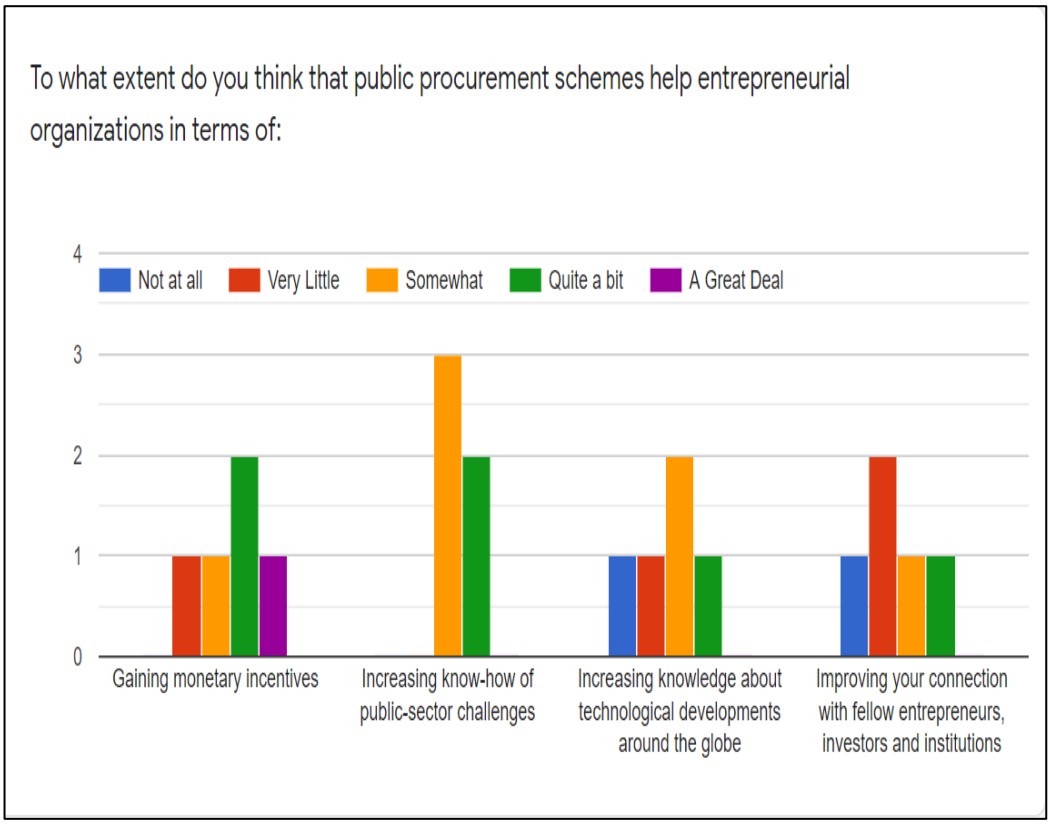


Figure 6: Response on the perspective on Public Procurement process in Defense sector – I

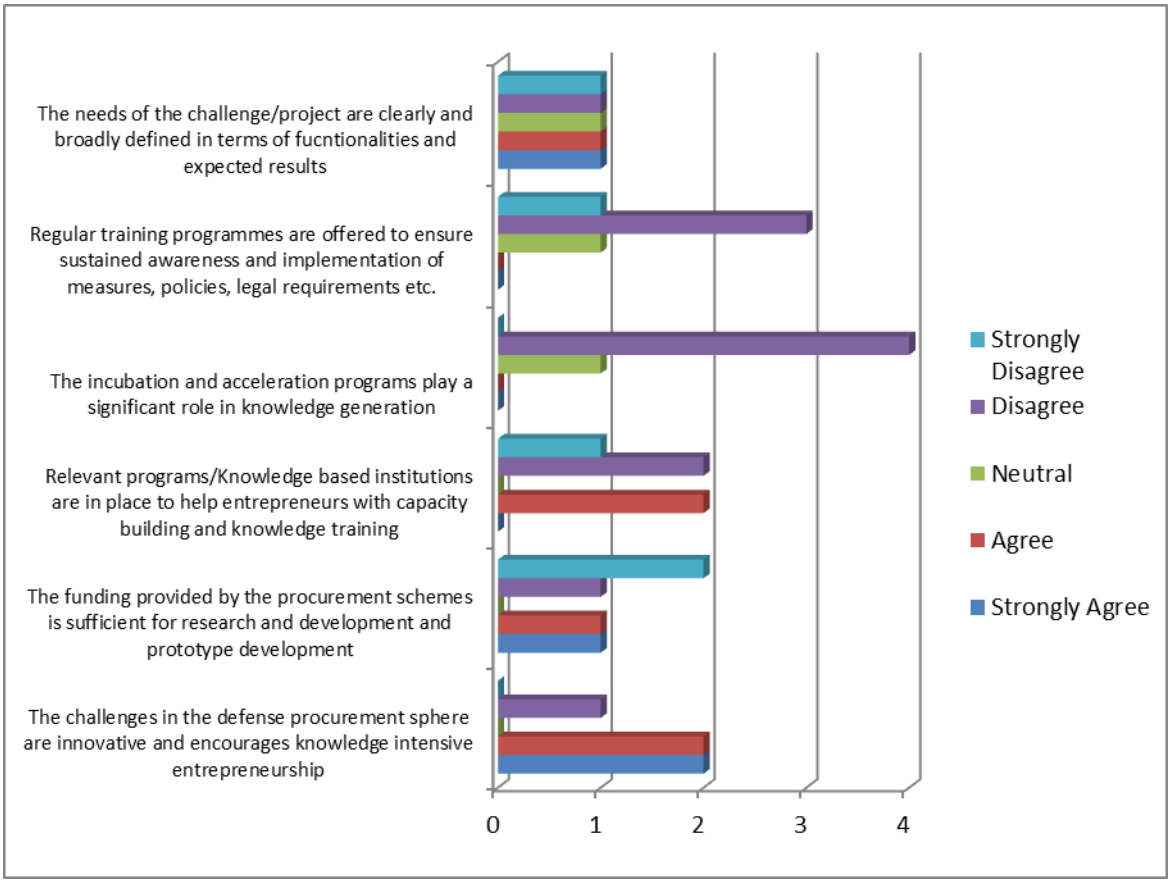
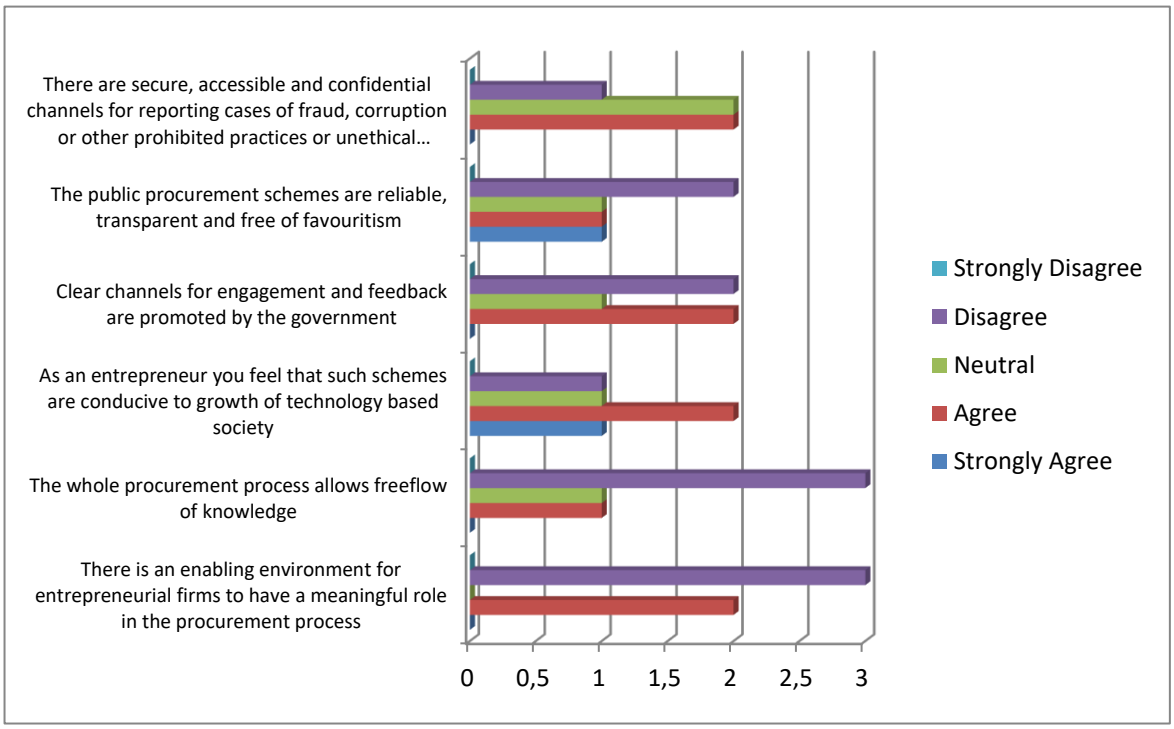


Figure 7: Response on the perspective on Public Procurement process in Defense sector - II



- The results indicate that the schemes do incentivize the entrepreneurial organizations. When asked whether the schemes help gain monetary incentives, a majority of responses were in affirmative.

- The users find that the public procurement schemes are backed by secure, accessible and confidential channels for reporting fraud, corruption and unethical practices. Entrepreneurs also feel that such schemes are conducive to the growth of a technological based society. Most importantly, there is a very positive response towards the notion that challenges in defense public procurement process encourages knowledge-intensive entrepreneurship.

- One time investments seem insufficient for both research and development and prototype development. This also reflects in the answer provided when asked whether the funding provided by a particular procurement schemes is enough. The question got mixed reviews where three respondents disagreed and two strongly agreed.

- The overall response received towards the schemes and initiatives are positive which can be showcased through the following comments:
  "*It has been a great learning experience and has opened up opportunities for attracting other defense related projects*."; *"We have to win on our own merit and efforts";* "*My firm has somewhat benefited*"; "*We have immensely benefited from the procurement schemes*".

- It is pointed out that the research and development phase faced some barriers due to lack of availability of required raw materials and testing labs; as put by one of the respondent - "*Barriers faced with respect to defence R&D/indigenization: procurement of defence and aerospace grade raw material and testing laboratories*." - Manya Jha, Morphedo

- Further questions on the quality of delivery of programs received somewhat divided reviews. For example, when asked if the needs of the challenge/project are clearly and broadly defined in terms of functionalities and expected results, the respondents had scattered reviews with each person choosing different views.

- A definitive answer to whether the schemes help in improving connections with fellow entrepreneurs and investors could not be sourced.

- The area which is associated with some negative sentiment was about knowledge enhancement and flow. Almost, all parameter related to knowledge were skewed towards disagreement with the idea that the schemes can help in increasing know-how and knowledge about technological developments happening around the globe for example.

- Majority of the respondents agreed with statements such as public procurement schemes are reliable, transparent and free of favoritism. One of the indicators of this could be that the percentage of Open/Advertised eTenders inclusive of defense tenders in the fiscal year 2020-21 is about 60% (CPPP Dashboard, 2021).

Further desk research was undertaken in order to gauge the reason behind the genesis of some defense startups, the technologies they use, type of innovation and type of defense procurement. The following table depicts the findings:

Table 2: Assessing the types of innovation, procurement and relevance of Defense Startups (Author)

S.no.	Startup	Founded in	Project	Technology feature	Association with	Type of Innovation in terms of Technology	Type of Innovation In terms of Indian defense	Funding Raised	Type of Procurement	Relevance/Enablers
1	**IdeaForge**	2007	Unmanned Aerial Vehicles, Drone solutions - Surveillance, Reconnaissance	Sensors, RFID	Make in India, iDEX, Indian Army	Incremental	Incremental	$18.4 million	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Ban on import of drones by Govt. of India - Tax subsidies to drone manufacturers. - 1.2 Bn Product linked Incentive (PLI) Scheme for Drone Industry - Requirement of Vertical take-off drones in the absence of clear runway

2	**Tonbo Imaging**	2012	See through Armour, Imaging Equipments	Augmented Reality, Vehicular Communication Sytems, Electro-optics	Indian Army, DRDO, Make in India	Incremental	Incremental	$30.9 million	Buy & Make Indian	- Part of iDEX DISC -I challenge - Import embargo on defense items - Requirement to replace Israeli surveillance equipments and have indigenous ones
3	**Vinveli**	2013	Unmanned Aerial Vehicles, Combat Drones	Sensors, RFID	National Security Guard, Central Reserve Police Force	Incremental	Incremental	$20,000	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Ban on import of drones by Govt. of India - Tax subsidies to drone manufacturers. - 1.2 Bn Product linked Incentive (PIL) Scheme for Drone Industry
4	**Dimension NXG (AjnaLens)**	2014	AR headset for military use, Situational awareness system	Virtual Reality, Augmented Reality, Wearable technology, SnapDragon processor	DRDO, Indian Army and Navy	Incremental	Radical	$6.3 million	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Part of iDEX DISC challenge - Requirement of VR technology to increase battle field awareness. - Need for light weight headsets - Requirement of upgrading Man portable air-defense systems
5	**Sagar Defense Engineering**	2015	Unmanned Marine Vehicles	Sensors, Optical Sensors	Indian Navy	Incremental	Radical	$20,000	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Navy's requirement to shift from risky and expensive human diving to machinery that can remain submerged for long time in high combat zones - System which can be fitted to any manned vessel to make it unmanned
6	**Cron Systems (Cron AI)**	2015	3D perception processing	Deep-learning, Artificial Intelligence, Sensor, Semiconductor, Lidar, Radar	Startup India, Indian Armed Forces, DIPP	Incremental	Radical	$4million	Buy and Make Indian	- Requirement of the Indian Army to be equipped with IOT & Intrusion detection devices for border protection - DIPP recognition

7	**Combat Robotics**	2015	Chassis less Amphibious Ground Vehicle	Robotics, Semiconductor	Startup India, iDEX	Radical	Radical	$20,000	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Need for unmanned technology to help secure harsh terrains such as high-altitude mountainous regions and desert around Indian borders. - Ability of the system to carry machine guns, detect and neutralize explosives
8	**EyeROV**	2016	Remotely Operated Vehicles, Underwater Drones	Marine Robotics	MeitY Maker Village Kerala, Startup India, DRDO	Radical	Radical	$70,000	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Requirement to replace divers with systems for underwater terrains which can go down to 100 meters.
9	**Optimized Electrotech**	2017	Electro-optic Surveillance - Vision Series and Eye Series	Long Range Imaging, Motion detection, Artificial Intelligence	iDEX, CISF, Indian Army	Incremental	Radical	$2.8 million	Buy and Make Indian	- Requirement of border security solutions - Need for long range, any weather monitoring equipment
10	**Big Bang Boom Solutions**	2018	Anti-drone defense system	Electromagnetic Pulse, Radar technology, Sensors	DRDO, Indian Armed Forces, iDEX	Incremental	Radical	$1.2 million	Buy Indian - IDDM (Indigenously Designed, Developed and Manufactured)	- Ban on import of drones by Govt. of India - Tax subsidies to drone manufacturers. - 1.2 Bn Product linked Incentive (PIL) Scheme for Drone Industry

Factoring in the findings so far, actors contributing to the current public procurement setup in order to overcome the failures and achieve a holistic system for innovation was plotted on the System failures framework:

- In case of Infrastructure failure for example, when we try to map this on the failure framework; the missing actors who are appointed to fill the gaps are from Demand and Companies. We see further in the discussion section how and why these actors have been involved.

- In case of hard institutional failures, we can see that, through measures like General Financial Rules, all the actors have been involved in the process in order to overcome the failures in the absence of a comprehensive law for public procurement. Soft institutional failures require the intervention of knowledge institutions, demand and companies.

- In case of Interaction failure, plotting the insights on the failure framework, we can see that the most engaged actors are companies and knowledge institutions especially in the case of weak interaction failure. In case of strong interaction failure, we can say that Companies are pulled in to plug the failures along with government obviously being the driving force.

- For Capabilities failures, we see that actors from the third party, knowledge institutions and companies are pulled in to plug the failures.

Figure 8: Areas where public procurement through various schemes plays a role to overcome the failures (Author)

<table>
<tr><td>Failures/Actors</td><td>Demand
- Companies
- Large buyers</td><td>Companies
- Startups
- SMEs
- Large firms
- MNCs</td><td>Knowledge Institutions
- Universities
- Technology institutes</td><td>Third Parties
- Intermediaries
- VCs
- Banks</td></tr>
<tr><td>Infrastructure Failure</td><td colspan="2">Government eProcurement System (GePNIC), Government e-Marketplace (GeM), eProcure</td><td></td><td></td></tr>
<tr><td>Institutional Failure</td><td colspan="4"></td></tr>
<tr><td>Hard</td><td colspan="4">General Financial Rules (GFR), Central Public Procurement Portal (CPPP)</td></tr>
<tr><td>Soft</td><td colspan="3">Startup India, tHub, iDEX</td><td></td></tr>
<tr><td>Interaction Failure</td><td colspan="4"></td></tr>
<tr><td>Weak</td><td></td><td colspan="2">iDEX, Startup India</td><td></td></tr>
<tr><td>Strong</td><td></td><td>Central Vigilance Commission (CVC)</td><td></td><td></td></tr>
<tr><td>Capability Failure</td><td></td><td colspan="2">Startup India, Science Technology and Innovation Policy (STIP), Atal Innovation Mission (AIM), Accelerating Growth of New India’s Innovations (AGNii) scheme</td><td>Support for Prototype and Research Kickstart (SPARK)</td></tr>
</table>

7. DISCUSSION

In an attempt to gauge how successfully the defense sector has been able to devise public procurement in order to foster innovation and entrepreneurship, several institutions and programs surrounding the public procurement framework were studied and a questionnaire was administered to some startups which participated in procurement challenges and schemes organized by the Ministry of Defense, India.

Primary research shows that there definitely has been a surge in the growth of startups in the presence of initiatives such as iDEX. The scheme is supported by various knowledge institutions that help participants at every step of the procurement lifecycle. The incubation programs associated with the schemes help provide a platform for firms to enable them to increase their connections and develop skills and knowledge pertaining to innovation. The several innovation and incubation labs set up by these institutions provide expert mentoring, business acceleration programs and innovation labs. These kinds of platforms provide the firms an opportunity to expand their connection and in the process collect useful insights from industry experts and experienced professionals. Not only firms but also individual innovators can become a part of the ecosystem by taking part in open challenges. Also, by interacting with similar start-ups, an environment of healthy competition is encouraged. Estache and Iimi (2008) identify strengthening competition in public procurement as an important step towards good governance and economic efficiency. Such programs could be considered to fall under the “market-based entrepreneurship policy” which not only have government aid but also foster relationships between organizations and individuals by means of knowledge sharing (Preuss, 2011).

While reflecting on the questionnaire however, we come across some points of contradiction. For example, when we try to gauge the level of sustainability the funds provide, the results show that while the respondents agree that the schemes help in gaining incentives to a large extent, a majority of sentiment goes in favor of the notion that one time investments fall short when talking about cost incurred on R&D and prototype development. This highlights that though there are various incentive-based schemes, there is a need to revisit the effectiveness in terms of long term benefits.

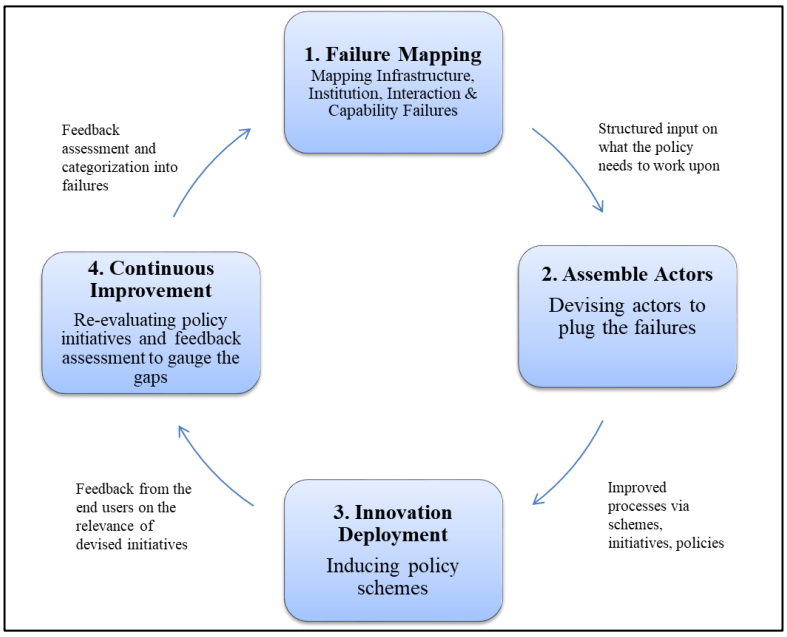
Training about policies, measures and legal requirements appears to be lacking. On asking whether incubation and acceleration programs play a significant role in knowledge generation, the majority were in disagreement. Almost all parameters related to knowledge were skewed towards disagreement with the idea that the schemes can help in increasing know-how and knowledge about technological developments happening around the globe. The reason being that though there are a lot of workshops and programs organized, these are not relevant to some firms. This reflects in the mixed response received on the question of whether relevant programs were in place to help entrepreneurs with capacity building and knowledge training. Similarly, when asked if the needs of the challenge/project are clearly and broadly defined in terms of functionalities and expected results, the respondents had scattered reviews with each person choosing different views. Again, this emphasis a need for revisiting the core purpose of knowledge training and gauge whether resources are relevant to the industry.

A desk research conducted on some other defense industry startups depicted in Table 2 shows that there is a definitely extensive use of modern technology. Initiatives such as iDEX depict that huge importance is given to modernize the defense industry along with achieving indigenization. The type of technology innovation achieved is Incremental and in some cases completely radical in terms of usage in the Indian defense sector. This is a positive sign and relays that such initiatives do give rise to innovation. These provide a push to entrepreneurs to foray into this sector and depicts that the government shows confidence in the capabilities of the domestic sector to supply sensitive defense equipment.

Reflecting on the realizations so far, relating the outcome to the System failure framework, we can see that the public procurement framework used by the defense sector has been effective in terms of providing an initial base and push to innovation and knowledge intensive entrepreneurship taking into account the failures that exist in the economy and actors from the procurement framework that help to overcome the failures. The outcome fits well with the theory that in order to find a solution to the issues, it is important to identify the causal factors and then implement clear steps and procedures to enable decision makers to objectively gauge performance of procurement systems (Kumar et al., 2017). However, we also see a need for exploring the option to add another important element to the framework and that is the need to re-evaluate, re-assess and collect continuous

feedback to keep the initiatives and programmes in line with the dynamic needs of the end-user. This will help to cyclically engage in the process to make it more robust. This idea is depicted in the following figure:

Figure 9: Suggested flow of framework activities (Author) (inspired by System Failure Framework for Innovation Policy Design (Woolthius, 2005)



The limitation of the study is that the data set is very small as many startups were unavailable to answer the questionnaire. However, as the nature of questionnaire reflects important feedback from the direct end-users from whom the initiatives have been designed, the currently collected data forms the basis for further research. A wider research can be undertaken to collect feedback from all end-users which are directly impacted by the schemes. Also, the questionnaire could be evolved further to include issues that are specific to individual schemes.

Conclusively, the defense sector in India has been able to kick start the use of public procurement effectively and acts as a benchmark for other sectors to follow suit. With the help of a feedback mechanism, the policy makers can achieve a more holistic view and create a robust procurement policy which is currently missing.

8. CONCLUSION

The framework of public procurement in India has become robust over the years. As we see throughout the discussion, the government and policy makers realize that the process of e-procurement and public procurement of innovation are important stepping stones towards achieving a technologically advanced society. Towards this goal the government has devised many schemes and initiatives. The research aimed to identify whether public procurement can be devised as a tool to nurture innovation and entrepreneurship. The approach of this paper was to first understand the failures and shortcomings that exist in the context of India that public procurement as an innovation policy measure could help to overcome. In order to first have a holistic view of the public procurement of innovation in India and to gauge whether the measures are appropriate as a tool to innovation, the author used the System Failure Framework for innovation policy design which is an extension of the market failure argument. The framework encapsulates four types of failures – infrastructure failure, interaction failure, institution failure and capability failure; along with the actors existing in the innovation ecosystems both causing and plugging the failures.

Theoretical information gathered for the study comprises information on failures in the Indian economy the need redressal and several schemes, policies and initiatives related to defense public procurement that have been used by the Government of India to plug the failures. The research in the thesis is an attempt to try and find the public procurement measures in the Indian defense sector that help overcoming the failures and also placing the different measures on the framework to show which measure is a remedy for which particular failure.

In order to understand the impression that public procurement challenges and schemes have on entrepreneurs especially who are involved with defense procurement, a questionnaire was designed to take feedback on their overall experience and a desk research was carried out to understand the background of the start-ups, type of innovation they achieved and the type of procurement carried out keeping in line with the Defense Acquisition Procedure.

Results reflect that the overall impact of public procurement schemes has been positive especially in the defense sector. The number of initiative and schemes being undertaken by the government reflect that there is a clear goal of inducing innovation and entrepreneurship in the economy. The public procurement framework provides a structured path in this direction. The only missing element is the re-evaluation and reassessment of the devised schemes in order to gauge the effectiveness and impact on the end user. This can be overcome by introducing a feedback mechanism in the public procurement framework. Towards this goal, a framework flow has been suggested by the Author which has integrated a feedback mechanism in the steps of policy design approach.

KOKKUVÕTE

Innovatsiooni riigihanked on kujunenud poliitiliseks vahendiks, mida saab kasutada innovatsiooni ja ettevõtlusvõimaluste edendamiseks. Lõputöö käsitleb innovatsiooni riigihankeid Indias ja kuidas see on mänginud rolli innovatsiooni ökosüsteemile tõuke andmisel ja ettevõtluse soodustamisel. Erilist tähelepanu pööratakse kaitsesektorile, et näha, kuidas see on uuenduste riigihankeid kohandanud, kavandades spetsiaalseid algatusi, mis toovad päevavalgele erinevaid stsenaariume ja väljakutseid, mida saab lahendada uuenduslike lahenduste ja toodetega. Kuna üldise struktuuri ja skeemide kohta puudub tagasisidemehhanism, annab lähtepunkti selle lõputöö uurimine. Analüüs viiakse läbi innovatsioonipoliitika kavandamise süsteemirikete raamistiku abil, et näha, kuidas India riigihangete algatused mängivad rolli nende puuduste ületamisel; koos küsimustikupõhise uuringuga, et hinnata algatuste üldist tõhusust ja koguda tagasisidet. Tulemused näitavad, et innovatsioonialgatuste riigihanked on Indias keskendunud suuresti innovatsioonile ja ettevõtlusele ning neil on potentsiaal mõelda välja tervikliku innovatsioonipoliitika vahendina. Neid saab muuta kindlamaks, võttes arvesse lõppkasutajate (antud juhul ettevõtjate) ees seisvaid probleeme ja töötades riigihangete kaasavama poliitika väljatöötamise nimel.

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APPENDICES

Appendix 1 – Web-based Questionnaire

1. Your Name
2. Name of your Organization
3. Position in the Organization
4. Please list the Defence procurement project(s) you have been a part of
5. How would you describe the nature of procurement you were involved in?
    - Direct
    - Catalytic
    - Pre-Commercial
6. What is the average time period invested in one defence project?
7. To what extent do you think that public procurement schemes help entrepreneurial organizations in terms of: (Scales: Not at all, Very Little, Somewhat, Quite a bit, A great deal)
    - Gaining monetary incentives
    - Increasing know-how of public-sector challenges
    - Increasing knowledge about technological developments around the globe
    - Improving your connection with fellow entrepreneurs, investors and institutions
8. Please indicate the extent to which you agree to the following statements: (Scales: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree)
    - The challenges in the defence procurement sphere are innovative and encourages knowledge intensive entrepreneurship
    - The funding provided by the procurement schemes is sufficient for research and development and prototype development
    - Relevant programs/Knowledge based institutions are in place to help entrepreneurs with capacity building and knowledge training
    - The incubation and acceleration programs play a significant role in knowledge generation
    - Regular training programmes are offered to ensure sustained awareness and implementation of measures, policies, legal requirements etc.
    - The needs of the challenge/project are clearly and broadly defined in terms of functionalities and expected results
    - There is an enabling environment for entrepreneurial firms to have a meaningful role in the procurement process
    - The whole procurement process allows free flow of knowledge
    - As an entrepreneur you feel that such schemes are conducive to growth of technology based society
    - Clear channels for engagement and feedback are promoted by the government
    - The public procurement schemes are reliable, transparent and free of favouritism
    - There are secure, accessible and confidential channels for reporting cases of fraud, corruption or other prohibited practices or unethical behaviour.
9. What percentage of your turnover is attributed to such schemes and challenges?
10. How has your firm benefited overall from participating in such schemes.

11. From your experience with public procurement, what would you identify as the most significant barriers to innovation?