Accelerating Timelines for System Induction: Role of iDEX

Dissertation Submitted to the Panjab University, Chandigarh for the award of degree of **Executive Masters in Public Administration and Public Policy,** in partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration (2023-24)

Submitted by

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INDIAN INSTITUTE OF PUBLIC ADMINISTRATION

NEW DELHI

CERTIFICATE

It is hereby declared that this dissertation is my original piece of work and to the best of my knowledge and belief, it contains no material previously published or written by any other person. I am aware of the University's norms and regulations regarding plagiarism including the disciplinary action that it may invite. Any use of the works by any other author, in any form, is adequately acknowledged at their point of use or in the Bibliography.

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I have the pleasure to certify that **Commodore Arvind Chari,** has pursued his research work and prepared the present dissertation titled '**Accelerating Timelines for System Induction: Role of iDEX**', under my guidance and supervision. The same is the result of research done by him/her and to the best of my knowledge; no part of the same has been part of any monograph, dissertation or book earlier. This is being submitted to the Panjab University, Chandigarh, for the purpose of **Executive Masters in Public Administration and Public Policy** in partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration (APPPA) of Indian Institute of Public Administration (IIPA), New Delhi.

I recommend that the dissertation of Commodore Arvind Chari is worthy of consideration for the award of Executive Masters degree of the Panjab University, Chandigarh.

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List of Abbreviations

4IR	4th Industrial Revolution
AI	Artificial Intelligence
AID	Agence de l'innovation de Défense (Defence Innovation Agency, France)
ASTRID	*Accompagnement Spécifique des travaux de Recherches et d'Innovation Défense*
BCG	Boston Consulting Group
BHEL	Bharat Heavy Electrical Limited
BEL	Bharat Electronics Limited
CTP	Commercial Technology Pipeline
DAP	Defence Acquisition Procedure
DARPA	Defence Advanced Research Projects Agency
DEF	Defense Entrepreneurship Forum
DDP	Department of Defence Production, Government of India
DOP	Defence Offset Policy
DPIIT	Department for Promotion of Industry and Internal Trade, GoI
DPP	Defence Procurement Procedure
DPSU	Defence Public Sector Undertaking
DPM	Defence Procurement Manual
DRDO	Defence Research and Design Organisation, Government of India
EDT	Emerging and Disruptive Technologies
EU	European Union
HAL	Hindustan Aeronautics Limited
IDEX	Innovations for Defence Excellence
IDDM	Indigenously Designed Developed and Manufactured
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MOQ	Minimum Order Quantity
MR-SAM	Medium Range-Surface to Air Missile
MSME	Micro, Small and Medium Enterprises
NATO	North Atlantic Treaty Organisation
OCPP	Other Capital Procurement Procedure

POC	Proof of Concept
PSU	Public Sector Undertaking
RAPID	Régime d’appui à l’innovation duale
RDA	Research, Development and Acquisition
SBIR	Small Business Innovation Research
SBTT	Small Business Technology Transfer
TPCR	Technology Perspective and Capability Roadmap
USAF	United States Air Force

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Executive Summary

1. The concept of innovation is multifaceted and extends beyond mere novelty, encompassing problem-solving methodologies within constraints. In India, innovation, colloquially referred to as "Jugaad," permeates various spheres, from academia to sports fields, illustrating its universal applicability. India's burgeoning entrepreneurial ecosystem reflects a paradigm shift towards self-reliance, with the nation emerging as the third-largest startup ecosystem globally, fostering innovation across diverse sectors. In the defence domain, innovation has historically been intrinsic, driving solutions in tactics, equipment, and supply chain management. However, when it comes to modernisation, traditional defence R&D establishments face challenges in keeping pace with technological evolution, necessitating a shift towards open innovation models. Major global powers, including the US, UK, and NATO, have established defence innovation hubs to address this gap, promoting collaboration and competition in developing defence solutions. India's response to this imperative is Innovations for Defence Excellence (iDEX), an initiative aimed at fostering indigenous defence innovation through engagement with various stakeholders. Despite advancements, achieving self-reliance in defence remains a challenge, underscored by factors like funding constraints and reliance on imports. The pressing need to accelerate the transition from prototype development to full-scale production in the defence sector underscores the critical role of defence innovation challenges like iDEX.

2. This study aims to assess the role of iDEX in accelerating timelines for system induction into the Armed Forces. It seeks to analyse the global and domestic defence innovation landscape, focusing particularly on the regulatory frameworks such as Innovations for Defence Excellence (iDEX). The study will examine the processes involved in transitioning iDEX prototypes to full-scale production and induction into service, identifying obstacles faced by firms in this process. By evaluating these challenges and opportunities, the study aims to develop a set of strategies to facilitate faster assimilation of prototypes and technologies into the defence sector through iDEX, thereby fostering innovation and enhancing India's self-reliance in defence.

3. This study adopts a mixed-methods research approach, combining qualitative and quantitative methods to identify and analyse challenges hindering effective defence innovation in India and propose strategies to address them. Qualitative methods offer insights into organizational culture, policy impacts, and collaboration dynamics, while quantitative methods analyse trends and correlations in defence innovation data. The study utilizes both primary and secondary sources, with a primary survey targeting professionals engaged in iDEX, conventional defence indigenization, and innovation. The semi-structured survey tool gathers viewpoints on various aspects, complemented by secondary data analysis of articles, research papers, and government policies.

4. The study's rationale stems from the imperative of self-reliance or ‘Atmanirbhar Bharat’ in the defence sector. Research questions encompass various dimensions, including the current defence innovation landscape, regulatory frameworks, prototyping to production processes, and leveraging iDEX for enhancing self-reliance in defence. The study's scope covers the iDEX initiative, addressing qualitative and quantitative analyses of defence innovation challenges, with limitations related to historical data availability and scope confined to unclassified open-source information.

5. A comprehensive review of literature has been undertaken and can be broadly classified as papers on the ‘Defence Innovation’ process itself; studies on how ‘defence innovations’ strategies are implemented globally and studies specific to Indian defence innovation eco-system. The literature survey shows that ‘Defence Innovation’ has become a global imperative, prompting the adoption of 'Open Innovation' practices to expedite the integration of New Age Technologies into Armed Forces worldwide. Despite strong military R&D organizations, the evolution of innovation ecosystems and the effectiveness of programs like iDEX remain pivotal topics for discussion in subsequent chapters. While literature on defence innovation is abundant, considering the confidential nature of the work, some gaps persist. Most literature underscores the need for user-centric, open, and collaborative approaches, emphasizing the emergence of Emerging and Disruptive Technologies (E & DTs) from commercial rather than military needs. However, gaps exist in the conceptualization of performance metrics, discussion

of trade-offs between different innovation types, exploration of external factors shaping global defence innovation, and examination of processes and timelines for technology assimilation post-prototyping. Addressing these gaps would enable a more rigorous and comprehensive analysis, informing policymakers and practitioners to enhance defence innovation strategies and outcomes.

6. In order to get a better insight into the global best practices, the study examines the defence innovation framework of the United States, France and Israel. The countries were so chosen since all three countries already had a robust defence-industrial complex with established R&D organisations. Yet, they have all understood the need to adopt a more agile and innovative approach if they are to harness the new-age technologies into the military which are driven by the commercial considerations in the civil world. They have accordingly resorted to creating newer structures to foster defence innovation. Administrations have also published ‘innovation strategies’ with very well-defined objectives on what are the fields of study and outcomes they are expecting from these programs. Two global superpowers at the forefront of innovation China and Russia were omitted from the study due to both paucity of time and non-availability of adequate literature.

7. In the Indian scenario, the government created the iDEX framework in 2018. The processes that have been set have to a large extent catalysed the Indian industry to start investing in the Defence. The iDEX framework has also shown the Armed Forces and a few DPSUs to start thinking ‘out of the box’ and seek out solutions to both day-to-day problems and long-term strategic issues by nurturing/exploiting the vibrant technological eco-system available within the country.

8. As part of the study, a large number of start-ups/innovators/MSMEs and service officers who handle iDEX were approached for their feedback. Based on the analysis of the responses a SWOT Analysis has been presented both on the start-ups/innovators and iDEX. Further, the following conclusions can be drawn on the efficacy of the iDEX process.

(a) While the thrust on indigenisation has been there, iDEX has given an impetus to the indigenisation process. The data shows that iDEX has introduced many young innovators/ entrepreneurs/ start-ups and MSMEs into the defence eco-system.

(b) It has enabled the faster assimilation of newer technologies into the Armed Forces.

(c) As on date, iDEX has been leveraged to introduce smaller, stand-alone auxiliary systems into the Armed Forces. However, in order that iDEX can be used to develop larger Sensors (like Radars/ Sonars/ EW systems); Combat Management Systems or Weapon systems the processes need to be refined further. As these systems require multi-disciplinary specialities, lead program integrators need to be designated and the innovation eco-system needs to be strengthened further to be able to work in such a collaborative environment.

(a) The timelines for processing cases, despite the enablers in the DAP-2020 have not reduced significantly, insofar as system induction is concerned.

(b) Funding, complex procedures, lack of guarantees of production orders, lack of domain expertise are some of the challenges faced by the start-ups/ innovators.

(c) On the service side, sustainability of start-ups, supply chain vulnerabilities, long term product support and quality assurance are challenges which need to be addressed to strengthen the eco-system.

9. **The Way Ahead**. After engaging with start-ups and government officials who have utilized iDEX, as well as conducting a thorough analysis of global trends, several points warrant consideration for strengthening the iDEX process.

(a) **Innovation Strategy**. There's a need for a defined long-term strategy to leverage iDEX effectively, prioritizing technologies aligned with evolving threat scenarios and fostering a robust defence innovation ecosystem.

(b) **Processes**. Simplification of processes, particularly in timelines, outcomes assessment, and feedback mechanisms, is imperative to enhance efficiency and effectiveness.

(c) **Funding**. Addressing funding challenges and exploring innovative funding models, such as gradient-based matching contributions, could enhance sustainability and outcomes for start-ups and innovators.

(d) **User Interaction**. Facilitating deeper user involvement throughout the innovation process ensures alignment between technology solutions and user needs, thereby enhancing program effectiveness.

(e) **Trials**. Streamlining trial processes, adjusting timelines realistically, and fostering symbiotic relationships among stakeholders are crucial for smoother and efficient trial execution.

(f) **Supply Chain Vulnerability**. Mitigating supply chain vulnerabilities during proposal evaluation and prototype development is essential for scalability and long-term support.

(g) **Lack of Domain Knowledge**. Addressing the lack of domain knowledge among innovators and start-ups, as well as understanding user requirements, can be achieved through engagement with retired service personnel and skill upgrades.

(h) **Collaboration**. Facilitating partnerships between innovators/start-ups and larger entities like PSUs can address scalability and product support challenges while preserving the start-ups' identity and intellectual property rights.

10. In summary, iDEX, in its current iteration, marks a significant initial stride along a lengthy path. The agility it injects into the indigenization process and its swift integration of numerous entrepreneurs into the defence ecosystem within a short span deserve recognition. iDEX holds the promise of revitalizing a stagnant defence-industrial complex and facilitating the provision of the Armed Forces with cutting-edge, domestically designed and developed military equipment. To realize this potential, it's imperative to continually solicit feedback from stakeholders and refine processes for greater efficacy. Additionally, as a nation, we ought to delineate a 'defence innovation strategy' outlining the priority areas iDEX will tackle versus those addressed by conventional establishments. This strategic delineation will channel efforts toward new and niche technologies, expediting the timeline for system induction.

Chapter 1 – Introduction

"Innovation is the process of turning ideas into manufacturable and marketable form"

Watts Humphrey

Introduction

1. Innovation, what is it? By definition, innovation is a noun, meaning "a new method or idea" or "the creating and use of new ideas and methods"[1]. I would define Innovation as a method of solving a problem or finding a solution to a problem, when there are constraints. Colloquially in India, innovation is loosely interchanged with the Hindi word "Jugaad". Innovation is not restricted to the technical fields but universally applicable. Be it in schools, colleges, on the battlefield or on a sports field; be it cooking or implementing a public policy, one can innovate anywhere. Sometimes, you can generate innovative solutions in-house; at times however, a rank outsider (someone with a totally different skill set) may just give you that little hint that could help you solve the problem.

2. Innovation does not have a 'one-size-fits-all' solution. For an innovation to be successful you need to have an ecosystem wherein you can ideate; collaborate; implement and hopefully create value[2]. The process itself takes time and many times the solution may not yield the desired results. What is important here is not the result in itself (a positive result is obviously great for morale) but rather the ability to try and find a solution despite the constraints imposed. Satell (2017) defines four types of innovation and created "an Innovation Matrix to help leaders identify the right type of strategy to solve a problem, by asking two questions: *How well can we define the problem?* and *How well can we define the skill domain(s) needed to solve it".*

(a) **Sustaining Innovation**. This is the most common type of innovation, where we improve existing products or services with well-defined problems and skills.

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[1] Definition as per the Cambridge English Dictionary.

[2] Cowan KM & Haralson Lyn E (2009)

(b) **Breakthrough Innovation**. This is when we face a well-defined problem that requires unconventional skills or approaches to solve, such as developing a new vaccine or a quantum computer.

(c) **Disruptive Innovation**. This is when we create new markets or value propositions with well-defined skills but poorly defined problems, such as Uber or Netflix.

(d) **Basic Research**. This is the most exploratory type of innovation, where we seek to discover new knowledge or phenomena with poorly defined problems and skills, such as the Higgs boson or CRISPR.

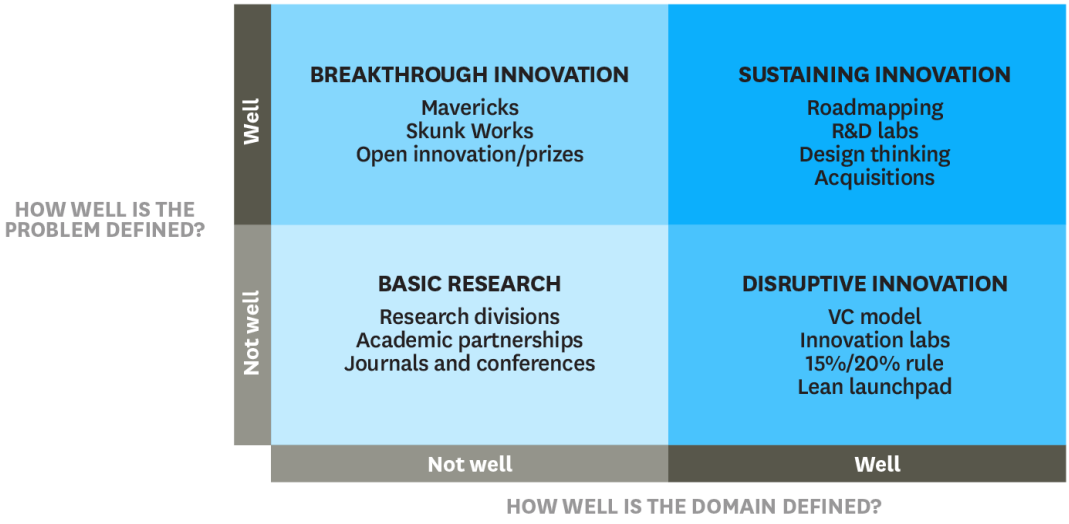

Figure 1: Innovation Matrix [Source : Greg Satell(2017) HBR]

3. **<u>Innovation in India</u>**. If the early 19th century saw our freedom fighters call for swadeshi; global geo-politics and the COVID-19 pandemic has once again reminded us that resilience lies in self-reliance. The war-cry this time is 'Go vocal for Local' and the best way to do that is innovate. If the 80s saw encouragement and a clamour for 'a government job'; this decade is witnessing the encouragement and growth of entrepreneurs. The eco-system is being made conducive for an individual to be an entrepreneur and create a Start-Up. Indian

entrepreneurs are commanding attention in the global business arena. As of May 31, 2023, India has established itself as the third-largest startup ecosystem worldwide, boasting over 99,000 startups officially recognized by DPIIT across 670 districts nationwide. Notably, India holds the second position in innovation quality among middle-income economies, excelling particularly in scientific publication standards and university quality. Innovation transcends boundaries in India, with startups addressing challenges across 56 diverse industrial sectors. Noteworthy sectors include IT services (13%), healthcare and life sciences (9%), education (7%), agriculture (5%), and food & beverages (5%). The nation proudly hosts 108 Unicorns, collectively valued at $340.80 billion, symbolizing the vibrant entrepreneurial spirit flourishing within its borders[3]. The Digital India programme, has essentially leveraged India's skill set in technology services sector and introduced a slew of digital products. Digital payments, digital documentation, digital innovations in the field of Public Administration have made Public Service delivery transparent and accessible to all users.

Defence Innovation

4. Innovation has been an integral part of the military through time immemorial. There are numerous instances of battle field Commanders finding innovative ways to win the war when the odds were against them. Be it battlefield tactics, equipment maintenance or management of supply chain issues, innovation is in the DNA of most military personnel. So, what is defence innovation? While there are numerous definitions, the processes of generating and fielding technologies and other products, services, processes, or practices that are new or improved in the defence context.

5. Traditionally, military R&D has been government owned and sponsored. Most major developed/developing countries have established R&D establishments for systems development and induction (both for domestic and export use). In the past Military technology has been adopted into numerous commercial applications, what one would call 'Tactical to Practical' e.g. Radars,

[3] Source: Indian Unicorn Landscape - Startups, Growth, FDI, Investors (investindia.gov.in)

Microwave Ovens (an off-shoot of Radar Tech), Lasers and even the Internet (a DARPA project).

6. Today, however, the roles have been reversed. Traditional defence R&D Establishments are unable to keep up with the fast-changing evolution in the technology. The exponential increase in the computing powers of Integrated Chips, the fast-paced development of Internet applications, development of Artificial Intelligence (AI) & Machine Language (ML) have all changed the landscape of technological innovation. The potential military applications of these 'Dual-Use' technologies is tremendous, and militaries world-over have found the existing R&D Establishments lacking. The US[4], UK, France, Canada[5], Australia[6], NATO[7] and even the EU[8] have all created defence innovation hubs/ departments and resorted to creation of structures that promote "Open Innovation", "Innovation Challenges" or similar competitions to encourage development of new technologies and solutions for defence applications. Defence innovation is considered a critical element of strategic competition among nations, as it enables them to develop, integrate, and use Emerging and Disruptive Technologies (EDTs) in military applications. It is also a complex and challenging process that requires alignment among multiple drivers, such as threat perceptions; political support; agile organisational structures, and high investment levels.

7. These challenges or competitions invite individuals, start-ups, companies, R&D establishments to propose and develop innovative solutions for defence applications. The focus and objectives of these challenges vary as per the need of the user, but mostly they address issues of contemporary and disruptive technologies. Some seed capital is put up by the government/ military and the individual/start-up is in most cases required to complete the challenge by developing a prototype/ demonstrating a Proof of Concept (POC). Thereafter, if

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[4] US – Defense Innovation Unit Experimental (DIUx) – www.diu.mil

[5] Canada - Innovation for Defence Excellence and Security (IDEaS) - https://www.canada.ca/en/department-national-defence/programs/defence-ideas.html

[6] Defence Innovation Hub - https://www.innovationhub.defence.gov.au

[7] NATO - Defence Innovation Accelerator for the North Atlantic (DIANA) - www.diana.nato.int

[8] European Union – European Union Defence Innovation Scheme (EUDIS) - www.eudis.europa.eu/

the prototype meets the user requirements, the system may be inducted into service. Israel, Russia and China are also major defence powers who are leveraging technological innovation for modernising their military, but there are no known Open Innovation challenges of both nations. A more rigourous study on some of these challenges will be undertaken in Chapter 3.

8. **Innovations for Defence Excellence (iDEX)**. In such a nebulous environment, can India be far behind. iDEX is the Indian defence innovation ecosystem initiated by the Department of Defence Production (DDP), Government of India to foster innovation & technology development in the Defence & Aerospace Sector by engaging innovators, entrepreneurs to deliver technologically advanced solutions for modernizing the Indian Military. iDEX will engage Industries including MSMEs, start-ups, individual innovators, R&D institutes and academia and provide them grants/funding and other support to carry out R&D development which has good potential for future adoption for Indian defence and aerospace needs[9]. The core objectives are to: -

(a) **Facilitate**. Facilitate rapid development of new, indigenized and innovative technologies for the Indian Defence and Aerospace Sector, to meet needs for these sectors in shorter timelines.

(b) **Create**. Create a culture of engagement with innovative start-ups, to encourage co-creation for defence and aerospace sectors.

(c) **Empower**. Empower a culture of co-creation and co-innovation with the defence and aerospace industries.

Statement of the Problem

9. Self-reliance in the Defence Sector is the ultimate aim of any nation. One of the many factors differentiating the developed and developing economies, is that the developed nations have an indigenous defence industry, while developing nations are dependent on imports to meet their defence needs. To date the

[9] Source: www.idex.gov.in

backbone of R&D for the Indian Defence Forces has been the Defence Research and Design Organisation (DRDO)[10]. DRDO Labs spread across the length and breadth of the country, have been engaged in theoretical research as well as product development. Defence PSUs such as Bharat Electronics (BEL), Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL) have been the production partners on Transfer of Technology (ToT) from DRDO. Gaps in the defence needs have been made good with imports. In addition, each service has an Indigenisation Cell which looks at indigenisation of systems as well as sub-systems/sub-assemblies/components to make good immediate shortfalls. Joint development in collaboration with friendly nations has also been resorted to in the field of missiles production (BrahMos with Russia MR-SAM with Israel).

10. Indigenous development of systems for the Defence and Aerospace sector has not fructified at the pace one would have liked. There are numerous factors which have been responsible for delayed development of systems. Lack of funding; denial of technology; the non-availability of core competencies/ manufacturing technology within the country in certain areas, heavy capital investments coupled with insufficient MOQs, archaic procurement processes are just some of the reasons[11]. The last two decades has seen a growth and there has been a marked increase in the indigenous content of systems. The Make-in-India program, strong organisational leadership, the incorporation of the offset clause in large scale capital procurements, involvement of the academia by the respective services and the financial autonomy to the field units to find innovative solutions to day-to-day problems have all contributed in no small measure towards the march for self-reliance. The recent conflict in Ukraine has only heightened the urgent need for self-reliance in the defence sector. Thus, there is a need for a more cohesive approach which would provide the necessary impetus for assimilation of the latest technologies in the defence sector and boost self-reliance.

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[10] Behera, L. K. (2014)

[11] This information is based on personal experience over the last twenty-five years by the researcher during the course of his various appointments and interactions with serving and retired members of the armed forces, industry captains, and senior scientists from DRDO.

11. The key problem statement therefore is to examine how effective or to what extent do defence innovation challenges (like iDEX) will accelerate the process moving from prototype development to full-scale production in the defence sector.

Research Objectives

12. To identify and analyse the key challenges hindering effective defence innovation in India and propose strategies for addressing these challenges. It will have the following objectives: -

(a) To analyse the defence innovation landscape globally and in India.

(b) To examine the existing regulatory frameworks related to defence innovation (iDEX) in India.

(c) To examine the stipulated processes of transition from iDEX prototypes to production/induction into service.

(d) To assess the challenges encountered by a firm while taking an iDEX prototype to production within the existing regulations and observing the stipulated processes.

(e) To develop a comprehensive set of strategies for faster assimilation of the prototypes/technology into the defence sector through iDEX.

Research Design

13. This study will adopt a mixed-methods research approach, combining both qualitative and quantitative methods. Qualitative methods can provide in-depth insights into organisational culture, policy impacts and collaboration dynamics; while quantitative methods can help analyse trends and correlations in defence innovation data.

14. The study would rely on both primary and secondary sources. The primary survey would employ a semi-structured tool to take a survey to take view of various professionals engaged in iDEX, conventional indigenisation in the Defence sector, Scientists from DRDO, professionals from DPSUs and innovators/start-ups in this field wherein some close-ended questions would be asked. Secondary data would include an exhaustive analysis of various articles, research papers, books and relevant Government policies Therefore, the research approach would be primarily qualitative supported by some quantitative reasoning - the research design would be descriptive.

Rationale/ Justification

15. Atmanirbhar Bharat especially in the Defence Sector is the need of the hour. We also need to be technologically concurrent with global trends to be able to combat threats. The policy framework aims at fast tracking adoption of new technology/ systems into the defence sector. However, the new paradigm in its present form keeps the established R&D organisations and defence manufacturing facilities out of its ambit at the preliminary stages. It is therefore imperative to study the efficacy of using Defence Innovation Challenges as a vehicle for adoption of new technology/ systems into the Armed Forces. It is also imperative to assess the impact of such special purpose vehicles on the growth of the private defence industry in meeting the National Strategic vision of Atmanirbhar Bharat by 2047. It is also important to study whether such a special purpose vehicle is restricted to the development of disruptive technologies or will it also be relevant to development of core technologies.

Research Questions

16. The following questions would merit consideration: -

(a) **Identify the Current Defence Innovation Landscape**

(i) **Global Trends**. What are the various Defence Innovation Challenges been used in other nations? What are the best practices of defence innovation that can be contextualised for India?

(ii) How different is iDEX from the older methods of indigenisation adopted by the Defence Sector?

(iii) What shortfalls in the Defence and Aerospace industry are being addressed by the iDEX challenges?

(iv) What are the opportunities and challenges anticipated in the long-term sustainability of iDEX for a meaningful impact?

(b) **Assess Regulatory Frameworks**. What are the current regulatory frameworks that are facilitating innovations in Defence?

(c) **Prototyping to Production**.

(i) How do defence organizations currently navigate the transition from prototype to production in the context of innovation?

(ii) What are the primary challenges faced during the transition process, and how does one overcome these obstacles.

(iii) What strategies can be employed to streamline the transition from prototype to production, ensuring efficiency and effectiveness?

(d) How can the iDEX opportunity be leveraged to enhance self-reliance in the Defence and Aerospace Sector to align with the Strategic National Objective of Atmanirbhar Bharat and Vision 2047?

Scope/ Limitations/ Delimitations

17. The study is based on the iDEX: Innovations for Defence Excellence initiative. The research aims to provide insights into various dimensions of defence innovation, ranging from technological and organisational challenges to policy and collaboration barriers. The scope encompasses both qualitative and quantitative analysis, ensuring a holistic understanding of the subject matter. Additionally, the proposal addresses the crucial aspect of transitioning prototypes to production, highlighting strategies for effectively bridging the bap between innovative ideas and operational implementation.

18. Due to the recent implementation of the scheme, there is a limitation of historical data which would preclude long term analysis and trending. The study is limited in scope to only those aspects which are unclassified and available as open-source information. While the study will draw comparisons with the current defence R&D mechanism, the focus would be more to examine whether this innovative method of defence innovations through crowd-sourcing will provide the necessary impetus for the defence sector to become technologically self-reliant; and how will the defence sector transition from prototypes to production systems.

Research Methods to be Applied and Data Sources

19. To get comprehensive feedback on the research objectives, data was collected from the primary and secondary sources.

(a) **Primary Data**. Primary data was collected from the various stakeholders identified. The data was collected in form of a questionnaire which was shared with the stakeholders. The stakeholders were grouped into two major groups.

(i) **Innovators/ Start-ups & MSMEs**. They were identified to provide feedback on how effective the scheme has been and has it facilitated ease of doing business with the Government/ Service Headquarters.

(ii) **Users – Service Officers/ Program Managers**. The second group was the Service Officers/ Program Managers who are utilising the iDEX program to facilitate induction of systems into the service.

(iii) The rationale of using two groups (the Users and the Innovators) was to see how both sides view the iDEX program and see if there are hurdles or roadblocks which are common. This would give a better understanding to the policy makers on how to tweak the policy to facilitate faster induction.

(b) **Secondary Data**. Secondary data was collected through research papers available on the open domain and various government websites (Indian and foreign) which are related to Defence Innovation.

20. **Challenges in collecting Primary Data**. One of the major challenges was collecting responses from the innovators/ start-ups/ MSMEs. While a few were responsive and quick to give inputs; many of the start-ups were reluctant to commit to answer on paper (figuratively speaking). The questionnaire was shared with the respondents both directly after speaking to them. The questionnaire was also forwarded through the professional Directorates at the Service HQ; TDAC of the Navy and Army Design Bureau (i.e. those who are presently working with these start-ups). Efforts to seek data from the DIO did not fructify, despite requests and follow-ups with the COO and the staff. All data on iDEX procedures and statistics are open-source data.

21. The broad Chapterisation scheme is enumerated below.

(a) **Chapter 1 - Introduction**. The chapter will give an overview of the subject highlighting all the important aspects. It will cover the Problem Statement and the Research Objectives.

(b) **Chapter 2 – Review of Literature**. The chapter will summarise the learnings from the review of literature.

(c) **Chapter 3 – Global Trends in Defence Innovation**. This chapter will discuss the global trends in Defence Innovation. It will examine how and where all Defence Innovation Challenges have been adopted, to what extent and what is the impact of these challenges.

(d) **Chapter 4 – Preliminary Study of iDEX and its Implementation**. This chapter will examine the implementation of iDEX over the last four years. It will examine how the three services have leveraged the iDEX platform and what have been the results. It will assess the efficacy of the program with respect to the induction of the systems into the armed forces

(e) **Chapter 5 – Findings & Observations**. This chapter will analyse the findings and observations. Based on the analysis, it will assess what challenges are faced in the process of faster adoption/ assimilation of the new technologies/ products into the service.

(f) **Chapter 6 – Recommendations & Conclusion**. This chapter will examine the impact of iDEX on the defence eco-system and recommend any changes to the existing policy framework to make the process more effective and efficient.

Chapter 2 – Review of Literature

1. Defence innovation is a critical element of strategic competition among nations, as it enables them to develop, integrate, and use emerging and disruptive technologies (EDTs) in military applications. However, defence innovation is also a complex and challenging process that requires alignment among multiple drivers, such as threat perceptions, political support, organisational structures, and investment levels. The available literature can be broadly classified as papers on the 'Defence Innovation' process itself; studies on how 'defence innovations' strategies are implemented in various countries including economic impact of defence/military spending and studies specific to Indian R&D.

Defence Innovation

2. Kotila et al (2023) in their report for RAND Corporation, examine how DoD can improve the commercial technology pipeline (CTP), which is the process of identifying, developing, and adopting private-sector innovations for military use. The report uses a mixed-method qualitative approach, including literature review, interviews, case studies, and a policy game, to analyse the current state of the CTP, identify challenges and gaps, and propose alternative approaches to strengthen the CTP. The report develops a model of the CTP that consists of three phases (identification, development, and adoption) and a set of core enabling functions that occur within and across these phases. The report finds that the CTP is not well-functioning, as it lacks shared mission, common goals, clear roles, coordination, collaboration, information sharing, and aligned incentives among CTP stakeholders. The report also identifies specific challenges and gaps in CTP functions, such as technology scouting, problem curation, transition planning, and funding. They offer recommendations to address these challenges and gaps, such as fostering a shared sense of mission, developing and promulgating strategy and guidance, defining and communicating roles and responsibilities, facilitating information sharing and collaboration, implementing incentive structures and metrics, developing more rigorous and coordinated approaches to technology scouting and problem curation, establishing a portal and navigation support services for new entrants, assigning responsibility for oversight of the CTP,

providing flexible funding to close transition gaps, and implementing DIO best practices.

3. Flagg et al (2022). Have in their report the nature of the defence innovation problem for the U.S. Department of Defense (DoD), argued that that the DoD needs to create an improved innovation ecosystem internal to the DoD, not simply reform the existing acquisition framework or focus on the external community. Their report identifies four main recommendations to achieve operationally significant innovation: creating organizations that teach and sustain red teaming and experimentation, crafting experimentation and iteration opportunities that engage war fighters, developing repositories of learning that create long-term corporate memory, and attracting and retaining people and leaders with the skills, incentives, and empowerment to navigate the dynamic new world of technology. The report also suggests some practical next steps to implement the recommendations, such as piloting experimentation organizations, repositories of learning, training and education programs, incentives and promotion criteria, and policy simulators.

4. Collins (2022) in a four-part series published for the DEF[12], explores the defence innovation ecosystem in the United States, emphasizing the challenges and opportunities in defence sector innovation. the government plays an active role as an early-stage investor in basic research and as a customer for large-scale programs of record, while also supporting small and medium sized firms to cross the valley of death[13]. The author highlights how major defence firms innovate through acquisitions of smaller firms with proven technologies, rather than invest in long term R&D. The piece covers various niches supporting defence innovation, including research and development, software, network facilitation, and venture capital. It spotlights initiatives improving military software, collaborations fostering

[12] DEF – Defense Entrepreneurs Forum is a non-profit organisation in the US that through various events, initiatives and partnerships aims to engage the veteran community to encourage disruptive thinking.

[13] The "Valley of Death" in the startup world refers to the challenging phase where a new company faces significant financial and operational hurdles, often between the initial development stage and achieving sustainable profitability. It's a critical period where many startups struggle to secure necessary funding and resources to bridge the gap from concept to market viability. Successfully navigating this valley is crucial for a startup's survival and eventual success.

innovation, and investments in defence startups. The author reflects on the US defence innovation landscape, advocating for smarter budget allocation and a balance between top-down guidance and bottom-up feedback. He states that the US needs to improve how it spends its R&D, procurement, and maintenance budgets, rather than just increasing them. He suggests some ways to change the budgeting and acquisition process to shrink the valley of death for startups and commercial technology. The article acknowledges the role of creativity within budget constraints and highlights indicators of successful innovation.

5. Cheung (2021) defines defence innovation as the transformation of ideas and knowledge into new or improved products, processes and services for military and dual-use applications. He argues that defence innovation is influenced by four interrelated factors: the strategic environment, the defence industrial base, the innovation system, and the organizational culture. He also proposes a typology of defence innovation based on the degree of novelty, complexity, and risk involved. He identifies four types of defence innovation: incremental, architectural, modular, and radical. The article examines defence innovation in different countries and regions, such as small countries with advanced defence innovation capabilities (Israel, Singapore), closed authoritarian powers (North Korea, Russia), large catch-up states (China and India) and advanced large powers (U.S.). The author aims to provide a comprehensive and comparative analysis of the drivers, dynamics, and outcomes of defence innovation across these cases. He also seeks to assess the implications of defence innovation for global security and stability in the era of great power competition and technological revolution. However, while he has classified India as a 'incremental Catch-up state', his analysis of the defence innovation system in India is mostly based on the writings of Behera (2014) which is outdated and thus presents a very skewed picture of defence innovation in India[14].

[14] While Cheung has thrashed the Indian defence innovation system with exception of the strategic weapons component of DIS. He writes "One important caveat though is that the strategic weapons component of the Indian DIS has demonstrated a much better track record for innovation than its conventional counterpart. Innovation in nuclear, ballistic missiles and space capabilities has been a bright spot in an otherwise lacklustre Indian innovation landscape." Yet, when it comes to North Korea he writes "In contrast to India's weak efforts at defence innovation, North Korea has been far more successful in its efforts to advance up the innovation ladder primarily limited to strategic capabilities". Which

6. Barboux (2020) in his research paper explores how the defence innovation system has changed in response to various factors, such as technological, political, economic, and doctrinal changes. The paper focuses on three interrelated dimensions of the transformation, the first dimension is the evolution of defence-related knowledge bases, which are the sets of knowledge and skills that underpin defence innovation. The paper argues that defence-related knowledge bases have become more complex, diverse, and dual-use, meaning that they can be applied to both civilian and military domains. The paper also discusses how different types of knowledge bases (analytical, synthetic, and symbolic) affect the ability to innovate in defence. The second dimension is the emergence of disruptive technologies, which are technologies that have the potential to radically change the existing technological paradigms and create new operational capabilities. The paper identifies some of the disruptive technologies that are relevant for defence, such as artificial intelligence, biotechnology, nanotechnology, quantum technology, and cyber technology. The paper also examines how these technologies challenge the traditional boundaries of the defence industrial base and require new forms of collaboration and governance. The third dimension is the transformation of operational capabilities, which are the combinations of equipment, systems, doctrines, and human factors that enable military operations. The third dimension is connected to the evolution of military customers' doctrines and capabilities towards net-centric and multi-domain command and control (C^2), the latter having a structuring effect on defence innovation systems.

7. The recent evolutions in defence related innovation management and its re-organisation towards joint efforts operating user-centric innovation and open innovation rationales in parallel to more traditional perspectives are explored by Merindol and Versailles (2020). The paper argues that there is a shift from a top-down, technology-driven approach to a more user-centric, open, and collaborative approach that involves various stakeholders and intermediaries. The paper

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essentially comes across as ‘different yardsticks for different nations. His commentary also pre-dates the iDEX initiative.

identifies four main drivers of this shift namely the changing nature and perception of threats and vulnerabilities, which require more agility, adaptability, and resilience in defence capabilities. Convergence of political, military, and societal support for innovation, which creates a favourable environment for experimentation and risk-taking. A renewed innovation organisation and governance, which reflects the degree of centralisation, coordination, and integration of innovation activities and actors; and the investment in innovation, which determines the level and allocation of resources for research and development, procurement, and innovation intermediaries.

8. Budden and Murray (2018) present an MIT framework for innovation ecosystem policy, which aims to help policy-makers design and implement policies that support vibrant innovation ecosystems. The paper defines innovation as the process of taking new-to-the-world ideas from inception to impact, and distinguishes between two key capacities for innovation: innovation capacity (I-Cap) and entrepreneurship capacity (E-Cap). The authors identify five critical dimensions for inputs into the I-Cap and E-Cap production function: human capital, funding, infrastructure, demand, and culture/incentives. It also provides examples of policy levers that can enhance or hinder these inputs in different contexts. They emphasize on the need for a systemic, multi-stakeholder, and evidence-based approach to innovation policy. While this paper is not specific to defence innovation, subsequently, the authors have used this framework to undertake an analysis of the defence innovation ecosystem across various countries as well as to assess the ‘Kessel Run’ the USAF software innovation program.

Global Trends

9. Beck (2024), the Director of the Defense Innovation Unit (DIU) and Senior Advisor to the Secretary of Defense, presents his vision for “DIU 3.0”, a new phase of defence innovation that aims to deliver strategic impact by leveraging commercial technology at speed and scale. The article argues that the US Department of Defense (DoD) faces a shifting threat landscape, especially from the People’s Republic of China (PRC), which is investing heavily in offsetting U.S.

military advantages and challenging the international order. The article claims that the DoD must complement its traditional acquisition pathways with disruptive innovation from the tech sector to maintain its technological superiority and deter or win major conflicts. The article outlines eight lines of effort for DIU 3.0, which include: focusing on the most critical capability gaps and embedding with the war fighter; partnering with the DoD's "engines of scale" to ensure successful transition and integration of prototypes; catalysing the DoD's innovation entities into a community of impact; taking the partnership with the commercial tech sector to a new level; realizing the potential of tech partnership with allies and partners (***he highlights DIU's partnership with iDEX for the launch of Maritime Challenges***); building the trust and momentum required for speed and scale; and retooling DIU to support all of the above. The article concludes by calling for a bold and collaborative approach to defence innovation, and warns that the U.S. cannot afford to get it wrong or transfer the risk of inaction to the future war fighter.

10. Scheulter et al (2022, 2023) in their reports for the Boston Consultancy Group (BCG) have quantified the defence innovation readiness gap across 59 countries. The study is based on a comprehensive review of defence ministries (MoDs) innovation activities across 59 countries conducted in 2021 and subsequently followed up in 2022. The study assessed 59 MoDs across 11 dimensions of innovation readiness and found that they failed to match their 2021 results by an average of 8% in 2022. The study also identified five actions that MoDs should take to close this gap: rebalance the innovation portfolio with a greater focus on operational outcomes and fielding fast; access untapped value and de-risk programs through superior insight into supplier economics; expand the definition of interoperability beyond the development of new technologies to include acquisition, operations, and sustainment of legacy products; reinforce cyber defences across the entire innovation ecosystem; and benefit from the increasing investments in climate and sustainability innovations. The study also classified the innovative practices across MoDs into 5 major models namely Creators and Expanders (China, Russia USA); Solution Builders (Australia, Canada, Austria); Fast Adopters (India, Brazil); Deployers (Indonesia, Philippines, Vietnam) and Specialists (Israel).

11. In his paper on ‘Open Innovation in Defense’, Briant (2022) raises the pivotal question of whether it is a passing trend or a transformative philosophy. He asserts that open innovation aims to identify, stimulate, and incorporate innovations from the civilian sector into the military with a shorter induction cycle. This approach has gained momentum, especially with the emergence of dual-use technologies like drones and AI. Briant argues that open innovation provides operational advantages to the military, enhancing productivity and freeing up resources. The author examines the French Defence Innovation Agency (AID), established in 2018 to structure defence innovation, but notes that startups still encounter challenges in dealing with the state and scaling up production for the Armed Forces. Briant suggests that strengthening open innovation in France requires ongoing efforts to identify relevant startups, offer robust support until they mature, and facilitate their financing and scaling up.

12. Sloane and Pothier (2021) provide a systematic conceptualisation of defence innovation and analysed how five countries – China, France, Germany, UK, and US – prioritise among four key drivers: threat perceptions, political support, organisational structures, and investment levels. The study found that these countries have different approaches to defence innovation depending on their strategic objectives, culture, resources, capabilities, and partnerships. The study also highlighted some common challenges that these countries face in translating their defence innovation efforts into operational advantage, such as balancing between short-term needs and long-term goals; managing risk aversion and uncertainty; fostering collaboration across stakeholders; ensuring ethical standards; adapting to changing operational environments; and measuring innovation performance.

13. Molling and Schutz (2021) in their policy paper on defence innovation in Germany, argue that Germany has a capable but fragmented innovation ecosystem, which faces several challenges and problems in harnessing the full potential of technological innovation for military use. The paper identifies three main challenges: the “firewall” between civilian and defence research, the narrow focus on digitalisation and cyber innovation, and the cultural and political resistance to certain technologies and applications, such as uninhabited systems

and autonomy. The paper also discusses the recent reforms and initiatives that aim to address these challenges, such as the Cyber Innovation Hub, the Center for Digitization and Technology Research, and the European Defence Fund. The authors conclude that Germany needs to overcome its longstanding inhibitors, align its innovation policies with its allies and partners, and balance its resources and strategic patience for future defence innovation.

14. Dougherty (2020) in his paper “Accelerating Military Innovation: Lessons from China and Israel” explores the practices and policies that enable China and Israel to accelerate military innovation, and whether some of these practices could be adapted by the United States. The paper argues that China has effectively managed a complex military-technical transformation by adopting a whole-of-government approach, investing heavily in research and development, fostering civil-military integration, accessing foreign technology, and implementing institutional reforms. The paper also argues that Israel has achieved maximum innovation at the lowest cost by leveraging its small size, strategic culture, human capital, entrepreneurial ecosystem, public-private partnerships, and international cooperation. The paper suggests that the United States could learn from both cases by adopting a more agile, collaborative, and risk-tolerant approach to military innovation.

15. Budden and Murray (2019) apply the MIT approach to innovation, ecosystems and stakeholders to national security and defence models in different countries. The document defines innovation as the process by which ideas move from the earliest stages of inception to impact, and distinguishes between two types of innovation: formal Innovation (with a capital I) and informal innovation (with a lower case i). The document identifies three key concepts for understanding innovation: ecosystems, capacities and stakeholders. Ecosystems are geographically-bounded hubs where the right blend of inputs, human agents and incentives foster innovation. Capacities are the twin engines of innovation, consisting of Innovation Capacity (I-Cap) and Entrepreneurial Capacity (E-Cap), each with five categories of inputs. Stakeholders are the five key groups that participate in innovation ecosystems: government, corporates, universities, entrepreneurs and risk capital providers. The document analyses the innovation

models used by various countries for national security and defence, focusing on the roles, structures, cultures and resources of their innovation agencies and how they engage with the wider ecosystems. The countries covered include the USA, UK, Australia, Israel, Canada and France. The document also provides some recommendations for the UK Ministry of Defence (MoD) on how to design a new defence innovation agency.

16. Budden et al (2021) also studies the Kessel Run a hybrid unit of the U.S. Air Force (USAF). The article explores how the USAF created and scaled a new unit called ‘Kessel Run’ to develop and deliver software solutions for its operational needs. The article used the same MIT framework of innovation to analyse how Kessel Run adopted a different approach to software acquisition and development, based on agile methods, user-centric design, rapid experimentation, and novel contracting and funding mechanisms. The article highlights how Kessel Run built a distinctive organizational culture that fostered collaboration, learning, and empowerment among its members, who came from diverse backgrounds and skill sets. The article concludes that Kessel Run has shown the ability to deliver innovative software solutions for the USAF. While the author concludes that Kessel Run was a success, he cautions that Without a deeper understanding of the ‘why’ behind Kessel Run’s new way of working, efforts to replicate its success elsewhere (in the U.S. and other militaries, but also others in the public and private sector) could prove less effective, and possibly futile.

17. Wilkinson and Jewell (2017) assess the UKs defence innovation initiative which was launched in 2016. The authors contend that, even after a year, there is a lack of comprehension regarding what innovation entails and how to effectively implement it. They argue for a Defence Innovation System that considers the temporal and dynamic aspects influencing innovation, emphasizing the need for sensitivity to diverse timescales in innovation requirements and responses. The authors assert that innovation should be seamlessly integrated into the day-to-day processes of the Defence, cautioning against isolating it as a separate 'initiative,' as such an approach risks failure. They recommend the development and implementation of an Enterprise Level Defence Innovation for a

successful innovation ecosystem, advocating for a comprehensive strategy over fragmented approaches.

18. Steinbock (2014) discusses the challenges for America's defence innovation. The article was written in the backdrop of US Defence Secretary Chuck Hagel's unveiling of the new defence innovation policy in 2014. In his paper he the challenges and opportunities for U.S. defence innovation in the context of global competition and budget constraints. He traces the history of U.S. defence R&D, the key defence R&D funders and performers, and the impact of defence R&D on the U.S. innovation system and economy. Steinbock identifies several crossroads of defence innovation, such as sequestration and limited budgets, short-term policies, acquisition challenges, Spin-ffs and Spin-Ons, defence industrial base, inter-service rivalry, defence contractor R&D intensity, and foreign competition. He argues that a robust federal policy to restore defence-related innovation and production in the United States would pay dividends on two fronts: continued U.S. defence strength through superior technology and broader U.S. commercial global competitiveness.

19. A fair amount of literature is available on the strategies adopted for Defence Innovation in Russia, China, Israel, US and France. To the western world Russia and China are studied as a matter of threat perception, while the research on Israel, France and US focusses more on the processes and economic impact. Zysk (2012) examines how Russia is pursuing select 4th Industrial Revolution (4IR) technologies, such as Hypersonic and Artificial Intelligence (AI), to enhance its military capabilities and overcome the challenges posed by the changing strategic environment and the technological competition with the US and China. The author argues that Russia is driven by both the need to close the capability gaps with its rivals and the opportunity to exploit the potential transformation of warfare that these technologies may bring. However, the author also acknowledges that Russia faces significant structural, economic, and institutional constraints that limit its ability to leverage its ambitions within the 4IR. The author provides an overview of Russia's defence innovation system, its main actors, and its priorities, as well as a detailed analysis of two key 4IR technologies: Hypersonic and AI. The author concludes that Russia has shown the ability to experiment with

4IR technologies, to amplify existing symmetric and asymmetric capabilities, and to create interconnected systems that may provide critical advantages, but it also remains uncertain whether Russia can sustain its innovation efforts and achieve its strategic goals in the long term. It is interesting to note that at the time of writing the article, the author would not have considered the Russian invasion of Ukraine. Since Feb 22, when Russia invaded Ukraine, active use of Hypersonic missiles namely the Kinzhal (KH-47M2) have been reported with a degree of success. The use of drones from both sides is also sign of innovative technologies disrupting the conventional battlefield.

20. China's meteoric rise largely attributed to its unwavering political will to develop and leverage technology has been a topic of numerous studies. China's strategies on military/ defence innovation have also caught the eye of many a researcher. Nouwens and Legarda (2018) in their paper, "Emerging technology dominance: what China's pursuit of advanced dual-use technologies means for the future of Europe's economy and defence innovation" examine how China is pursuing civil-military integration and developing advanced dual-use technologies that can have both civilian and military applications. The paper argues that China aims to leapfrog the United States and Europe and achieve dominance in these technologies, which will have major implications for the future of global security and competitiveness. The paper also analyses how Europe lacks strong and coordinated strategies to promote and protect its own innovation in this field, and how China is accessing European technology and know-how through various means. The paper concludes by offering some policy recommendations for Europe to address this challenge and leverage its own competitive advantages.

21. Cheung (2011) examined how innovation takes place within the Chinese defence Research, Development, and Acquisition (RDA) system. The paper reviews the evolving frameworks of analysis of technological innovation in industrial systems, with emphasis on the coupled technology-push, market-pull model. The paper argues that the Chinese defence RDA system has evolved from a top-down to a coupled model of interaction between weapons developers and military end-users over the past 60 years. The paper also discusses the important reforms that have taken place in the Chinese defence RDA system since the late

1990s, as well as the serious structural impediments that continue to exist that threaten to hinder the effectiveness

Indian Context

22. In the Indian context, Behera (2014) examined India's defence innovation performance, especially of the Defence Research and Development Organisation (DRDO) and the defence industry. The article argues that the innovation performance of these two players is constrained by lack of a higher organisational structure which could provide direction and required thrust to the indigenous R&D. At the same time, the innovation performance is also constrained by poor investment on R&D, 'miserly attitude' of the defence industry towards R&D, poor human resource base, and the lack of reform of the entities responsible for innovation. The article provides an overview of India's defence innovation system, its main actors, and its priorities, as well as a detailed analysis of the challenges and shortcomings faced by the DRDO and the defence industry. The article also discusses some of the initiatives and reforms undertaken by the government to improve the defence innovation ecosystem, such as the Defence Procurement Procedure (DPP), the Defence Production Policy (DPrP), the Defence Offset Policy (DOP), and the Technology Perspective and Capability Roadmap (TPCR). Of course, the article pre-dates the government's latest initiative of iDEX which was launched in 2018 and naturally does not address the issue of 'defence innovation challenges' and what has been its impact.

23. Vedachalam (2021) in his paper India's 'Innovation Ecosystem: Mapping the Trends', examines the key parameters that govern the global and Indian innovation ecosystems, such as research investment, education policy, researcher density, publication output, number of patents registered, and the startup environment. He discusses the global innovation index, the emerging technologies, and the innovation trends in big economies such as China, France, Japan, and the US. He also analyses the factors that could catalyse the growth of Indian R&D ecosystem, such as R&D missions and spending, education and researcher density, patents and publications, private and university participation, and knowledge-based startups. He highlights the need for India to integrate

science, technology and innovation policies into national development strategies, increase R&D spending, improve the quality of education, encourage private sector and university involvement, and foster entrepreneurship and innovation

24. Ghosh (2016) in his book Indigenisation – 'Key to Self-sufficiency and Strategic Capability' attempts to study the defence industrialisation process adopted by developed and developing nations to analyse, orient and adapt their best practices to the Indian defence industry. His analysis (pre-dating the iDEX process) revealed that there was a need to re-align and remodel the Indian defence industry apparatus to align with the vision of accelerating indigenisation, self-sufficiency and strategic capability.

25. A more recent study by Gopal (2021) argues that the issues of Defence R&D In India have often been addressed through the lens of the industry and R&D organisations itself. He argues that the innovation ecosystem needs a reformulation and recommends nurturing a new class of scientists – military scientists i.e. military practitioners who can carry out defence R&D with a more user centric approach and deliver systems by leveraging their technical expertise and experience gained within the organisation. He makes a specific case for the Indian Army and recommended that R&D must shift from the DPSUs to in-house development within the military. While this may not be entirely feasible, given the organisational constraints and the job specifications of the military, iDEX however seeks collaborative and user-centric development and should address some of the concerns brought out by the author.

26. In a two-part Blog post, Kalebere (2023) gives an overview of the Indian defence startup ecosystem and the various policy initiatives and reforms that have supported its growth and development. He argues that the emergence of homegrown defence startups has led to a transformative shift in the Indian defence sector, as these startups are playing a crucial role in advancing the modernization efforts of the Indian armed forces. He cites examples of some of the successful defence startups in India, such as Tonbo Imaging, Idea Forge, Astra Microwave, and New Space Research. He also identifies some of the major challenges faced by the defence startups, such as lack of access to testing facilities, complex procurement procedures, lengthy certification processes,

limited market size, and competition from foreign suppliers. He suggests some possible solutions to overcome these challenges, such as creating a conducive regulatory environment, facilitating access to funding and infrastructure, promoting collaboration and co-creation, and expanding the domestic and global market opportunities. The blog post concludes by stating that with the government's continued focus on indigenization and self-reliance, these startups are poised to play a vital role in driving innovation, fulfilling defence equipment and system requirements thus contributing to national security of an Atmanirbhar Bharat.

Summary

27. 'Defence Innovation' is the need of the hour and this fact is globally accepted. The concept of using 'Open Innovation' to fast-track assimilation of New Age Technologies into the Armed Forces is now a norm in most major militaries (irrespective of how strong a military R&D organisation there is). The extent to which the innovation eco-systems have developed, the IDEX program and the effectiveness of the same will be discussed in the subsequent chapters.

28. Insofar as the review of literature is concerned; there is a lot of literature available on the topic of 'defence innovation' which is surprising due to the confidential nature of the work. Majority of the literature talks about the need for defence innovation and have identified the requirements of a user-centric approach, open, and collaborative approach that involves various stakeholders; strong political will; a change in mindset of the military and the traditional R&D Establishment; acknowledging the fact the EDTs will probably arise from commercial needs rather than military needs. In a networked environment, leveraging dual-use technologies, with innovators who are not military savvy will need to be a norm and not an exception.

29. Notwithstanding the positives, there are some gaps which need to be studied. It is possible that some of the gaps in the studies are probably due to the fact that due to the confidential nature of work, a lot of data becomes off-limits at some point of the study. Some of the major gaps identified are: -

(a) The available literature identifies broad frameworks and the drivers of defence innovation. With exception of the BCG (2023) measurable performance outcomes are not available. A more rigorous conceptualization of performance metrics for assessing defence innovation would enable a more systematic and rigourous analysis across different cases and contexts.

(b) The available literature does not address the potential trade-offs and challenges involved in pursuing different types of defence innovation, such as the costs, risks, and uncertainties associated with radical innovation versus the benefits, reliability, and compatibility of incremental innovation. A more nuanced discussion of the pros and cons of different types of defence innovation would help policymakers and practitioners make informed decisions about their innovation strategies and priorities.

(c) The literature do not explore the role of external actors and factors in shaping the state of global defence innovation, such as the influence of allies, partners, competitors, and adversaries; the diffusion and proliferation of technologies; the regulation and governance of innovation; and the ethical and social implications of innovation. A more comprehensive and holistic examination of the external environment would provide a richer understanding of the opportunities and threats for defence innovation.

(d) There is no literature available on the processes and or the timelines adopted by various nations for assimilating the technology / product/ service post prototyping into a specific service. This factor needs to be studied to assess whether or not these innovation challenges have in fact reduced the timelines for assimilation of new technologies into the services. Which in turn will give us feedback on what course corrections to adopt to make the process more robust and effective.

Chapter 3 – Global Trends

1. **Introduction**. In the rapidly evolving landscape of defence, innovation ecosystems play a pivotal role in driving advancements that bolster national security and military capabilities. Several global trends are shaping the trajectory of defence innovation ecosystems. The need to assimilate and integrate Artificial Intelligence (AI) and autonomous systems into defence capabilities; revolutionizing unmanned vehicles, robotics, and decision support systems is urgent. The emphasis on cybersecurity innovations reflects the growing threat of cyber-attacks, prompting the development of advanced technologies to safeguard military networks and critical infrastructure. Space-based technologies, including satellite communications and Earth observation, have become integral components of defence strategies worldwide. The concept of multi-domain operations, emphasizing integrated capabilities across land, sea, air, space, and cyberspace, is gaining prominence as military forces seek comprehensive solutions to complex challenges.

2. Quantum technologies, with their potential to revolutionize data processing and secure communications, are emerging as critical areas for defence innovation. Moreover, the focus on supply chain resilience, incorporating digital manufacturing technologies and 3D printing, underscores the importance of adaptive and distributed production capabilities. International collaboration is a key trend, with nations and organizations increasingly engaging in joint efforts to exchange knowledge, technologies, and research initiatives.

3. Countries world over have recognised the need for innovation in developing newer capabilities for their Armed Forces and a number of programs/ initiatives have been formulated to encourage the defence innovation ecosystem.

The US[15], UK, France, Canada[16], Australia[17], NATO[18] and even the EU[19] have all created defence innovation hubs/ departments and resorted to the use of "Innovation Challenges" or competitions to encourage development of new technologies and solutions for defence applications. Defence innovation is considered a critical element of strategic competition among nations, as it enables them to develop, integrate, and use Emerging and Disruptive Technologies (E & DTs) in military applications This chapter explores notable programs, accelerators, incubators shaping defence innovation ecosystems globally. In order to prevent digressing from the core study on iDEX, the study will be restricted to a look at the innovation eco-systems of a few countries namely, the US, France and Israel.

The Innovation Ecosystem Vocabulary

4. Before we delve deeper into the world of Defence Innovation, we need to understand some basic terms and definitions[20].

Accelerator	Accelerators offer competitive and structured programs focused on scaling the growth of an existing company. Accelerators typically provide some amount of seed money and a network of mentors. Programs are typically a few months in duration culminating in an opportunity to pitch to investors at the conclusion of the program
Challenge	A challenge can be a single or recurring contest or competition aimed at solving problems where

[15] US – Defense Innovation Unit Experimental (DIUx) – www.diu.mil

[16] Canada - Innovation for Defence Excellence and Security (IDEaS) - https://www.canada.ca/en/department-national-defence/programs/defence-ideas.html

[17] Defence Innovation Hub - https://www.innovationhub.defence.gov.au

[18] NATO - Defence Innovation Accelerator for the North Atlantic (DIANA) - www.diana.nato.int

[19] European Union – European Union Defence Innovation Scheme (EUDIS) - www.eudis.europa.eu/

[20] Definitions have been obtained from the following resources. https://aida/mitre.org and Kotila B et al (2023). Strengthening the Defence Innovation Ecosystem.

	emerging technologies have the potential to provide non-traditional solutions, or to expand the pool of participants to address critical issues. Challenges may offer cash prizes or may be part of a broader Challenge-Based Acquisition (ChBA) strategy that may result in a government contract.
Connector	The objective of connector organizations is to build networks and create relationships between government organizations, industry, private equity firms, and academia to facilitate partnerships to solve challenging problems by generating new solutions
Defence Innovation	The processes of generating and fielding technologies and other products, services, processes, or practices that are new or improved in the defence context.
Defence Innovation Organisation	The set of organizations, activities, functions, and processes that develop, produce, and field new or improved technologies and capabilities for military use
Funding Opportunity	Funding opportunities are offered by organizations that seek to invest in and enhance the chances of success of entities (often start-ups or small businesses) pursuing advancements in technology. These are not government contracts or agreements
Government Contracting Authority	An organization with government contracting authority can execute contract awards or agreements for government projects. These organizations have Contracting Officers who are authorized to execute awards and agreements on behalf of the government.

Incubator	Incubators focus on start-up and entrepreneurial entities with innovative ideas. They may provide seed funding and a collaborative physical environment to grow ideas, brand identification, and business plans. Not-for-profit and government or university operated incubators seek to enhance the economy and/or advance the state of the art of the industrial base for government stakeholders

The US Ecosystem

5. The US defence innovation ecosystem is amongst the largest and most elaborate globally. In addition to DARPA and the Service Research Labs, there exist a number of Innovation Units, accelerators, incubators and connectors. Figure 1 (Collins, 2021) shows a graphical overview of the entire innovation eco-system in the US. As can be seen, the number of organisations and agencies addressing the various issues of innovation is exceptionally large. Another visualisation can be seen in Figure 2 (MITRE - Understanding DoD, n.d.).This visualisation maps the various agencies/ programs with their task, and gives us an idea on how many agencies converge on a similar function. While there are a number of agencies and organisations, for the purpose of this study, only a few of the US programs will be examined.

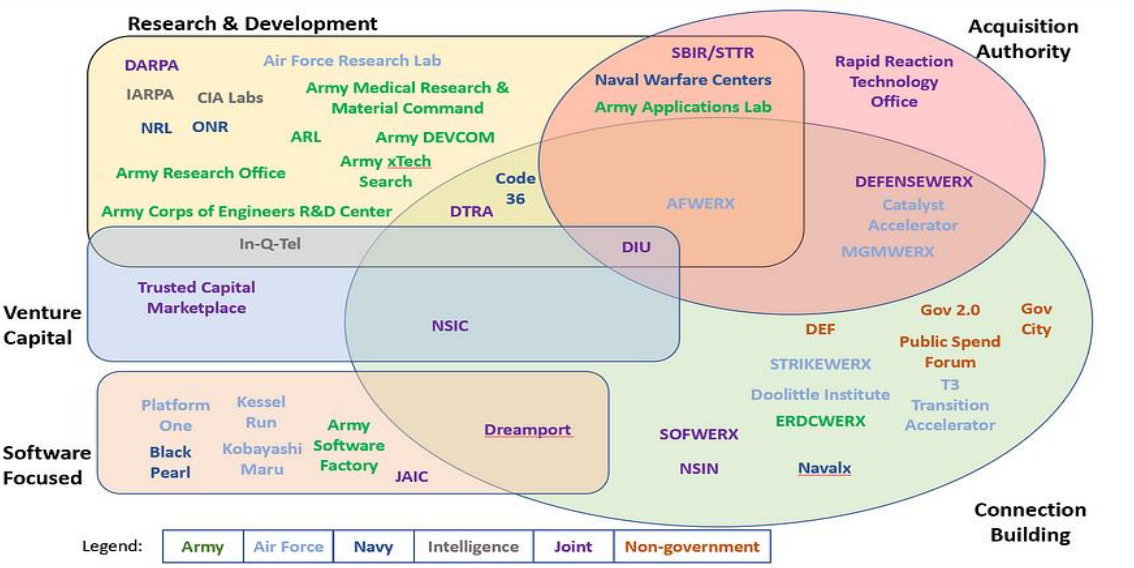

Figure 2: The Innovation eco-system in the US. [Source: Collins(2022)]

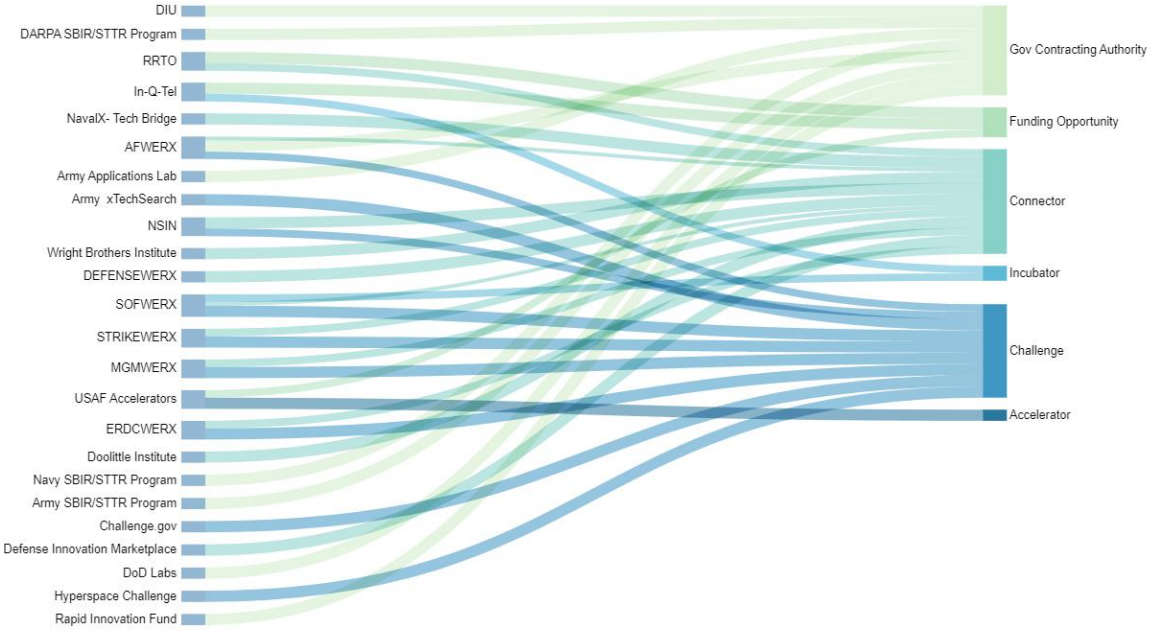

Figure 3: Visualising the Innovation Eco-system at Technological Readiness Level 9 [Source : MITRE.org]

Defence Innovation Unit

6. The Defense Innovation Unit (DIU) is a unique entity within the U.S. Department of Defense (DoD) established in 2015 with the aim of tapping into commercial innovation to address defence challenges more rapidly and effectively. It operates as a link between the traditional defence establishment and the dynamic, rapidly evolving world of technology startups and commercial firms. DIU has physical offices strategically located in innovation hubs like Silicon Valley, Boston, Austin, and the National Capital Region, enabling close collaboration with key players in the tech industry.

7. One of DIU's primary functions is to scout for cutting-edge technologies developed by non-traditional defence contractors—such as startups, small businesses, and academic institutions—that can be adapted for military use. This involves identifying promising solutions, prototyping them, and facilitating their integration into existing military systems or processes. DIU engages in various activities to achieve its objectives:

(a) **Technology Scouting**. DIU actively searches for emerging technologies with potential military applications. It keeps abreast of advancements in areas like artificial intelligence, cybersecurity, autonomy, and advanced manufacturing, among others.

(b) **Prototype Development**. Once promising technologies are identified, DIU works with its partners to develop prototypes or minimum viable products (MVPs) to demonstrate their feasibility and effectiveness in meeting defence needs.

(c) **Partnerships and Collaborations**. DIU fosters partnerships with a wide range of stakeholders, including startups, venture capital firms, academic institutions, other government agencies, and traditional defence contractors. These collaborations facilitate knowledge sharing, resource pooling, and technology transfer.

(d) **Acquisition Innovation**. DIU employs innovative acquisition practices to streamline procurement processes and accelerate the delivery of solutions to end-users. This includes leveraging Other Transaction Authority (OTA) agreements, which offer more flexibility and speed compared to traditional acquisition methods.

(e) **Technology Transition**. Once prototypes are successfully developed and validated, DIU helps transition them into operational use within the military. This involves working closely with relevant DoD stakeholders to ensure smooth integration and deployment.

8. Within the DIU ecosystem, several entities play distinct roles in driving innovation and collaboration across various domains. AFWERX fosters innovation within the United States Air Force (USAF), facilitating rapid prototyping and deployment of cutting-edge solutions to enhance military capabilities. SOFWERX similarly focuses on advancing innovation within the Special Operations Forces

community. DEFENSEWERX[21] serves as an innovation hub for solving complex defence and security challenges through partnerships between government, industry, and academia. Kessel Run[22] specializes in agile software development for the USAF, while Kobayashi Maru[23] focuses on accelerating the development and deployment of artificial intelligence technologies for defence applications. Together, these entities within the DIU ecosystem contribute to strengthening national security through the integration of innovative technologies and approaches.

9. Performance of DIU (DIU, 2022) in terms of the number of proposals solicited and contracts awarded are shown in Fig 4. Fig 5 shows a trend analysis of the DIU from 2016 – 2022.

Figure 4: Snapshot of the Performance of DIU FY 2022-23 {Source DIU website}

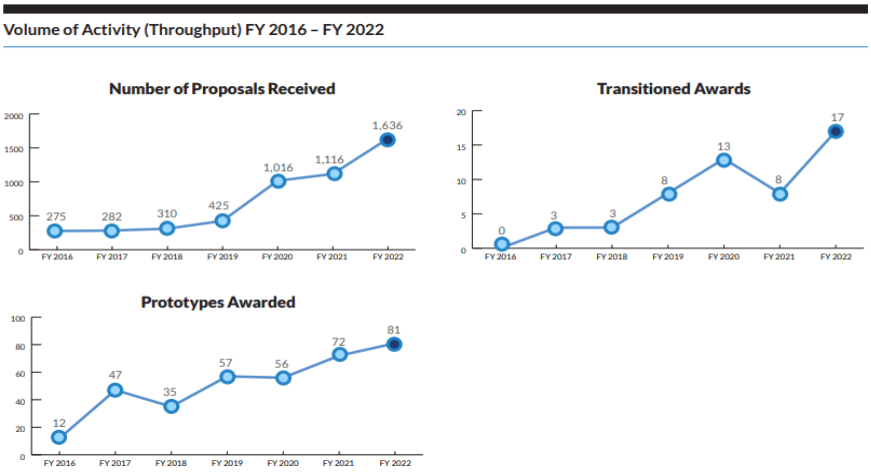

Figure 5: Trend Analysis of DIU Activity FY 2016-22 {Source: DIU Website}

[21] www.defensewerx.org
[22] www.kesselrun.af.mil and Budden et al(2021)
[23] Krolikowski (2021)

10. **Defense Advanced Research Projects Agency (DARPA) vs DIU**. Many of us are familiar with DARPA, so if the US already had an agency developing cutting edge technology, why the need for establishing DIU. In short, both DARPA and DIU are entities within the United States Department of Defense focused on driving innovation. they differ in their mission, approach, scope, and organizational structure. DARPA primarily focuses on long-term, high-risk research with the potential for transformative impact, while DIU focuses on rapidly integrating existing commercial technologies to address immediate defence needs. The table below shows a comparison between both agencies.

	DARPA	DIU
Mission	DARPA's primary mission is to develop breakthrough technologies for national security. It focuses on long-term, high-risk research and development projects that have the potential to yield transformative capabilities for the military	DIU's mission is to accelerate the adoption of commercial technology to address immediate defence challenges. It seeks to identify existing commercial solutions and rapidly prototype and integrate them into military systems
Approach	DARPA pursues ambitious, forward-looking research programs that often involve fundamental scientific and technological advancements. It operates on a longer time horizon and is willing to take on high-risk projects with the potential for high payoff	DIU operates more as an intermediary between the Department of Defense and the commercial sector. It focuses on leveraging existing commercial technologies and solutions to meet immediate defence needs. DIU emphasizes speed and agility in identifying, prototyping, and deploying innovative solutions.
Scope	DARPA's scope is broad and encompasses a wide range of scientific and technological domains, including artificial intelligence, robotics, cybersecurity, biotechnology, and more. Its projects often have applications beyond the military, with potential civilian benefits	DIU's scope is narrower and focused on identifying and adapting commercial technologies specifically for military use. It prioritizes solutions that address pressing defence challenges, such as improving military readiness, enhancing cybersecurity, and modernizing legacy systems

Structure	DARPA operates as an independent agency within the Department of Defense, with its own budget, leadership, and research programs. It has a relatively small staff of government employees and relies heavily on external researchers, contractors, and academic institutions to execute its projects.	DIU operates as a smaller organization within the Department of Defense, with offices in various innovation hubs such as Silicon Valley, Boston, and Austin. It has a leaner structure and often partners with external organizations, including startups, venture capital firms, and academic institutions, to source and develop innovative solutions.

Small Business Innovation Research (SBIR)/ Small Business Technology Transfer (SBTT)

11. The SBIR (Small Business Innovation Research) and SBTT (Small Business Technology Transfer)[24] programs are initiatives administered by various U.S. government agencies, including the Department of Defense, NASA, the National Institutes of Health, and others. These programs aim to stimulate technological innovation and facilitate the commercialization of research by providing funding opportunities to small businesses.

SBIR Program

(a) SBIR focuses on funding research and development (R&D) projects carried out by small businesses. It encourages these companies to engage in innovative R&D efforts that have the potential for commercialization.

(b) The program is structured in three phases: Phase I involves feasibility studies and proof-of-concept research, Phase II focuses on further development and commercialization, and Phase III involves the commercialization of the developed technology with non-SBIR funds.

[24] www.sbir.gov/tutorials

(c) SBIR funding is typically awarded through competitive solicitations, where small businesses submit proposals addressing specific agency research topics.

SBTT Program

(d) SBTT, on the other hand, emphasizes collaboration between small businesses and research institutions, such as universities or Federally Funded Research and Development Centres (FFRDCs).

(e) The program requires small businesses to partner with a research institution, and the research institution typically performs at least 40% of the work under the project. Like SBIR, SBTT funding is provided through competitive solicitations, and projects are typically structured in similar phases as SBIR projects.

12. Both SBIR and SBTT programs have several objectives and benefits:

(a) Encouraging technological innovation and R&D across various sectors.

(b) Fostering partnerships between small businesses and research institutions, which can lead to the transfer of technology and knowledge.

(c) Promoting economic growth and job creation by supporting the development and commercialization of innovative products and services.

(d) Enhancing the competitiveness of small businesses in the marketplace by providing them with access to non-dilutive funding for R&D.

13. **Funding Patterns**. The SBIR (Small Business Innovation Research) and SBTT (Small Business Technology Transfer) programs offer funding opportunities to small businesses to stimulate technological innovation and foster technology transfer.

(a) **SBIR Funding**. SBIR provides funding in three phases:

(i) **Phase I**: This phase typically involves feasibility studies to determine the scientific, technical, and commercial potential of a proposed innovation. Phase I awards are generally smaller in size and shorter in duration.

(ii) **Phase II**: Successful Phase I projects may receive additional funding to further develop the technology, conduct research, and perform prototype development. Phase II awards are larger in size and longer in duration than Phase I awards.

(iii) **Phase III**. Phase III does not involve direct SBIR funding but rather focuses on commercialization and transition of the technology into practical applications. Phase III funding typically comes from non-SBIR government contracts, private investment, or sales revenue.

(b) **SBTT Funding**. SBTT funding follows a similar structure to SBIR but emphasizes collaboration between small businesses and research institutions. The funding is divided between the small business and the research institution, with the small business typically receiving the majority share.

(i) **Phase I.** SBTT Phase I funding supports research conducted jointly by the small business and the research institution. It aims to determine the feasibility and technical merit of the proposed innovation.

(ii) **Phase II**. Successful Phase I projects may receive additional funding to further develop the technology and conduct additional research. Like SBIR Phase II, SBTT Phase II awards are larger and support more extensive development efforts.

(iii) **Phase III.** Similar to SBIR, Phase III focuses on commercialization and transition, with funding coming from non-STTR sources to bring the technology to market.

	SBIR	**SBTT**
Phase I	6 months, $110,500 max	6 months, $166,500 max
Phase I (Option)	4 month option	No option
Phase II	2 years, $100,000 max	2 years, $ 1,100,000 max
Phase II Enhancement	Extends Phase II contract for upto 1 year, matches upto $ 550,000	No enhancement
Phase III	Unlimited time, non SBIR funding	Unlimited time, non STTR funding

Table 2: Comparison of SBIR/STTR Funding [Source: SBIR/STTR Training Module, US DOD]

(c) Both SBIR and SBTT funding opportunities are competitive, with small businesses required to submit proposals addressing specific research topics outlined in agency solicitations. The funding amounts, eligibility criteria, and application processes may vary depending on the participating federal agency. Overall, SBIR and SBTT funding provide valuable support to small businesses to advance innovative technologies and bring them to market.

13. The US Defence innovation system is perhaps the most complex network of innovators, government organisations, private partners, incubators, venture capitalists. It is the heart of perhaps the largest defence -industrial complex in the world. A broad mind-map/ schematic of the US defence innovation network is placed at '**Annexure 1**'. Notwithstanding the fact that the US has an established and proven R&D organisation in DARPA, a need was felt to create new structures to tackle modern day defence innovation. While the innovation eco-system has numerous successes, they have also had their share of setbacks. That study is

beyond the scope of the current research. Needless to say, defence innovation in India is still at a nascent stage and it will be decades before we can aspire to boast of a defence innovation ecosystem akin to what is available in the US.

FRANCE

13. The French defence ecosystem is characterized by a dynamic interplay between government entities, defence contractors, research institutions, and innovative startups, all working together to support the country's defence capabilities. At the core of this ecosystem is the Ministry of the Armed Forces, which oversees defence policy and procurement. The French defence industry comprises a mix of large multinational corporations like Thales, Dassault Aviation, and Naval Group, along with numerous SMEs and startups specializing in defence technologies. Collaborative initiatives such as defence clusters and innovation hubs facilitate cooperation among industry players, academia, and government agencies to drive innovation and technology development. Additionally, research institutions like ONERA (the French Aerospace Lab) and the French National Centre for Scientific Research (CNRS) contribute to cutting-edge research and development in defence-related fields. France also maintains a strong focus on international collaboration, participating in joint defence projects with European partners through organizations like the European Defence Agency (EDA) and NATO.

14. As with many modern militaries, the rapid changes in technology; a highly inter-connected world; a changing global order and changing threat scenario with terrorism and non-state actors posing a greater threat to national security, France too has had to change its strategy towards defence innovation. Both the *French Strategic Review*[25] and the Military Planning Act (LPM) 2019-2025 focussed on the need to prioritise innovation to meet future challenges.

15. The French system of Innovation in the defence sector is characterized by several initiatives and organizations that facilitate collaboration between the

[25] *French Strategic Review* published on 11 October 2017

government, defence industry, and innovative startups. Some of the key players in the French defence innovation eco-system are: -

(a) **Direction Générale de l'Armement (DGA)[26].** The DGA is the French defence procurement agency responsible for acquiring equipment and technologies for the French Armed Forces. It actively seeks innovative solutions from various sources, including smaller companies and startups. The DGA's role in fostering innovation and openness in defence procurement is crucial to the French system of Open Innovation.

(b) **Innovation Defense Lab (IDL)[27]**. The IDL is a platform established by the French Ministry of Défense to promote collaboration between defence stakeholders and innovative companies. It provides a space for experimentation, prototyping, and testing of new technologies and solutions. The IDL encourages cross-sector partnerships and facilitates the development of cutting-edge defence capabilities.

(c) **Defense Innovation Agency (AID)[28]**. Established in 2017, the *Agence de l'innovation de défense* (AID), or Defense Innovation Agency, is mandated to capture innovation and expedite its deployment across the French Ministry of Armed Forces, benefiting both military and civilian end-users. Functioning as an independent and autonomous entity, it serves as a central point of contact for innovation projects, facilitating collaboration and providing resources such as the Innovation Defence Lab to accelerate experimentation, prototyping, and deployment of innovative solutions. Additionally, the AID fosters the creation of innovation clusters and networks, promotes new procurement approaches, and engages in

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[26] "Direction Générale de l'Armement (DGA)" - Official Website: [DGA](https://www.defense.gouv.fr/dga)

[27] "Innovation Defense Lab (IDL)" - French Ministry of Defense: [IDL](https://www.defense.gouv.fr/dga/innovation-lab-defense)

[28] - "Defense Innovation Agency (AID)" - Official Website: [AID](https://www.defense.gouv.fr/dga/l-agence-de-l-innovation-de-defense-aid)

strategic foresight through initiatives like the formation of a 'Red Team' to envision disruptive scenarios and guide innovation efforts.

16. **Le document de référence de l'orientation de l'innovation de défense (DrOID)**. With its thrust on defence innovation, the French Ministry of Armed Forces issues a Defence Innovation reference guide annually (DrOID). The author was able to access DrOID-2022[29] . The document presents the objectives and challenges of the defence innovation policy of the French Ministry of the Armed Forces, which aims to ensure operational superiority, strategic autonomy, and performance.

17. Updated on an annual basis, this document provides insights into the initiatives spearheaded by the Defense Innovation Agency in conjunction with the Directorate General of Armaments (DGA), the armed forces, and various departments and services within the Ministry. It details the organization and governance of the innovation orientation process, which involves identifying evolving factors and defining innovation domains. Analysing key factors like the geopolitical context and technological trends, it addresses industrial, economic, societal, and environmental challenges, as well as legal and ethical considerations. Describing 16 innovation domains covering defence needs from information superiority to human resources, it lays out visions, objectives, benefits, and projects for each. Supported by instruments like the Defense Innovation Agency and the Innovation Purchasing, it integrates open innovation and encourages scaling up innovative solutions. Emphasizing the importance of a diverse network of innovation partners, including academia, defence industry, investment funds, and cooperation programs, it highlights valorisation of innovation projects and innovators within the Ministry, promoting their achievements and impact. Additionally, it provides a financial overview of allocated resources and offers perspectives and recommendations for the future.

18. The creation of the *Agence de l'innovation de défense* (AID) and defining the roadmap clearly through the publication of DrOID, the French government has

[29] Accessed online - The 2022 Defence Innovation Guidance Document (DrOID) is online | Ministry of the Armed Forces (defense.gouv.fr). the 2023 version of the document is not available in English.

clear understanding of what they want to achieve by promoting defence innovation. Devaux and Schnitzler (2020) in their analysis of the French defence innovation model state that France has identified three main pillars of defence innovation namely **programmed innovation**, **dual innovation**, and **internal innovation**.

(a) **Programmed Innovation**: This type of innovation is driven by long-term roadmaps and visions linked to future programmes. It involves a systematic approach to identifying and developing new technologies or capabilities that will be needed in the future. This could include anything from new weapon systems to advancements in communication technology. The key aspect of programmed innovation is that it is planned and organized around specific goals or outcomes. In order to support defence-oriented research in laboratories, a dedicated program ASTRID *(Accompagnement Spécifique des travaux de Recherches et d'Innovation Défense)*[30] ,[31] for open research on dual-use technologies is funded by the defence.

(b) **Dual innovation**. It is aimed at capturing and integrating civil technologies with defence applications. This means leveraging advancements made in the civilian sector for defence purposes. For example, a technology developed for the telecommunications industry might also have applications in military communications systems. Dual innovation allows the defence sector to benefit from the rapid pace of technological advancement in the civilian world. To support dual innovation among SMEs, a financial support package RAPID (*Régime d'appui pour*

[30] (Budden & Murray, Defense Innovation Report - Applying MITs Innovation Ecosystem & Stakeholder Approach to Innovation in Defense on a Country-by-country Basis, 2019)

[31] ASTRID (**Accompagnement Spécifique des Travaux de Recherches et d'Innovation Défense**): launched in 2012, this support mechanism allocates funding to dual use research projects up to € 300,000, for a period of 18-36 months. In a second step, ASTRID Maturation supports the maturation and development of ASTRID projects by allocating up to € 500,000, for a period of 2-3 years

l'innovation duale)[32],[33] which allocates grants to SMEs between 70-80% of the R&D expense.

(c) **Internal Innovation**. This type of innovation is based on the involvement of Ministry of Defence (MoD) personnel and end-users in developing and experimenting with new solutions. It's about fostering a culture of innovation within the organization, encouraging individuals to think creatively and come up with new ideas. This could involve anything from improving operational procedures to developing new tactical approaches. To facilitate internal innovation, a '*Cellule Innovation Participative (CIP)'* within AID supports innovation projects undertaken by civilian or military personnel of the MoD[34]. Selected projects get funding upto € 120,000 for prototype development. Further development is shifter to *Innovation Défense Lab.*

19. The French defence innovation system is definitely not as large as the US innovation system. Dr Emmanuel Chiva, Director of AID, in an interview to EDM magazine[35] has stated that while comparisons are being drawn with DARPA, the French AID action differs from DARPA in two key aspects. Firstly, DARPA boasts an annual budget of approximately $3.5 billion, whereas the AID's budget was increased to €1 billion for 2022. Secondly, their roles vary significantly: the Defence Innovation Agency oversees innovation across all defence domains, whereas DARPA shares its responsibilities with various innovation structures linked to different military services. France's approach involves a single agency centralizing defence innovation efforts, contrasting with DARPA's mission to prevent technological or strategic surprises by pushing innovation to the limits

[32] (Budden & Murray, Defense Innovation Report - Applying MITs Innovation Ecosystem & Stakeholder Approach to Innovation in Defense on a Country-by-country Basis, 2019)

[33] RAPID (**Régime d'appui à l'innovation duale**): launched in 2009, this support mechanism is also available to intermediate-sized enterprise (ETI) up to 2,000 employees since 2011. It has had an annual budget of € 50 million since 2015.

[34] This would be akin to the iDEX4Fauji programme run by DIO.

[35] *European Defence Matters (2021). France: All threads come together at AID. Issue 22, pp 16.* Retrieved from https://www.eda.europa.eu/info-hub/defence-matters/issue-20/french-defence-innovation-agency-a-holistic-approach-to-innovation

without immediate ROI considerations. Consequently, DARPA and AID operate under distinct objectives and success criteria. Notwithstanding, there has been a considered thrust from both the political and military leadership to promote defence innovation, which will surely bear fruits in times to come.

ISRAEL

"Since we fail in quantity, we must raise the quality"
David Ben Gurion[36]

20. A study on defence innovation cannot be possibly complete without the mention of Israel. One of the smallest countries in the world, with a population of 8.5 million, it has perhaps the most effective 'defence innovation' system in the world. When viewed from the outside, the Israeli defence innovation eco-system does not seem to be innovative as one would consider DIU or AID or iDEX, but its effectiveness cannot be questioned.

21. Israel has been able to develop advanced and cost-effective military capabilities by adopting three best practices: the Talpiot program, the use of operational demonstrators, and the close collaboration between the military, R&D, and industry sectors[37]. The Talpiot program is an elite training program that recruits the top STEM students in the country and educates them in both military and academic skills, creating a corps of technically trained military leaders who can identify and solve problems across the defence enterprise. The program also serves as a pipeline for future CEOs and entrepreneurs in the Israeli tech industry. The use of operational demonstrators is a key step in the Israeli military R&D process, where working prototypes of new technologies are provided to active military units for evaluation in the field. This helps fine-tune the technology, generate feedback, and win military support for the innovation. The Iron Dome[38] and Trophy[39] systems are examples of technologies that benefited from this practice. The close collaboration between the operational military, R&D, and industry sectors is facilitated by the fact that most of the scientists, engineers, and

[36] David Ben Gurion was Israel's first Prime Minister and Defence Minister. This quote is attributed to him during the establishment of the R&D Unit of the DDR&D in 1953.
[37] (Dougherty, 2020)
[38] The IDF's top 10 Innovations accessed online at www.idf.il
[39] (Gewirtz, Jason 2015)

executives in the Israeli tech industry are IDF reservists with prior military training. In addition, the R&D personnel interact frequently with industry counterparts and use fast and flexible contracting processes to support innovation.

22. The largest stakeholder in the Israeli defence innovation system are the Israeli MoD and Israeli Defence Forces (IDF). The Administration for the Development of Weapons and Technological Infrastructure (MAFAT) is Israel's defence ministry's central research and development agency, tasked with spearheading innovation and technology advancement in the defence sector. Established in 1965, MAFAT operates under the Directorate of Defence Research and Development (DDR&D) and plays a pivotal role in enhancing Israel's military capabilities and maintaining its qualitative edge in a rapidly evolving security landscape. MAFAT operates across a wide spectrum of defence domains, including aerospace, cybersecurity, land systems, naval technologies, intelligence. It collaborates closely with various stakeholders, including defence industry partners, academic institutions, research centres, and international counterparts, to drive innovation, research, and development initiatives. One of MAFAT's key objectives is to identify emerging technological trends and anticipate future threats, enabling Israel to develop and deploy cutting-edge defence solutions proactively. To achieve this, MAFAT invests in fundamental research, applied research projects, and technology demonstration programs, fostering a culture of innovation and entrepreneurship within the defence ecosystem.

23. **Talpiot Program**[40]. This is perhaps one of the most unique programs in the military world. The Talpiot program is an elite educational and training initiative within the Israel Defense Forces (IDF) designed to identify and develop exceptional individuals with strong academic backgrounds and leadership potential for roles in technological innovation and military research and development. Established in 1979, the program selects a small number of outstanding recruits each year from various academic disciplines, including physics, mathematics, computer science, engineering, and other scientific fields. Participants undergo rigorous training combining military service with specialized

[40] ibid

coursework, practical projects, and hands-on experience in cutting-edge technology domains relevant to national security. The program aims to cultivate a cadre of highly skilled professionals capable of tackling complex technical challenges, driving innovation, and maintaining Israel's qualitative military edge through the integration of advanced technologies into defence capabilities. Talpiot graduates often go on to pursue leadership positions within the IDF's research and development units, defence industry, academia, and other sectors, contributing to Israel's innovation ecosystem and national security posture.

24. **IDF Innovation Strategy**. In Sep 2022, the IDF hosted the first International Military Innovation Conference (IMIC-2022). As part of the conference, the IDF brought out an Innovation Strategy document. The IDF's Innovation Strategy presents a comprehensive roadmap for systematic transformation, aiming to establish lasting superiority over adversaries by implementing innovative concepts, mechanisms, and methods. Developed by the IDF's Combat Methods & Innovation Division (CMI), the strategy emphasizes innovation as a core organizational value. This document, organized into four parts, offers an overview of the strategy; discusses the current state of IDF innovation and provides insight into the IDF's vision for structural and conceptual evolution in the coming years. It identifies five key pillars for successful transformation, evaluated against criteria of relevance, methodical implementation, and effective outcomes aligned with the IDF's current and future needs (Figure 6 refers).

IDF Vision for Innovation	Creating long-term, continuous superiority over our enemies through the establishment of more rapid, more accurate and more methodical transformation and learning mechanisms.				
The Systemic idea	Relevant, effective, and methodical transformation				
Elements of the innovation system	1. Entrepreneurial and innovative culture	2. Empowering partnerships	3. Research, training, and learning	4. Applicative tools and mechanisms	5. Management of an innovation system
Main activities (Only top 3-4)	• Traditions of innovation • Training and learning • (All activities in the other elements of innovation)	• Throughout the IDF, and the general staff • The defense community • International colleagues • The industry and academia ecosystem	• Research institute for military innovation • Defense College for Innovation Intrapreneurship and transformation	• "Challenge" incubator • Management of innovation communities • Reserve Center of Excellence • Experimentation center	• Management of IDF and service branch innovation programs, collaboration with innovation sections • Running disruptive force design • IDF Innovation Dashboard
Qualitative & Quantitative Success Metrics	IDF human capital with respect to innovation and transformation, the presence of innovation traditions and how they take root	Orientation toward breaking down barriers and inputs/outputs of various collaborations	The impact of training on the sense of capability and the ability and willingness to lead transformation	The impact of mechanisms personal and organizational transformation measures, and the mechanisms' inputs and outputs	Inputs/outputs of the synergy between the portfolio of efforts, effect on decision-makers

Figure 6: The IDF vision for innovation. {Source: IDF-IMIC(2022)}

25. **INNOFENSE**. INNOFENSE[41] is an innovation centre for dual-use technological projects in the civilian and security sectors. It was created in a collaboration between the Israel Ministry of Defense, MAFAT (Administration for the Development of Weapons and Technological Infrastructure), and the IDF air and ground arms. The centre is operated by iHLS[42] and SOSA[43]. The program is designed to strengthen the links between the civilian and defence markets via the collaborative development of technologies, thus advancing and improving their integration in both markets. "The goal was to set up an innovation centre for Israeli entrepreneurs, based on a business model that would allow the defence establishment to receive what was important to it – new knowledge and

[41] INNOFENSE is the Israeli military equivalent of iDEX

[42] iHLS – Israel's Homeland Security is a private company established in 2012, founded the first **Security Accelerator** in the world in the homeland security field. The company also operates the **INNOFENSE innovation center** in collaboration with Israel Ministry of Defense – MAF'AT (Administration for the Development of Weapons and Technological Infrastructure). https://accelerator.i-hls.com/innofense

[43] SOSA is an Open Innovation Company, www.sosa.co

groundbreaking developments – at a relatively negligible cost, while giving entrepreneurs access to the defence establishment's knowledge sources and beta sites which are otherwise unavailable to civilian entrepreneurs"[44]. iHLS supports the startups in business development, penetration to relevant markets, legal advice, networking, and investments. Each project selected for INNOFENSE receives significant support and advising from the best leading mentors in MAF'AT, in addition to guidance and involvement of the defence arms in the project[1]. The startups that are selected by a committee of high-level representatives from the Ministry of Defense, MAF'AT, and IDF arms are recruited for a four to six-month cycle. Each project receives the sum of 200,000 NIS[45] (including taxes), in addition to support from the innovation centre, Ministry of Defense, MAF'AT, and the different IDF Arms.

23. Israel stands out in defence innovation despite its small size, with practices like the Talpiot program, operational demonstrators, and close collaboration among military, R&D, and industry sectors. Israel's defence innovation system is led by the Ministry of Defense (MoD) and the IDF, with MAFAT playing a central role in research and development. Over the years, their innovation strategy has led to the development of some of the world's finest weapon systems. However, understanding the changing threat scenario and rapid change in technology, the IDF's Innovation Strategy aims for systematic transformation to maintain superiority over adversaries. Like iDEX, the IDF in collaboration with iHLS has created INNOFENSE, an innovation centre, to fosters collaboration between civilian and defence sectors, supporting startups with mentoring and funding with an aim to assimilate the latest groundbreaking technology into the Armed Forces.

Summary

24. A scan of the global trends clearly indicates that defence administrations around the world are investing in innovation programs to assimilate the latest, cutting edge and dual-use technologies into their Armed Forces. All major militaries have at least one or more 'Open Innovation' challenge programs. Seed

[44] Bengo (2022)
[45] NIS – New Israeli Shekel. 200,000 NIS is approximately US$ 50,000

funding from the government with assistance of Partner Incubators and accelerators has become a norm. Even countries like the US and Israel who have established R&D organisations with a proven track record and backed by a robust defence-industrial complex have resorted to creating newer structures to foster defence innovation. Administrations have also published ‘innovation strategies’ with very well-defined objectives on what are the fields of study and outcomes they are expecting from these programs. Two global superpowers at the forefront of innovation China and Russia were omitted from the study due to both paucity of time and non-availability of adequate literature.

Chapter 4 - Innovations in Defence Excellence (iDEX)

Background

1. Before delving into the implementation of the iDEX procedure, it would be pertinent to get a background on the procurement process as followed by the Armed Forces (the primary users of the iDEX programme). Procurements in the Armed Forces are governed by two documents (which supplement the financial canons as prescribed by the Government of India), the Defence Procurement Manual -2009 (DPM-09) and the Defence Acquisition Procedure – 2020 (DAP-2020). The DPM -09 deals with revenue procurements, while the DAP-2020 deals with Capital Procurements.

2. The broad classification of the Capital acquisition process as derived from the DAP-2020 is shown in the figure below.

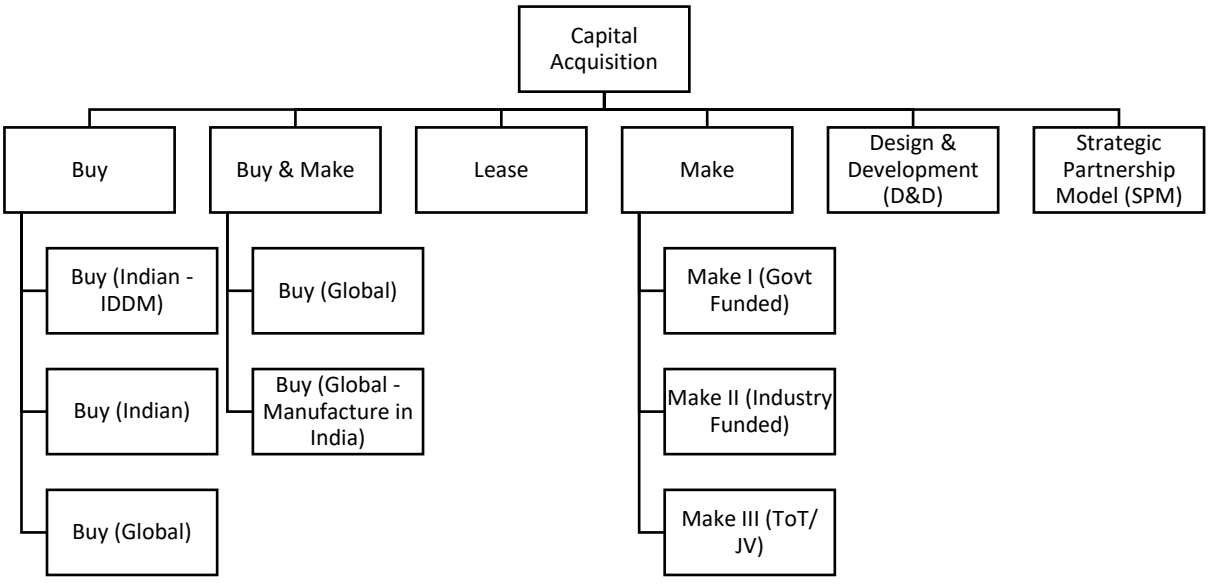

Figure 7: Classification of the Capital Acquisition Process[46]

3. **Traditional Model of System Development**. The conventional model of developing and inducting a system in the Armed Forces is enumerated below. In India, design and development would generally be undertake by the DRDO

[46] As derived from DAP -2020

(referred to as the Development Agency (DA)) and productionised by a defence PSU.

(a) **Identification of Requirement**. The need for a new defence system arises based on the strategic requirements of the armed forces, technological advancements, or gaps in existing capabilities.

(b) **Conceptualization**. Scientists/engineers of the Development Agency (DA) in consultation with the Users conceptualize the new system, taking into account the identified requirements, technological feasibility, and potential operational benefits. Based on the feedback of the DA and the SHQ, the budget and timelines

(c) **Research and Development**. The development process begins with extensive research and development efforts aimed at designing, prototyping, and testing the system. This phase involves theoretical studies, computational modelling, laboratory experiments, and simulation studies to validate the concept and feasibility of the proposed solution.

(d) **Prototype Development**. Once the initial design is validated, the DA develops prototypes of the system for further testing and evaluation. Prototypes are often subjected to various tests to assess their performance, reliability, and suitability for the intended application.

(e) **Testing and Evaluation**. The prototypes undergo rigorous testing and evaluation by the users both in the Lab and field. These evaluations may include simulated tests, field trials, and live-fire exercises to assess their functionality, effectiveness, and survivability in realistic operational scenarios.

(f) **Refinement and Iteration**. Based on the evaluation by the users and feedback from stakeholders, the DA refines the design of the system and iterates the development process to address any shortcomings or deficiencies identified during testing.

(g) **Certification and Qualification**. The system is certified and qualified by relevant authorities to ensure that it meets the required standards, specifications, and safety regulations.

(h) **Production**. Upon successful completion of testing and certification, the system produced by a suitable production agency (Public/ Private) under the ToT by the DA.

(i) **Lifecycle Support**. The Production Agency is then responsible to the Armed Forces for providing product support.

4. **The Need for Innovation**. The drawbacks in the traditional system is the fact that the DA (in the case of India, the DRDO) is also bound by the bureaucratic processes which bind Armed Forces procurements. While the procurement process in the armed forces starts after the prototype is qualified, the process for design and development of the prototype is also a prolonged process. With the rapid rate at which technology is changing, developing systems in a traditional and structured manner, results in systems being inducted into the forces which are most likely technologically obsolescent. Further, niche technologies in AI/ML, data analytic, drones are in fact dual-use technologies. The economies of scale and commercial viability in the civilian market make it more viable for tech entrepreneurs to develop products for civilian use rather than military use. Military research establishments trying to re-invent the wheel, so to speak, in developing these technologies for military use does not make sense. Thus, the concept of 'Open Innovation' has come in vogue to bridge the gap and enable faster assimilation of new age technologies into the defence and aero space industries.

Innovations in Defence Excellence (IDEX)

5. With an aim to enhance self-reliance and indigenisation, MoD concluded that a dedicated endeavour was necessary to connect and involve smaller enterprises, startups, and innovators possessing the capability, flexibility, and adaptability to provide the Indian military with inventive and resourceful

technological solutions. To effectively implement and establish this initiative, the Ministry of Defence devised and endorsed the Innovations for Defence Excellence (iDEX) framework. To implement the IDEX framework, a new Section 8 company, namely Defence Innovation Organisation (DIO), was formally launched by the Hon'ble PM during Def Expo 2018. It was setup by the Department of Defence Production, Ministry of Defence, with a budgetary support of Rs. 498.8 Crore from 2021-2026, the aim was to provide financial support to start-ups/ MSMEs/ individual innovators and partner incubators under the DIO framework. The objectives of the DIO as defined in the scheme document released by Dept of Defence Production is enumerated below.

6. The Defence Innovation Organization (DIO) [47] aims at creation of an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging Industries including MSMEs, startups, individual innovators, R&D institutes and academia and provide them grants/funding and other support to carry out R&D development which has good potential for future adoption for Indian defence and aerospace needs. The core objectives of the scheme are:

(a) Facilitate rapid development of new, indigenized, and innovative technologies for the Indian defence and aerospace sector, to meet needs for these sectors in shorter timelines

(b) Create a culture of engagement with innovative startups, to encourage
co-creation for defence and aerospace

(c) Empower a culture of technology co-creation and co-innovation within the defence and aerospace sectors

(d) Boost innovation among the start-ups and encourage them to be a part of Indian defence and aerospace ecosystem.

[47] As elucidated in the iDEX Document *ad verbatim.*

7. The structure of DIO/iDEX is shown in the figure below. As can be seen, the MoD, SHQs, DPSUs and the Start-ups/innovators are all stakeholders with the DIO being the facilitator between the users (MoD/SHQs/DPSUs) and the innovators.

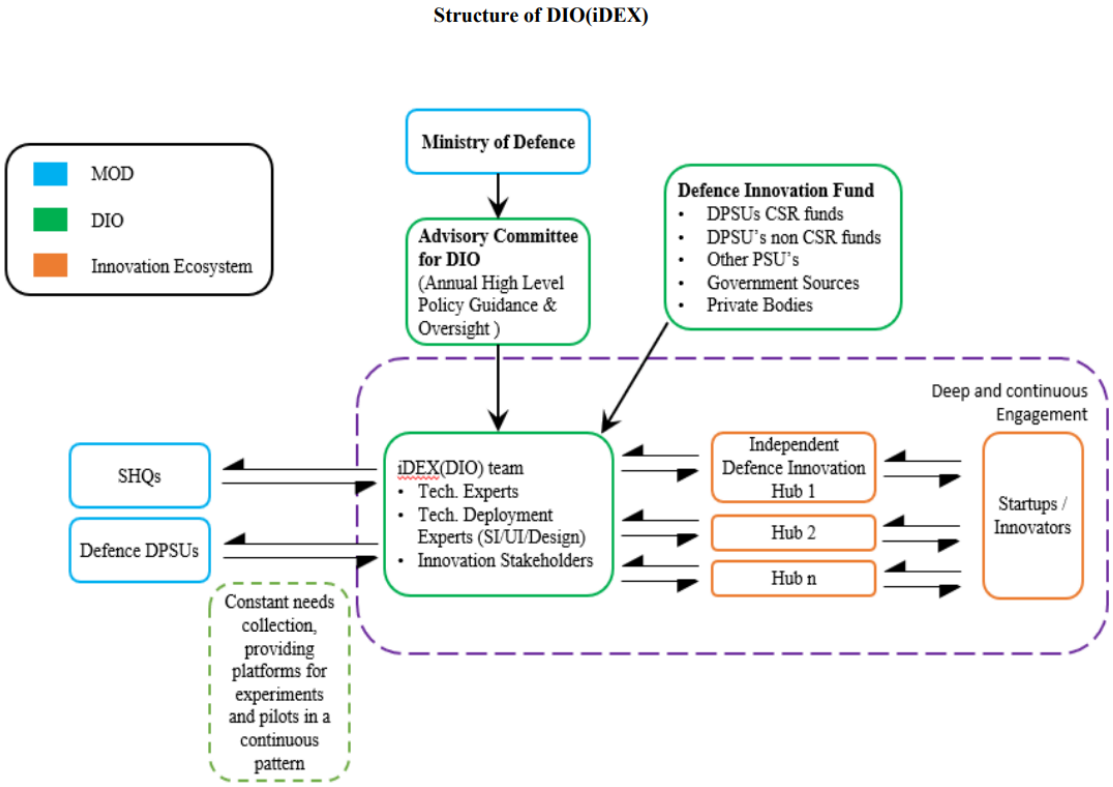

Figure 8: Structure of DIO {Source GoI(MoD)/DIO(n.d))}

The iDEX Framework Implementation

8. The iDEX framework focuses on facilitation for creating of prototypes and bringing of products/technologies to market (Defence or otherwise). with applicants being encouraged to spend on:

(a) Research & Development
(b) Prototyping
(c) Pilot Implementation
(d) Market Assessment

9. iDEX-DIO has launches of Defence India Startup Challenge (DISC) with problem statements from Armed Forces, DPSUs & OFB. After rigorous evaluation of the applications, winners are identified. Winner start-ups/ individuals receive innovation grants in technological areas through the Prototype funding guidelines called “Support for Prototype and Research Kickstart” (SPARK)[48], which entail provisioning of grants up to Rs 1.5 crore (depending upon the costing of the project and matching contribution) to the Startups. The funds will be disbursed in tranches based on the milestones decided by a high-powered selection committee for prototype development. Any number of potential candidates can be selected under each of the iDEX challenges. In addition to the flagship program DISC, other programs such as iDEX Open Challenges, iDEX4Fauji (i4F), iDEX Prime (with grants upto 10Cr), iDEX SPRINT (DISC 7), iDEX INDUS-X (joint problem statement with the US Navy) and iDEX - Internships have their own selection procedures as per published guidelines.

10. Apart from the fund, selected applicants may also be given entry to accelerator programs run by iDEX partners, where they will be supported in technology and business development through mentorship under the innovation and entrepreneurship experts. The selected applicants may also be supported in terms of access to defence testing facilities and experts for their product/technology development.

11. Once a startup or innovator is selected as a SPARK Grant winner after a multi-stage process, the Technical Appraisal begins. The Technical Appraisal is an assessment of the proposed budget, technology / product details, work breakdown structures, and requirements and support required. Once the Technical Appraisal is prepared mutually between iDEX and the grant winner, an Agreement is signed with supporting documents like certificate of incorporation, exclusive bank account statements for iDEX project etc. Note that individual innovators are required to form a startup before signing the agreement.

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[48] SPARK or Support for Prototype & Research Kickstart (in Defence) is the scheme for funding startups selected through the DISC challenges. Applicants showing capability, intent, and promise to be able to produce functional prototypes or to productize existing technologies will be awarded up to Rs. 1.5 crores, strictly on a milestone basis in the form of grant/equity/debt/other relevant structures.

12. **Funding**. The SPARK Grant determined during the Technical Appraisal is released in multiple tranches, based on completion of pre-established milestones and the deployment of Matching Contribution as per the agreement. Generally, the tranche amount for Tranche 0, 1, 2, 4 and 5 is 10%, 20%, 30%, 30%, 10% of the SPARK Grant. Once the agreement is signed, the Kick-off Tranche is released. For Tranche 3, there is no SPARK Grant, only the Matching Contribution is to be deposited by innovator. Likewise in Tranche 5, there is no Matching Contribution, only re-imbursement of funds by iDEX, DIO.

13. **Matching Contribution**. The rationale for matching contribution is given as a response to the FAQ on the iDEX website.

> "iDEX is designed to attract start-ups with innovative ideas products relevant to the Armed Services, and in this process, also create a vibrant Indian Defence manufacturing base. Meeting these objectives requires companies to have adequate capabilities to not just deliver on the product under the grant, to be able to service the equipment over its useful lifetime, and run a sustainable enterprise. iDEX would like its grant winners to expand and become self-sustaining enterprises, which requires a vibrant business plan and 'skin-in-the-game' from the founders. The substantial grant under SPARK from public resources are expected to be matched by matching contribution from the grant winning start-ups, to ensure the incentives are aligned with creating a viable product meeting Defence standard. The matching contribution in the Product Development Budget (PDB) is determined with varying amounts of cash, in-kind resources, and human resources, through a collaborative process between the iDEX Team and the start-up, under robust guidelines. iDEX is designed to support start-ups using public funds with the assumption that this assistance will help develop products and Indian Defence technology companies. It is assumed that start-ups competing for grants will be doing so with full faith and integrity, in the broader interest of the nation. While substantial flexibility is provided with the understanding that innovation requires prompt

decision making and frequent experiments, this flexibility should not be misused or abused. Any efforts to extract excess funds from iDEX or under-report matching contribution, despite the flexibility, will be assumed to be in bad faith, and proportionate penal action will be taken, including cross-govt blacklisting for future and withdrawal of all existing grants."

14. **Partner Incubators**. iDEX Partner Incubators play a pivotal role in fostering innovation and entrepreneurship. As part of the Innovation for Defence Excellence (iDEX), DDP has signed MoUs with partner incubators to serve as hubs for nurturing startups and innovators working on cutting-edge technologies relevant to defence and national security. Through iDEX Partner Incubators, startups receive essential support, including access to funding, mentorship, infrastructure, and networking opportunities. These incubators provide a conducive environment for startups to develop and prototype innovative solutions, collaborate with domain experts, and validate their ideas for potential adoption by the armed forces. By leveraging the expertise and resources of partner incubators, iDEX aims to harness the creativity and agility of the startup ecosystem to address critical defence challenges and enhance indigenous capabilities. As on date DIO has partnered with 28 incubators and one investor hub (with 10 investors).

Prototypes to Production

14. The iDEX framework, facilitates the finding solutions to problem statements issued by the Service Headquarters through the Open innovation Challenges. When compared to the traditional method of designing and developing systems (as mentioned in Para 3 above), the iDEX framework addresses the first 4 steps from identification of requirements to development of prototypes. Once a prototype is cleared by the SHQ (by meeting the SQRs), the system needs to be procured as per the guidelines issued in DAP 2020.

15. **iDEX and DAP 2020.** The ever-evolving governing document for Capital Acquisitions was issued in 2020 with subsequent amendments. As compared to

the previous avatar of this manual the DPP (2016), the new document has made changes in the procurement categories split the 'Make' category into three sub-categories, created categories of 'Innovation' and 'Leasing' as new categories. The new category of innovation is intended to foster innovation by involving individual innovators, technocrats, professionals, academics, smaller enterprises, start-ups and MSMEs[49], who could develop innovative solutions making use of any one of the following routes. The final product would be procured under the Buy (Indian- IDDM) category, with the provision for dispensing off with quantity vetting and scaling in iDEX cases[50]. Like Make II category, individuals/innovators/MSMEs can also submit Suo moto proposals for innovation to the SHQs for examination and if feasible initiate procurement for the same.

(a) Innovations for Defence Excellence (iDEX) Scheme under the aegis of the Defence Innovation Organisation (DIO).

(b) Technology Development Fund (TDF) Scheme managed by the DRDO.

(c) Indigenous Development by Services through Internal Organisations, such as the Base workshops/Dockyards/Base Repair Depots/ Internal Indigenisation organisations/Design Agency, etc.

16. **Timelines**. The timelines for processing the cases under iDEX and TDF schemes are promulgated in Appendix L and M of Chapter III of DAP-2020. Appendix L deals with the iDEX cases being progressed under Make II, while Appendix M deals with procurements being undertaken under TDF scheme.

17. The detailed procedure for processing cases[51] under the 'Innovation' category including Appendix L and M as specified in DAP-2020 is placed at **Annexure 2**.

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[49] DAP 2020, Chapter III, Section B, pp. 341-344
[50] Ibid. pp 341.
[51] Ibid. Chapter III, Section II. Pp 341-343A.

Effectiveness of iDEX

18. It is said that the proof of the pudding is in eating it. Since its inception, the DIO has released challenges under the Defence Innovation Start-up Challenge (DISC) and SPARK frameworks. The table below gives a snapshot of how iDEX has performed since inception[52].

300 Challenges	362 Winners	3 / 16 Services/ DPSU	28 Partner Incubators
7500+ Applications	1500+ Shortlisted	23 Nodal Agencies	₹330 Cr Grants Approved

Summary

19. To summarise, the iDEX framework has been in existence for nearly 5 years. The processes that have been set have to a large extent catalysed the Indian industry to start investing in the Defence. The iDEX framework has also shown the Armed Forces and a few DPSUs to start thinking 'out of the box' and seek out solutions to both day-to-day problems and long-term strategic issues by nurturing/exploiting the vibrant technological eco-system available within the country. In order to assess the effectiveness of the framework, I interacted with a large number of start-ups/ innovators and the officers in the Service Headquarters who are utilising the iDEX framework. Their responses have been collected and quantified and presented in the next Chapter.

[52] www.idex.gov.in. Dashboard Data on Home page. Accessed online on 27 Feb 2024.

Chapter 5 – Findings & Observations

1. **Primary Data**. Primary data was collected from the identified stakeholders through two separate questionnaire surveys addressing both the stakeholder groups – the Users responsible for using IDEX to address their needs of technology adoption and system induction; and the Innovators/ Start-ups/MSMEs – who are developing the new products and hoping to see the same inducted into the forces.

(a) The questionnaire for Innovators/ Startups (**Appendix 'A'**) had 33 questions. For the purposes of analysis, the questionnaire has been divided into 5 sections.

(i) Introduce yourself
(ii) Innovations in Defence Excellence (IDEX)
(iii) Prototyping
(iv) Testing and acceptance
(v) Taking it forward

(b) The questionnaire for officers of the three service HQs/ PSUs/ DRDO (**Appendix** '**B'**) had 27 questions. For the purposes of analysis, the questionnaire has been divided into 6 sections.

(i) Introduce yourself (your profile)
(ii) General Perceptions
(iii) IDEX
(iv) Impact on Induction
(v) Collaboration & Stakeholder Engagement
(vi) Challenges and Concerns and Way Forward

(c) Follow-up interviews were also conducted with some of the CEOs of the companies for their views on the responses received.

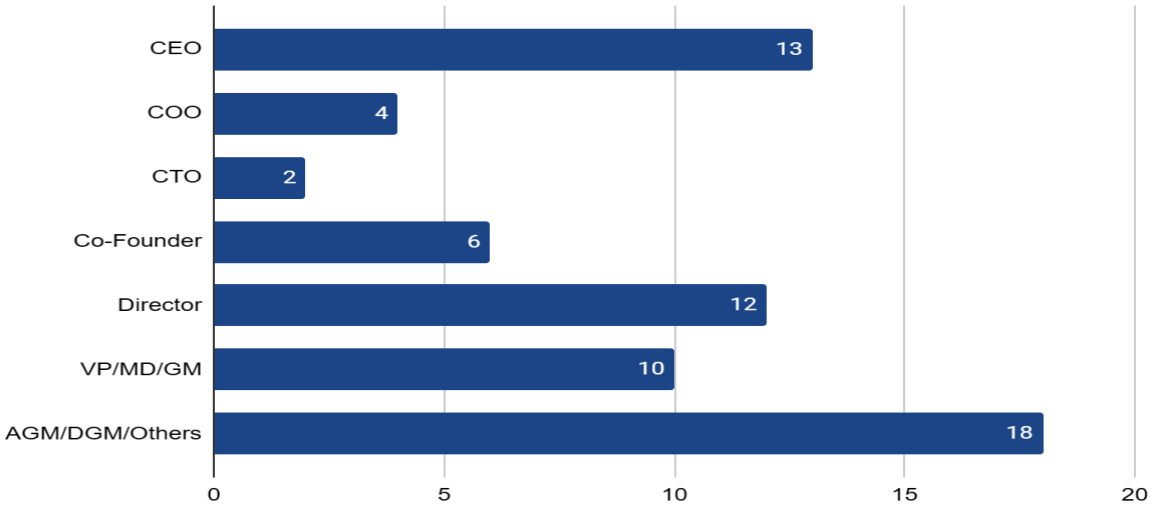
2. **Secondary Data**. Has been analysed and placed at the relevant places in the report.

Analysis of the Primary Data

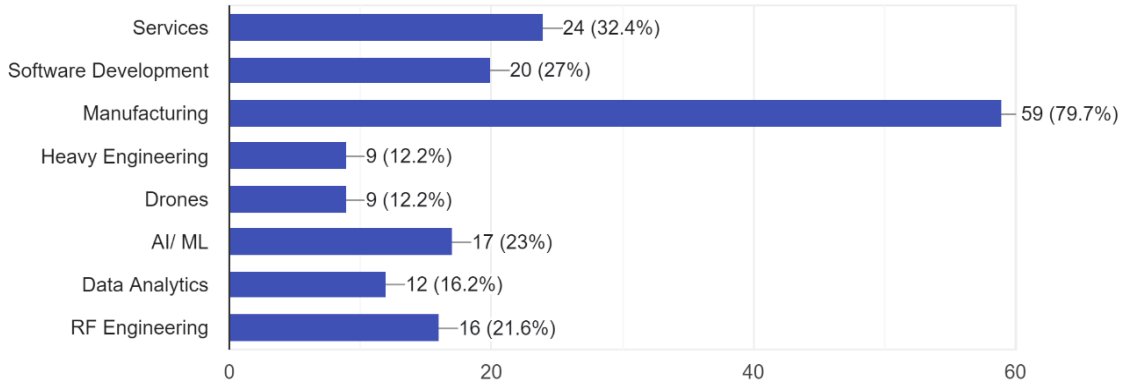
3. **Responses from Innovators/ Start-ups/ MSMEs**.

(a) Company Profile. This section is aimed at examining the profile of the respondents and their engagement with the defence and aerospace industry. The respondents were drawn out of the iDEX participants and the industry partners who are engaged with the Service Headquarters.

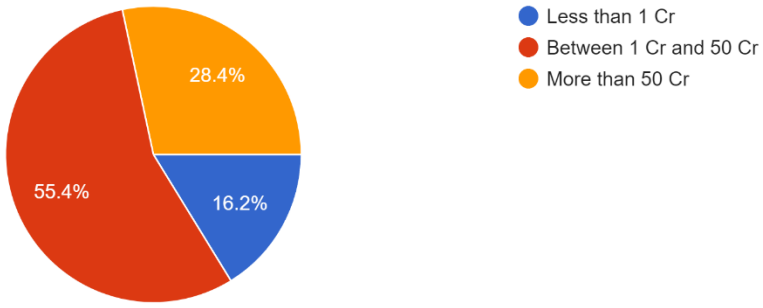
(i) Designation of Respondents Designation of Respondents. The respondents were a mix of owners and employees. All respondents were part of either the top or senior management. This respondent profile therefore would give a very balanced and nuanced view on the topic.



(ii) Sector of Operations**.** The respondents covered the full spectrum of operations as far as iDEX was concerned. Some of the respondents are involved in more than one sector. From the responses one can see that three major sectors of operations are covered namely Manufacturing, Software (including AI/ML/ Data analytics) and RF engineering (which is a niche field very relevant to the defence and aerospace industry).



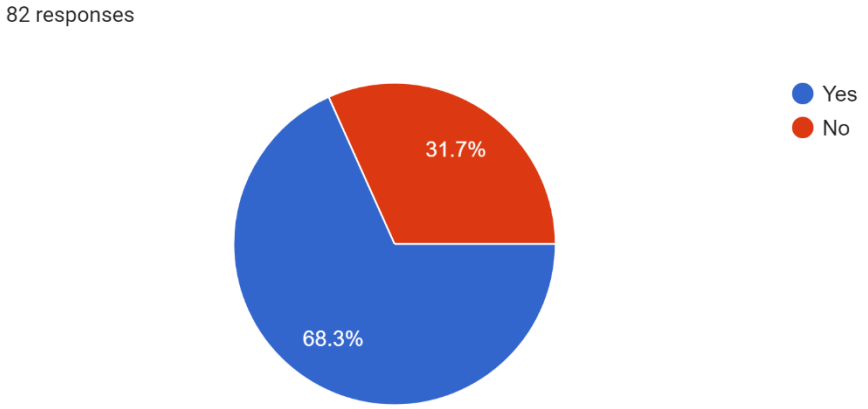
(iii) Annual Turnover of Company. 16% of the respondents have an annual turnover of less than ₹1 Cr. While 50% of the respondents did indicate a turnover of ₹1-50 Cr, based on the interactions with the respondents', funding support is one of the key elements required to ensure sustainability of these companies. Individuals/ start-ups may win challenges, but lack of funding may cause them to move to greener pastures.



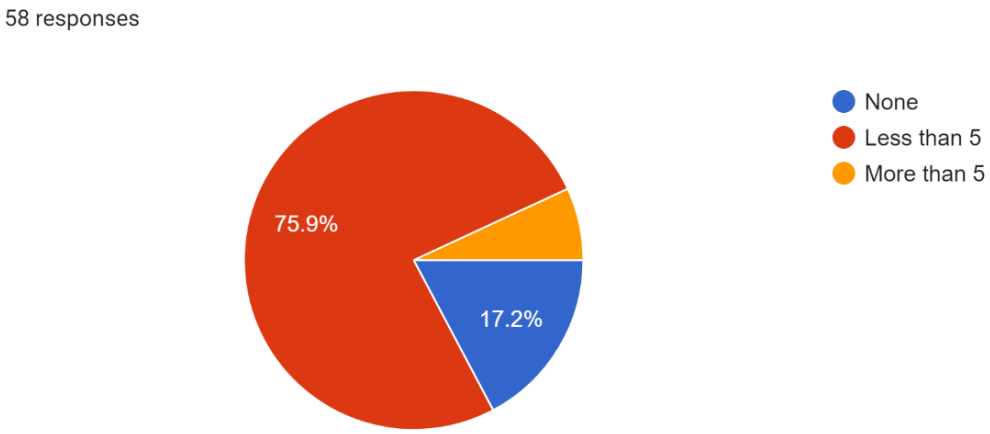
(b) **Innovations in Defence Excellence.** This section was designed with the aim of examining the respondent's knowledge and level of engagement of iDEX.

(iv) Has your firm participated in iDEX Challenges? 68% of the respondents had participated in iDEX. However, of the 30% respondents who had not participated in iDEX, many are actively working with the Armed Forces (especially the Navy) and some in

the defence industrial corridors like CODISSIA[53]. Many were unaware of iDEX and sought interaction with the concerned departments. Thus, iDEX needs to be branded better, so that the footprint improves. This would further propel the 'Make in India'/ 'Atmanirbhar Bharat' schemes.

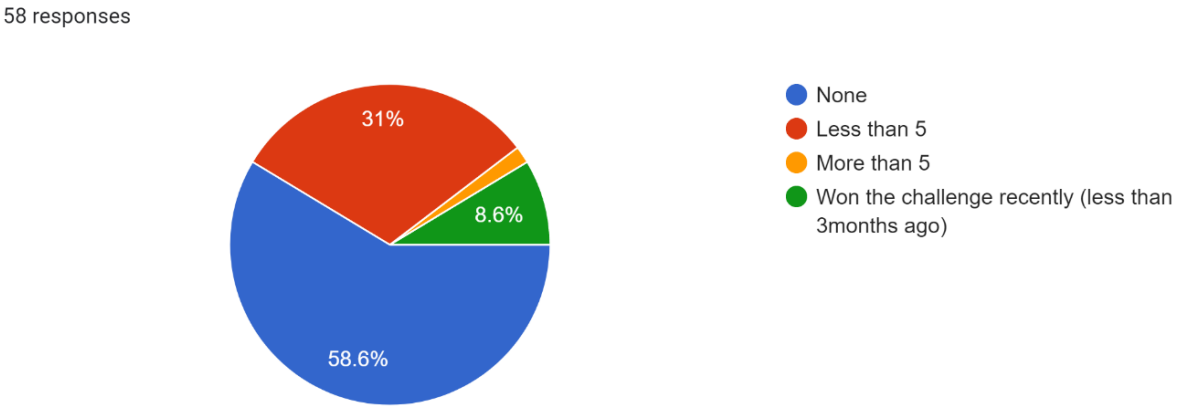


(v) How many IDEX Challenges has your firm won? Of the 68% respondents who have participated in iDEX, 76% have won less than 5 challenges, 7% won more than 5 challenges (albeit as per the iDEX rules a firm can be awarded only 5 challenges at one point of time). 17% of the respondents have participated but never won a challenge.

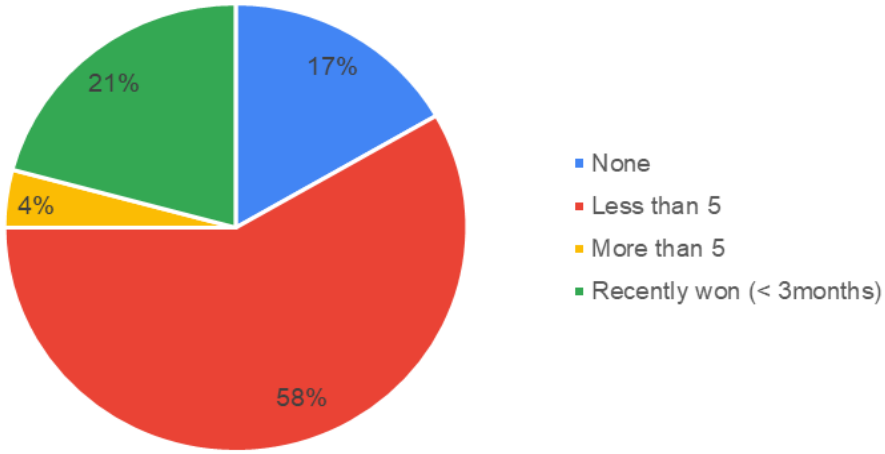


[53] CODISSIA- The Coimbatore District Small Industries Association. www.coidissia.com

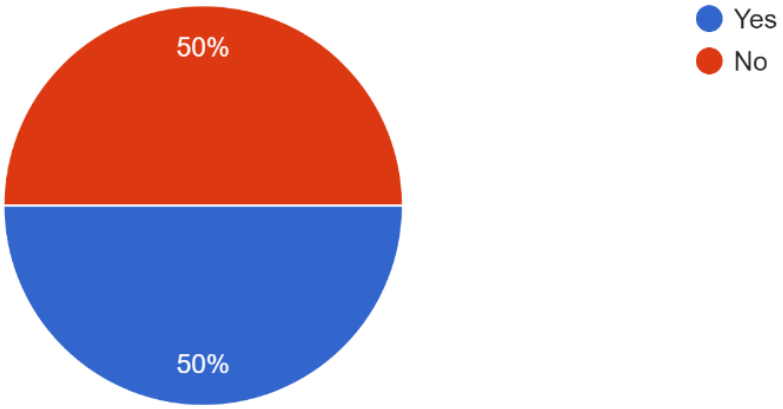
(vi) How many challenges have you completed the Challenge? As can be seen only 40 % of the respondents have won challenges.



(viii) How many challenges have been accepted by the MoD/ PSU? Of the respondents who have won challenges, almost 62% of the proposals have been accepted by the MoD/ PSU.

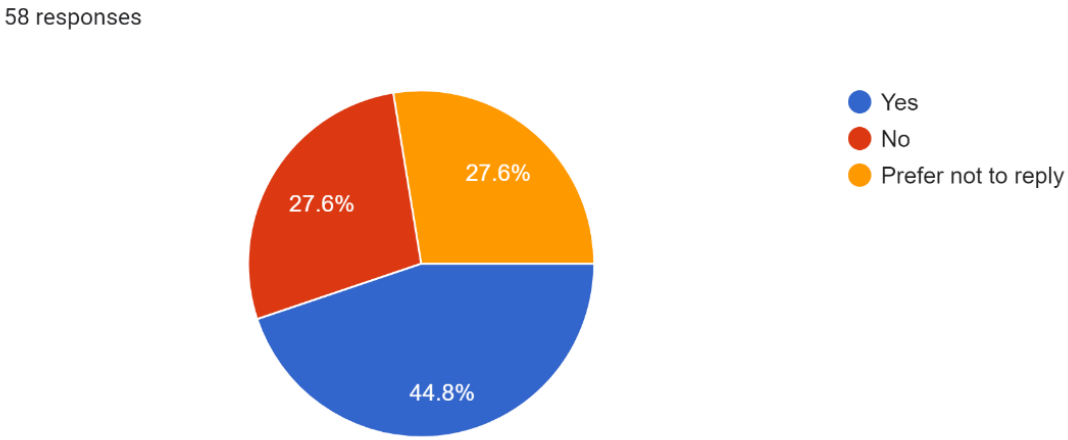


(viii) Was the funding amount through IDEX adequate for system/ prototype development? Funding is an issue which needs to be addressed if the defence innovation eco-system needs to be sustainable. From the annual turnover of the respondents examined at Para 3(a)(iii) above, even though 55% of the respondents have a turnover between ₹1 – 50 Cr, interactions with the respondents indicate that majority of then face difficulties in raising funds.



(c) **Prototyping.** This section examined how fast the start-ups were able complete the challenges/ complete the prototype; assess the level of indigenisation; identify the import content and the supply chain vulnerabilities.

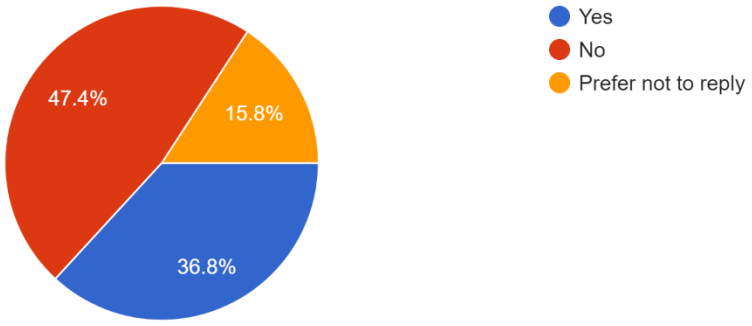
(ix) Was your firm able to deliver the prototype within the stipulated timelines? 48% of the respondents were able to deliver the prototypes within the stipulated timelines.



(x) Did your firm use Commercial-Off-The-Shelf (COTS) sub-systems/products to realise the prototype? The use of commercial off-the-shelf (COTS) components and subsystems in the manufacture of prototypes offers several advantages in terms of cost-effectiveness, time efficiency, and performance. Manufacturers

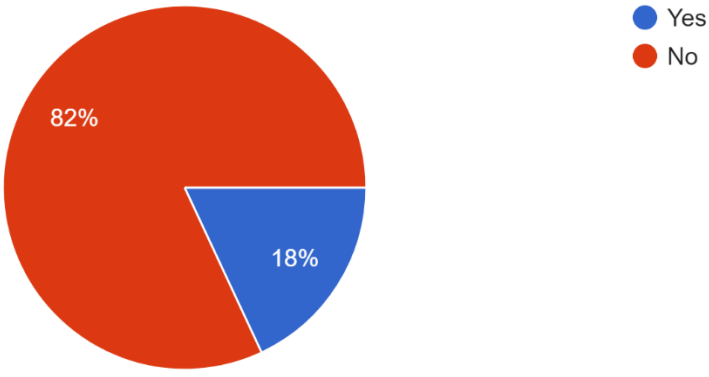
leverage readily available COTS components, to significantly reduce the development time and costs associated with prototyping. However, with the armed forces looking to accelerate timelines for induction, this could prove to be a critical factor when mass production orders are issued.

57 responses

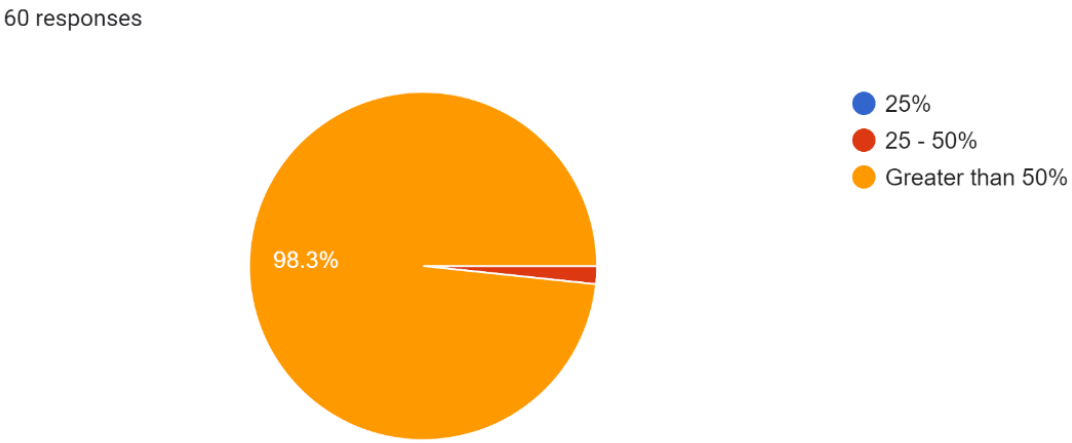


(xi) Does your firm have any foreign collaboration/ToT agreements? 82% of the respondents have no foreign collaborations/ ToT arrangements. This augurs well for the 'Make in India'/ Atmanirbhar Bharat initiatives.

61 responses

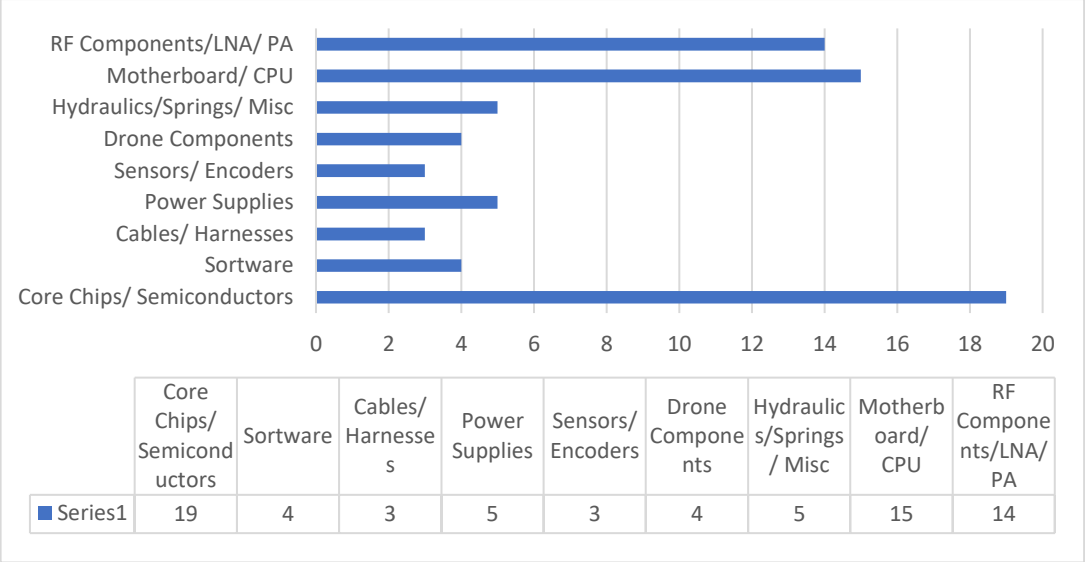


(xii) What is the indigenous content in your prototype? Almost all respondents have an indigenous content > 50%. This is in consonance with the requirements of DAP 2020, where the iDEX cases are to be processed under Buy (IDDM) [54] category.



(xiii) What components/ sub-systems do you import (choose more than one if applicable)? The graph below shows the broad category of components imported by the various respondents to manufacture the prototypes. While there is a thrust by the government to build a semi-conductor and display eco-system in the country[55], some thrust is required to establish manufacturing of RF components as well.

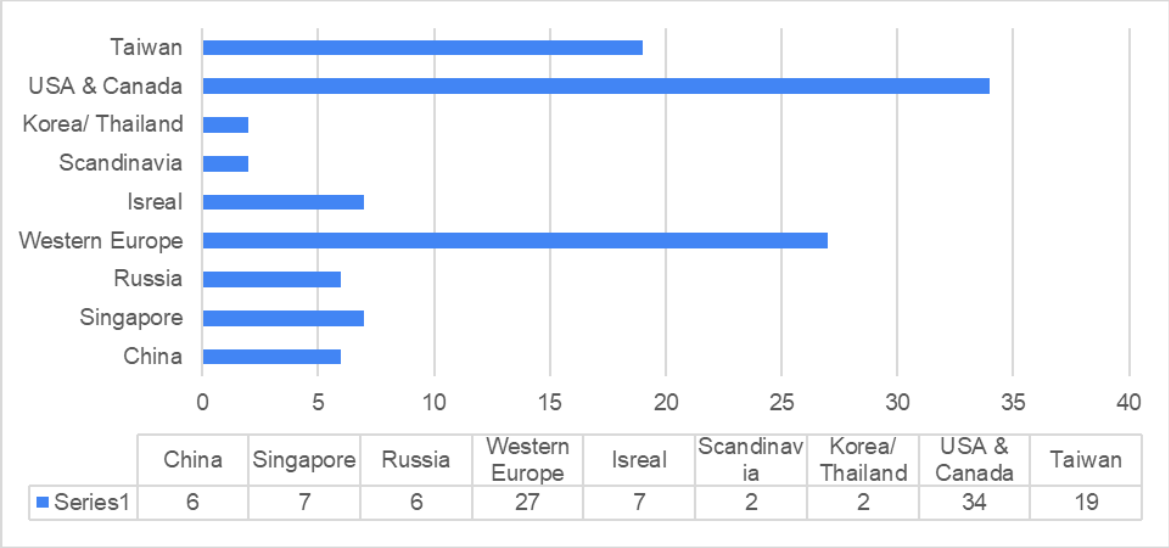
[54] **DAP 2020**. Chapter 1, pp2. Definition of **Buy (Indian-IDDM).** 'Buy (Indian-IDDM)' category refers to the acquisition of products from an Indian vendor that have been indigenously designed, developed and manufactured with a minimum of 50% Indigenous Content (IC) on cost basis of the base contract price.
[55] GoI(n.d). ism.gov.in. India Semiconductor Mission.



	Core Chips/ Semiconductors	Sortware	Cables/ Harnesses	Power Supplies	Sensors/ Encoders	Drone Components	Hydraulics/Springs/ Misc	Motherboard/ CPU	RF Components/LNA/ PA
Series1	19	4	3	5	3	4	5	15	14

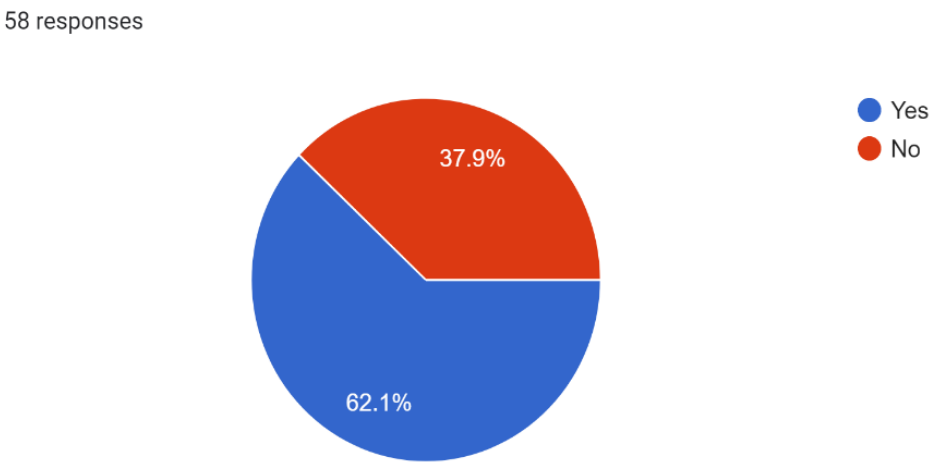
(xiv) What countries do you source your import components/ sub-systems from (choose more than one if applicable). Supply chain vulnerability has been greatly highlighted in the last few years (be it COVID-19, the Russia-Ukraine or Israel-Hamas conflicts). The need to have a reliable and sustainable supply chain in today's highly interconnected world is a key factor which drives defence innovation. This is an issue that not just India but almost all the world's top military manufacturers are grappling with. The chart below shows the countries from where components are imported[56]. USA & Taiwan are the two countries where maximum respondents imported their components from. Respondents also imported the components from Western Europe, Scandinavia, China and Russia as well. Some of the respondents have indicated that the components are manufactured abroad but sourced locally. This may augur well for prototype development, but needs to be strongly considered when viewed in the context of mass-produced systems which are inducted into the service and need high operational availability.

[56] Note: For the ease of presentation of data, respondents inputs have been grouped as **Western Europe** (which includes Germany, France, UK, Spain and Italy) and **Scandinavia** (which includes Finland, Denmark, Norway, Sweden)



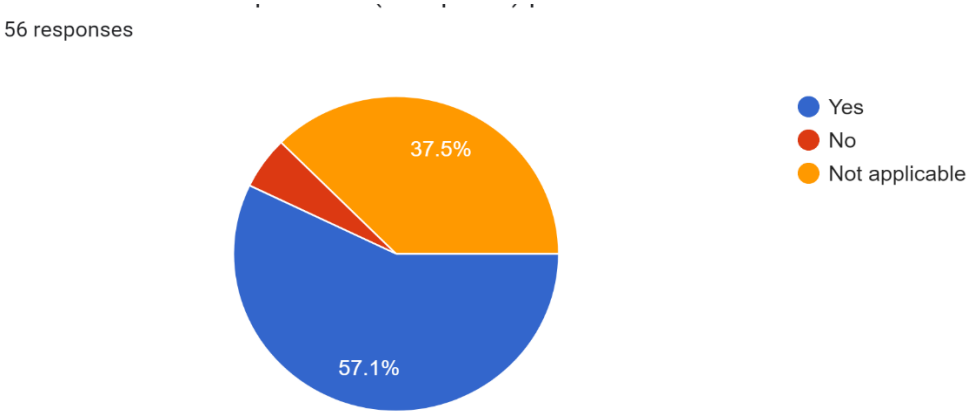
(d) **Support from Sponsoring Organisation for Testing and Acceptance.** This section sought views of the respondents on the level of support, user interaction and understanding of user requirements in terms of Quality Assurance.

(xv) Has your prototype been evaluated by the sponsoring organisation? 62 % of the respondents have indicated that their systems have been evaluated by the sponsoring organisation.

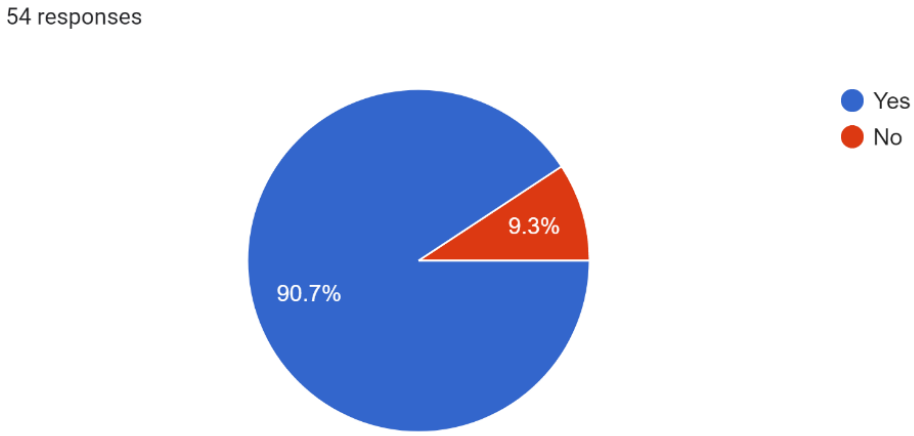


(xvi) Was a suitable trial platform (if required) provided? When considering the applicability of a trial platform for evaluation, almost

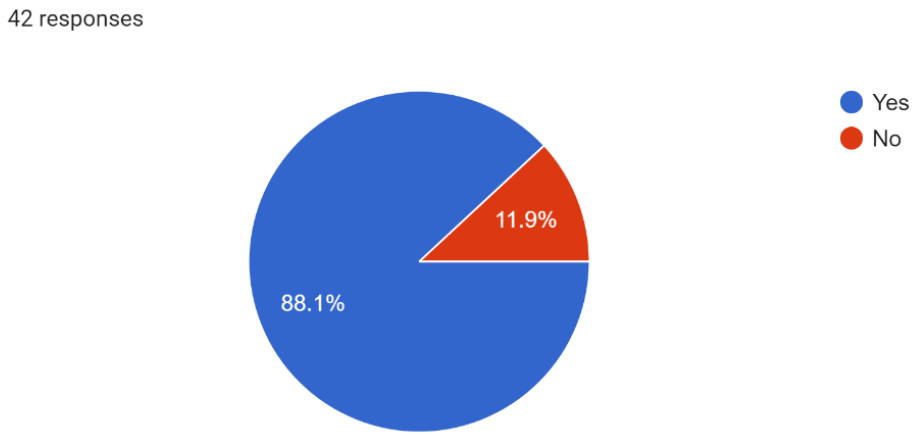
all respondents who required the platform were afforded one. Which indicates the seriousness accorded to the iDEX program by the three services.



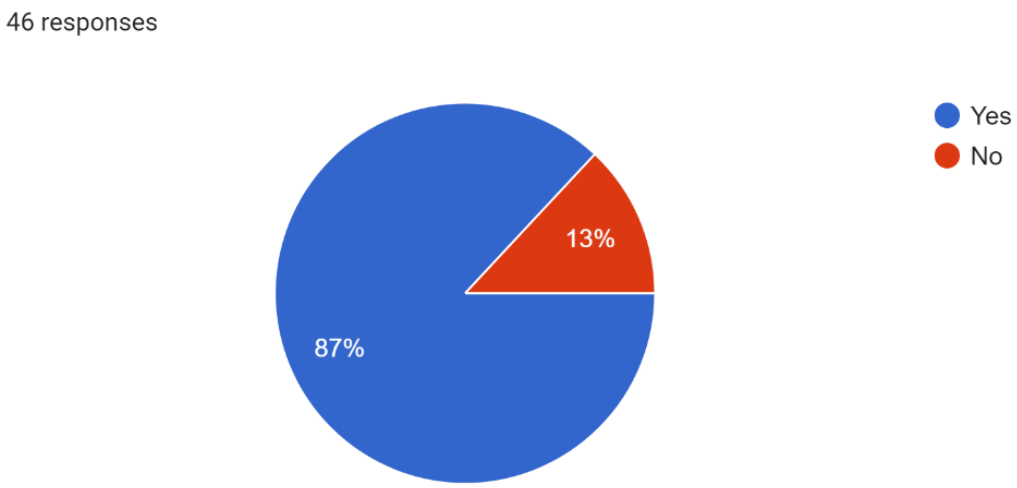
(xvii) Were you able to interact with the users during the trials/ evaluation process? Despite a very positive response on the user interaction, deeper interaction with the respondents reveal that many would like an even greater level of user involvement right from the get go.

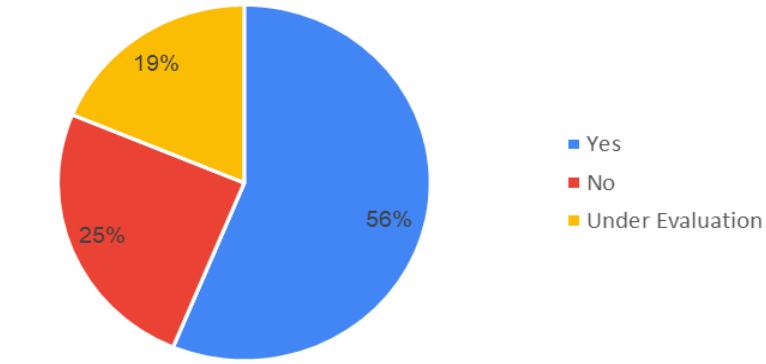


(xviii) Were the trials conducted as per the Approved Test Plans (ATPs)?



(xix) Did the product meet the specifier Qualification Requirements (QRs)? This is one question which got a varied response when comments were sought from the Users. 87% of the respondents (from the innovators/start-ups) felt that their prototype / POC met the user QRs, whereas on 56% of the users felt that the prototypes met their QRs. Some users indicated that the prototypes/POCs met their requirement to a large extent or met the requirements with iterations both of which are very acceptable outcomes in the larger scheme.

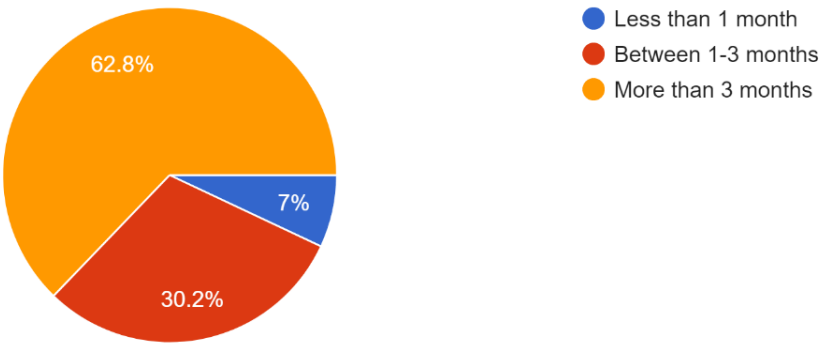




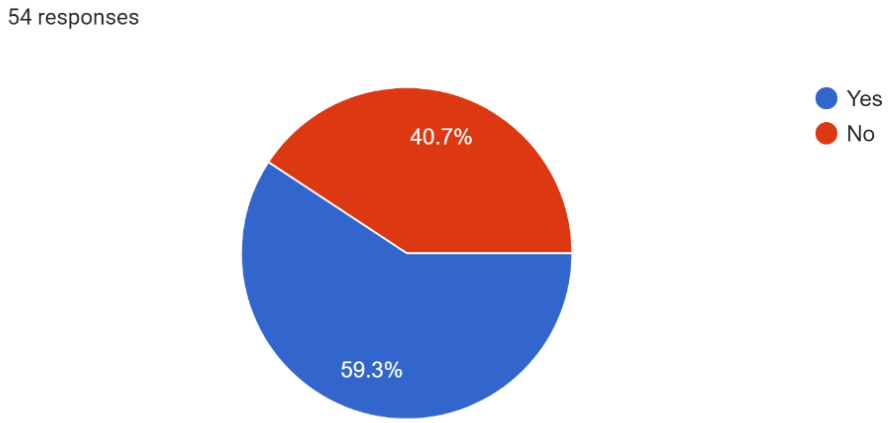
User Response on whether the prototypes met the QRs

(xx) What was the time taken to complete the evaluation? 63% of the respondents indicated that time taken for evaluation exceed 03 months. This is also in consonance with the responses obtained from the User directorates. User evaluation of the prototypes is perhaps the single most critical stage in the entire innovation process. Users need to understand that the prototype may have limitations which can only be overcome in an iterative manner. The development agency also needs to understand the requirements of the user in the field. The DAP stipulates the timelines for 'Single stage composite user trials and acceptance of trial report' as 7 weeks, which is not pragmatic, more so since iDEX is being used to develop innovative products which are not readily available in the market. If this clause is forced on the trial team, then trial teams will examine the prototype with a GO-NO GO criteria and probably reject the prototype at the first stage itself.

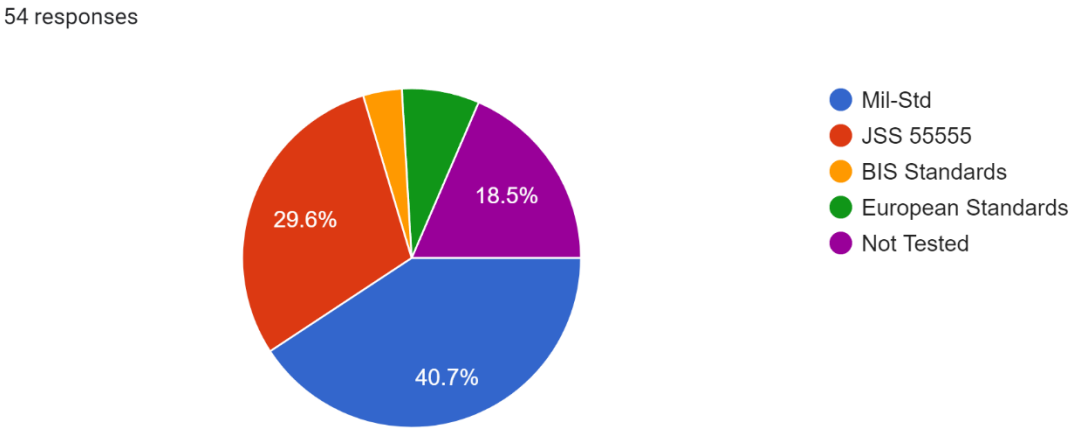
43 responses



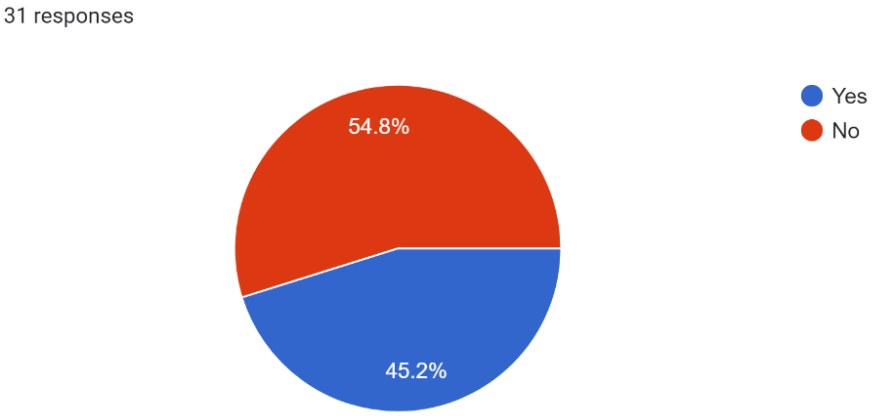
(xxi) Did the IDEX Challenge specify the Quality Assurance Plan required for your product to be tested? Given the dense electro-magnetic environment and the extreme terrain/ weather conditions that military equipment is operated under, QA testing is one of the most important components of system induction. The importance of having an approved QAP cannot be over emphasised. It is therefore imperative that the problem statements clearly bring out the QA standards to which equipment are expected to be tested (if not at the prototype stage, definitely prior induction). QA testing also has a cost component attached to it, which start-ups/ innovators need to consider when designing, developing and costing the system.



(xxii) What qualification standards is your prototype/product tested to? This was an interesting response which I received. While 40% of the respondents indicated that a QA plan was not specified in the problem statement, only 18% of the respondents indicated that their products were not tested to any standards. 72% of the respondents had tested their product to one of the known standards.

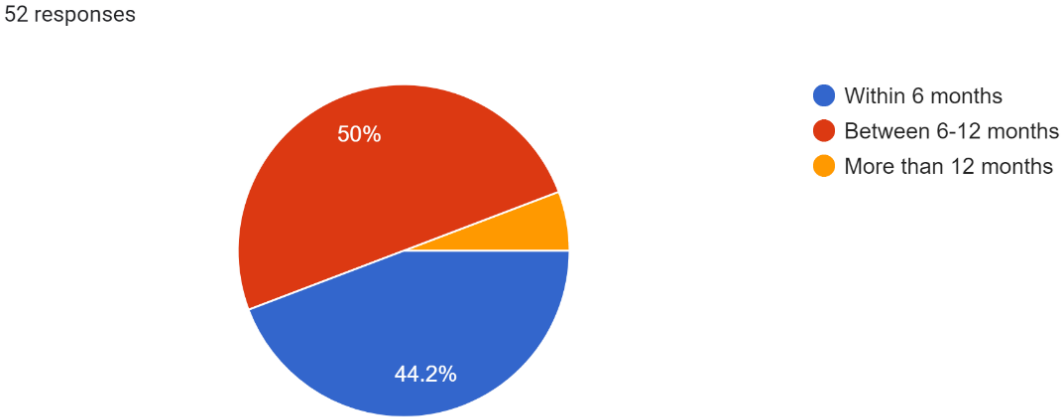


(xxiii) If your product qualified the evaluation did you get a production order? 54% of the respondents whose products were successfully evaluated got a production order. This is a very encouraging sign and if this percentage goes up, it will give a good boost to the innovation eco-system.



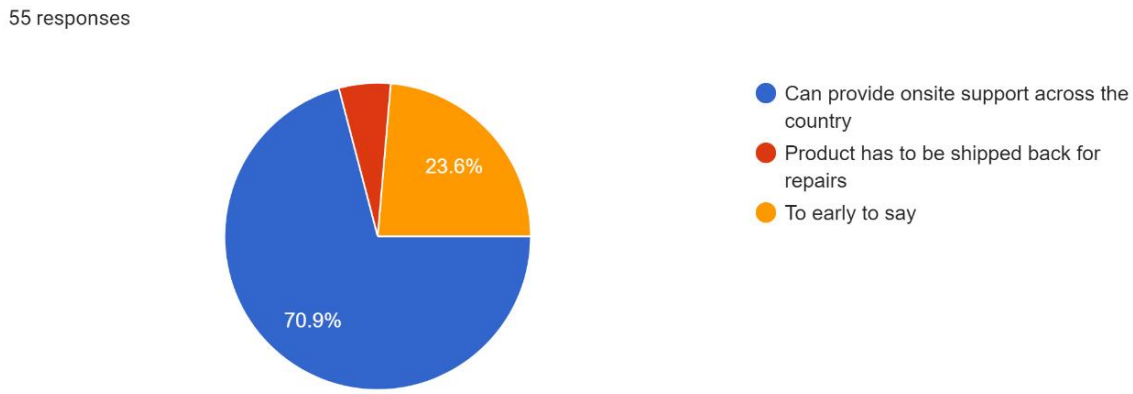
(xxiv) How well is your firm geared to scale up production (if you get the production order)**?** Scaling up production is one of the most important factors which will determine the success of the defence innovation eco-system. It is not enough to innovate, but to ensure the innovation reaches the user in a time bound manner. The entire premise that iDEX would in fact accelerate the timelines for system induction would be reliant on how fast a firm can ramp up production to meet the user requirements. With more than 50% of the

respondents indicating that scaling up production will take more than 6 months, there is a need to examine this issue. Start-ups cannot invest in infrastructure development till such time they have confirmed work orders. Commencement of infrastructure development for scaling up production after the work order is received will in all probability have a cascading effect on the product delivery. Thus, smaller start-ups/ innovators would need hand-holding. Using the production facilities of larger industrial houses/ DPUs could be considered.



(xxv) How well is your firm geared up to provide product support if production orders are placed? Product support is another important factor which will measure the success of a system inducted. As someone who has maintained weapons and sensors on frontline ships and in the dockyards, I can say out of experience, the best systems are those which can be maintained by the service personnel with minimal support from the OEMs. However, newer systems incorporating cutting edge technologies may not be possible to be maintained without OEM support. Availability of both the technician and spares is essential to ensure a high operational availability of the systems deployed in the field. Providing on-site support across the length and breadth of the country will have a cost implication. 70% of the respondents have indicated that they can provide on-site support which is promising. This would have to re-

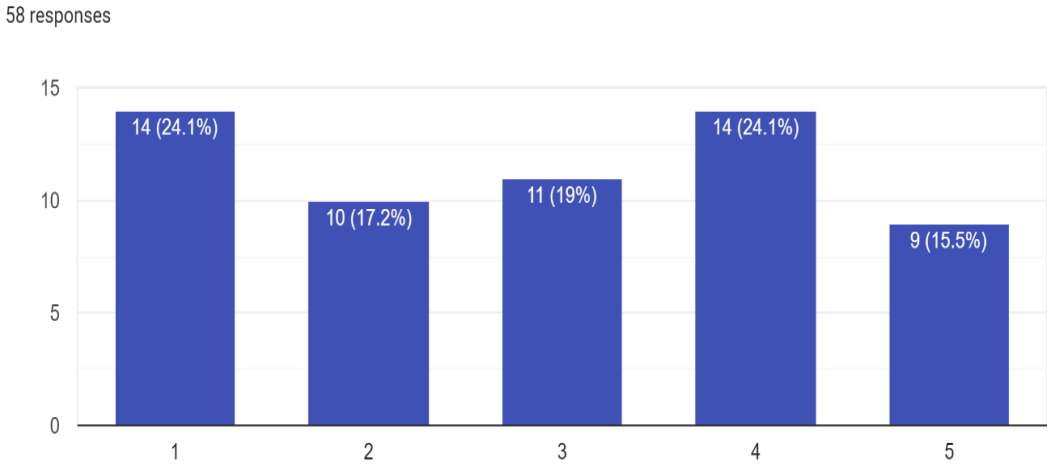
assessed with user inputs after the first of the products are exploited in the field over a reasonable period of time.



(e) **Taking it Forward.**

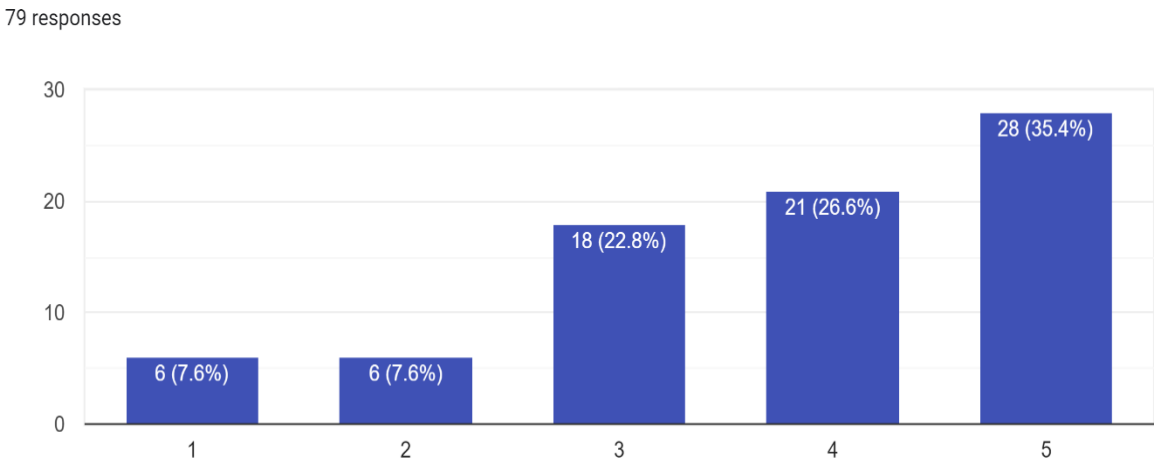
(xxvi) Does your firm have a current understanding of how to find, pursue, and win innovation funding opportunities within the GoI/MoD? (**1 – Little Understanding, 5 -excellent understanding)**.

As can be seen from the chart below, almost 40 % of the respondents have indicated that they have little or limited understanding of how to get innovation funding opportunities from the GoI/ MoD. This also bears out the fact that 35% of the respondents have not participated in iDEX despite being embedded within the defence eco-system. These companies not only have experience working with the defence forces, they have an awareness of the procedures, the operating environment and QA/ testing requirements. Onboarding these firms into iDEX would greatly enhance the effectiveness of the program. Therefore, more awareness programs on iDEX must be undertaken especially with the firms already embedded with the various defence establishments across the country.



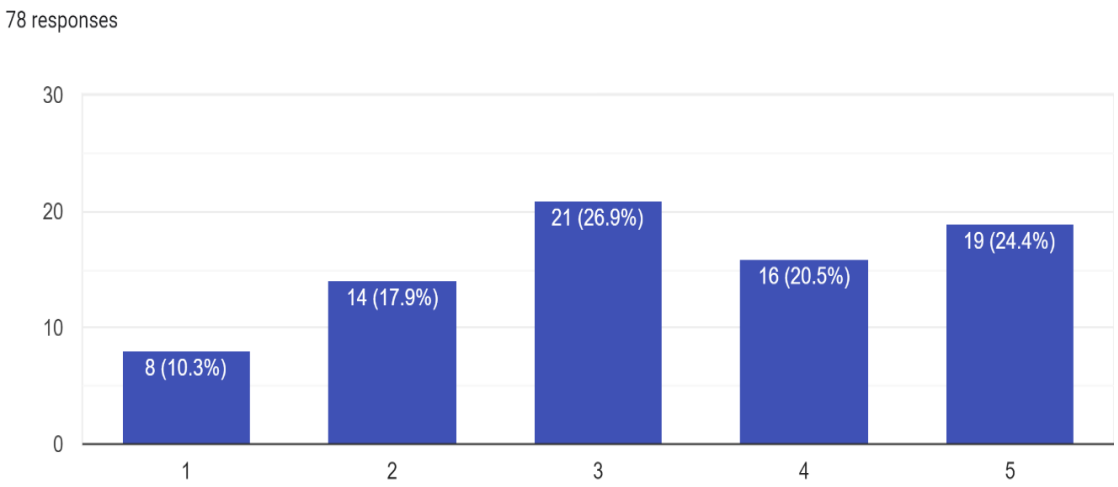
(xxvii) In your opinion, do you think the PSUs/ larger industrial houses can play a significant role in promoting innovators/ start-ups/ entrepreneurs? (1 – Little Understanding, 5 -excellent understanding)

A majority of the respondents opined that the PSUs/ larger industrial houses can play a significant role in promoting innovators. This could be in term of financial support (accelerator/ connector programs); in terms of partnership (albeit many innovators/ start-ups did express concerns on this count) or in extending the production/ testing facilities.



(xxviii) Do you think that partnering with a PSU/ large industrial house in the defence sector is favourable for the start-ups/ MSMEs/ innovators to scale up production and provide life-cycle support? (1 – Little Understanding, 5 -excellent understanding)

70% of the respondents felt that it would be favourable for start-ups/ innovators to partner with PSUs for scaling up production and provide life-cycle support. This despite the fact that 70% of the respondents who have won challenges have indicated their ability to provide on-site product support.



(xxix) What (in your opinion) are the biggest impediments to business growth in the defence sector (select more than one option if relevant)? An objective response was sought to this question from the respondents, with an option to highlight any other issues that they felt required attention. The responses could be broadly classified into 6 categories as given below.

(aa) **Complex Procedures**. Despite the improvement in 'Ease of doing business' especially with the promulgation of DAP 2020, 73% of the respondents still felt the procedures for doing business were complex.

(ab) **Lack of Funds**. 46% of the respondents highlighted 'Lack of funds' as an issue (more so with the funding pattern).

(ac) **Time Constraint**. 20% of the respondents highlighted time constraint to deliver the prototype as a challenge. This is in consonance with about 25% of the respondents not able to deliver the prototype within the stipulated timelines. Interaction with the users also bring out similar difficulties in completing evaluations within the timelines specified as also processing of the cases.

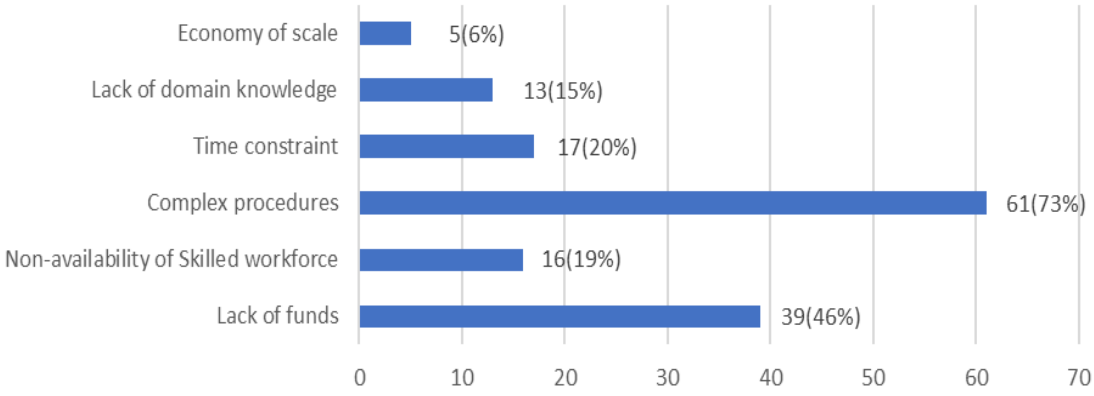
(ad) **Non-availability of Skilled Workforce**. 19% of the respondents highlighted the absence of skilled workforce. While the government has embarked on 'Skill India Mission'[57], more emphasis needs to be given towards skilling people to work in the defence and aero-space industry.

(ae) **Lack of Domain Knowledge**. 'Open Innovation' generally seeks solutions to problems from people outside the industry. Innovators/ start-ups with a different area of expertise and dovetail it to meet existing requirements. User interactions with the innovators and field trials are facilitated, however, operating in military environments is always a challenge.

(af) **Economy of Scale**. This factor has always been talked about when it comes to doing business with the defence. With the impetus on achieving higher levels of standardisation not only within a single service, but amongst the three services; the assimilation of dual-use technologies (with suitable

[57] Skill India Mission is a government scheme launched in 2015. It is an umbrella scheme that has many skilling schemes and programmes under it. The chief objective is to empower the youth of the country with adequate skill sets that will enable their employment in relevant sectors and also improve productivity.

modifications to meet service requirements); only 6% of the respondents felt this was a challenge.



(xxx) <u>What else in your opinion would be needed to strengthen the IDEX process for faster assimilation/ induction of your ideas/innovations/products into the Armed Forces</u>? A more subjective response was sought for this question. The unfiltered responses are reproduced at **Appendix** '**C**'. The summary of responses is enumerated in the succeeding paragraphs.

Funding

(aa) The respondents recommended enhancing the efficiency and effectiveness of grant processing within the IDEX framework. This includes expediting the grant approval process and ensuring grants are disbursed in a timely manner. Furthermore, it proposes a shift from the traditional matching grant model to a revenue-sharing arrangement, where startups receive a share of the sales revenue from the innovative products developed. Additionally, flexibility in matching contributions is proposed to accommodate startups' varying financial capabilities. *This could potentially alleviate concerns about the financial burden of failure in R&D projects, as*

payments would be tied to project milestones rather than contingent on project success.

(ab) Moreover, the recommendations seek to alleviate the burden on startups in terms of fundraising efforts. By providing full grants akin to DARPA's approach, startups can allocate more resources towards project completion rather than scrambling for funds. Additionally, a gradient contribution model is suggested, starting with lower financial commitments from the firm in the initial stages and gradually increasing as the project progresses. Simplifying the financial diligence process and forging partnerships with financial institutions for collateral-free funding further aim to streamline the funding and support ecosystem for startups involved in iDEX projects.

User Interaction

(ac) Despite the fact that 90% of the respondents stated that they were able to interact with the users during the trials. The respondents opined that user engagement should improve further and the process be streamlined for startups participating in innovation projects. This involves active user interaction and direct exposure to problem statements from customers, fostering collaboration between startups and established companies through interactive sessions and Memorandums of Understanding (MOUs). Additionally, there is a call for a platform where innovations can be presented, focusing on enhancing reliability, safety, and ease of use. Clarity on acceptance tests, regular technical reviews, and communication channels for unsuccessful proposals are also emphasized. Furthermore, involving end users and defence Public Sector Undertakings (DPSUs) from the outset, as well as ensuring access to technical specifications and subject

matter experts, are highlighted as crucial steps for successful innovation projects.

Testing & Trials

(ad) The respondents suggested enhancing the testing and evaluation processes within the innovation ecosystem. This includes advocating for greater involvement of testing agencies to optimize solutions from the outset and provide guidance to innovators who may lack expertise in this area. There is also a call for increased clarity on testing requirements and the availability of suitable testing facilities, particularly for military standards. Early engagement of regulatory bodies such as DGQA and TGME is recommended to expedite approval processes, while more support during trial phases is sought to ensure successful product induction, particularly for hardware systems.

Processes

(ae) The respondents suggested ways to improve the processes. This includes advocating for strategic funding and integrated support teams from all three services to assist start-ups and MSMEs in the defence and aerospace sectors. There is a strong emphasis on simplifying execution processes, ensuring proper understanding and compliance with new procurement procedures, and addressing loopholes in the procurement process to prevent delays and promote innovation. Additionally, suggestions are made to handle personnel turnover in the services effectively (this issue of service personnel turnover is also highlighted by the users). They have recommended better support for start-ups, expedite contract signing, and enhance knowledge sharing and transparency within the iDEX ecosystem. Overall, the focus is

on creating a more agile, supportive, and efficient environment for innovation and procurement in the defence sector.

Information, Training and Awareness

(af) The respondents highlighted the need for increased awareness and engagement with stakeholders, particularly Small and Medium Scale Enterprises (SMEs), regarding iDEX opportunities. This includes arranging programs, seminars, and promotional activities to facilitate participation and provide information about available opportunities. There is a call for regular communication and training programs aimed at both defence personnel and SMEs, to increase familiarity with innovative technologies, procurement processes, and the challenges and opportunities associated with participation in defence projects. Additionally, there is an emphasis on increasing awareness through seminars and government-led initiatives to support and guide SMEs in leveraging iDEX opportunities effectively.

Orders

(ag) The respondents recommended providing assurances and incentives for innovators participating in iDEX challenges. This includes the inclusion of Minimum Order Quantity (MOQ) criteria upon successful completion of a challenge, ensuring that innovators are guaranteed a certain volume of orders if their system proves successful. Additionally, there is a call for some form of guarantee of orders for innovative systems, rather than orders being solely based on the lowest bidder (L1 basis), which can discourage innovations that may increase costs. Innovators seek assurance of further business opportunities, such as mass production of prototypes, to justify their investment in developing innovative solutions.

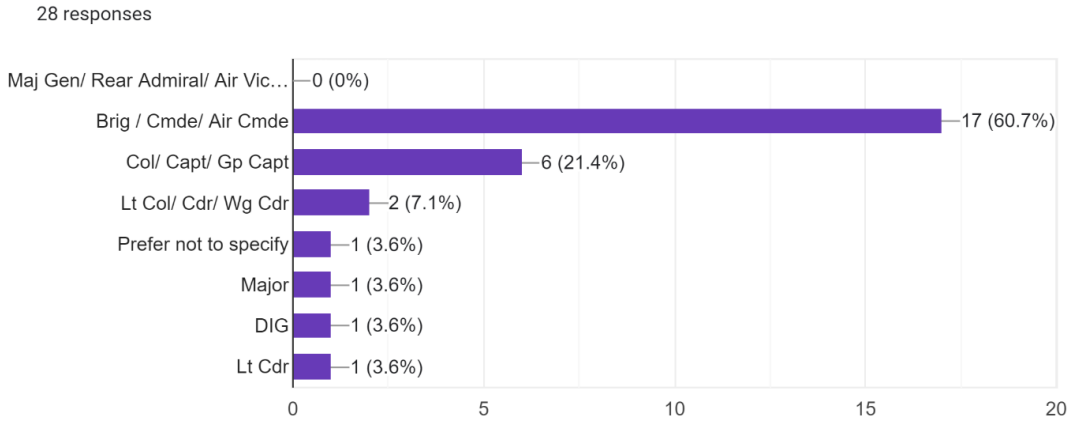
Suggestions include releasing Purchase Orders (POs) for Minimum Viable Product (MVP) trials and/or assuring MOQ orders to provide tangible support and incentives for innovators.

Emulate Global Examples

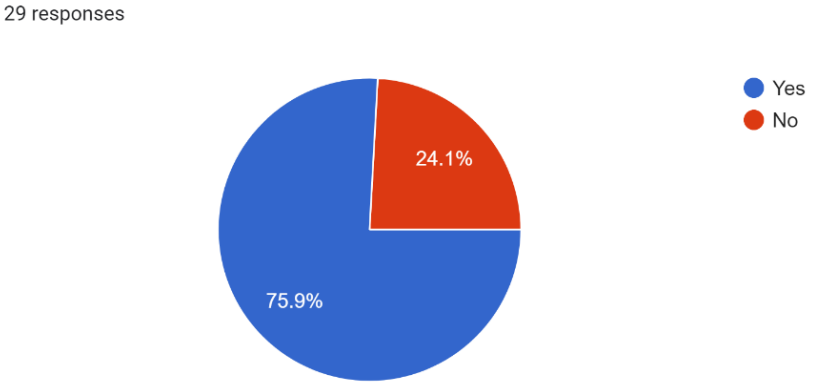
(ah) Some of the respondents have highlighted alternative models for promoting innovation and supporting smaller companies within the defence sector. For example, in the United States, companies winning large defence contracts are required to allocate a significant portion to smaller companies and startups, fostering innovation and diversity in the defence industry. This approach is contrasted with schemes like iDEX, with examples such as Palantir, which was incubated by the CIA. The recommendations urge organizations like the DMA, SHQ, and relevant agencies to critically evaluate the iDEX process and refrain from offloading their strategic programs. Instead, they suggest exploring models such as AFWERX, NATO DIANA, ISRAEL MAFAT, IA France, DIUx USA, and IN-Q-TEL for inspiration, which prioritize innovation and collaboration with smaller companies and startups in the defence sector.

4. **Responses from Users**. The responses elicited from the users (i.e. Service Officers/ Officers of DPSUs dealing with iDEX) are enumerated in the succeeding paragraphs.

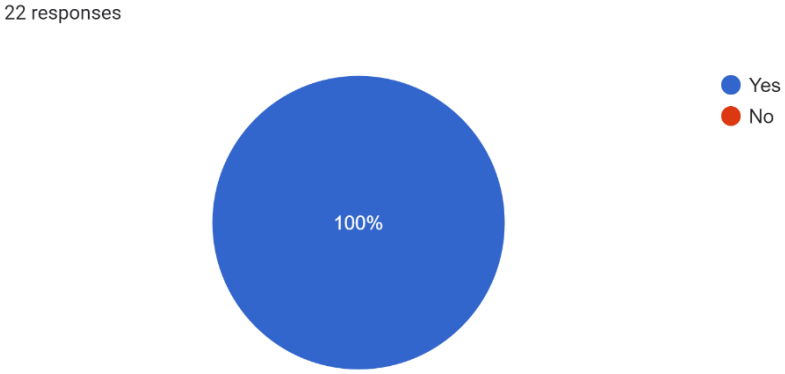
(a) Respondent Profile**.** It may be noted, that the questionnaire was circulated only to those officers who responsible for the induction of equipment/ systems (through the conventional approach and through iDEX). The respondents include both the Principal Directors and the case officers who are dealing with iDEX.



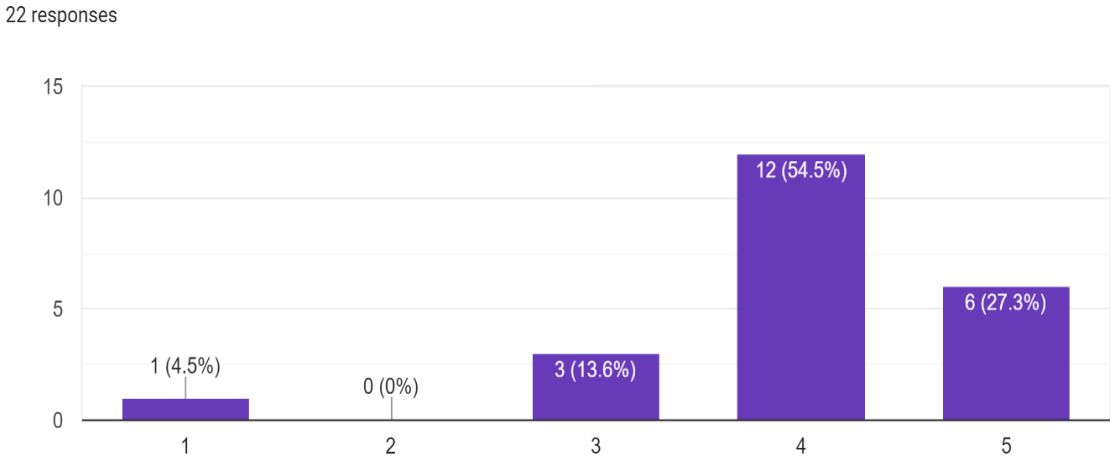
(b) <u>Are you involved with indigenisation/ innovation in your current role or have been so in the last 5 years</u>? 75% of the respondents have been directly involved in indigenisation/ innovation during the last 5 years.



(c) <u>Are you aware of the iDEX Scheme</u>? Of the respondents who are involved with the indigenisation efforts in the SHQs, all were aware of the iDEX scheme.



(d) To what extent do you believe innovation challenges and crowdsourcing initiatives (like iDEX) accelerate the assimilation of the latest technologies in the defence industry (Scale: 1 - Not effective at all, 5 - Very effective). Almost all the respondents felt that the 'Open Innovation' help accelerate assimilation of the latest technologies into the armed forces.



(e) In your opinion, how do innovation challenges and crowdsourcing impact the speed and efficiency of technology adoption in the defence sector? [*The responses to this question were subjective. The responses as received are reproduced ad verbatim at* ***Appendix*** *'D'. A summary of the responses is given below*]

(i) These responses from the users in response to his question reflected diverse viewpoints on the impact and efficacy of the IDEX initiative. On one hand, proponents highlight its ability to swiftly introduce low-end technology products, often achieved through the customization of Commercial Off-The-Shelf (COTS) items for military applications. Additionally, iDEX challenges are lauded for facilitating the rapid integration of Dual Use Technology, which otherwise faces prolonged development and procurement processes.

(ii) Conversely, critics point out potential drawbacks, such as perceived sluggishness and excessive oversight within the initiative. Some argue that focusing on indigenization efforts outside of iDEX may yield more sustainable results in the long run. Nevertheless, there is consensus on the importance of implementing faster absorption policies within the defence services to keep pace with the technological advancements spurred by iDEX. Moreover, the initiative is recognized for bridging the gap between industry/start-ups and the defence sector, offering opportunities for Micro, Small, and Medium Enterprises (MSMEs) to secure funding, transition to production, and enhance their technological capabilities.

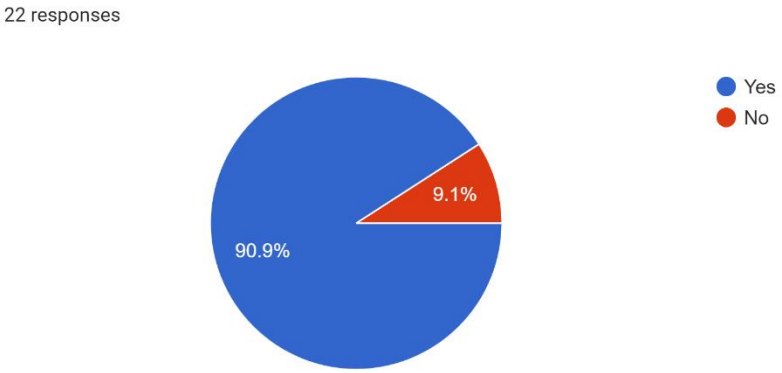
(f) What do you think are the key success factors for innovation challenges and crowdsourcing in defence technology assimilation? [*The responses to this question were subjective. The responses as received are reproduced ad verbatim at Appendix 'D'. A summary of the responses is given below*.]

(i) The success of innovation challenges and crowdsourcing in defence technology assimilation hinges on several key factors. Firstly, stakeholders must adopt an open-minded approach to embrace new ideas and innovations. Access to capital and specialized knowledge is essential to fuel these endeavours, enabling the development of niche products and technologies. Central to success is the clear definition of firm requirements, laying a solid foundation for projects such as those facilitated by iDEX.

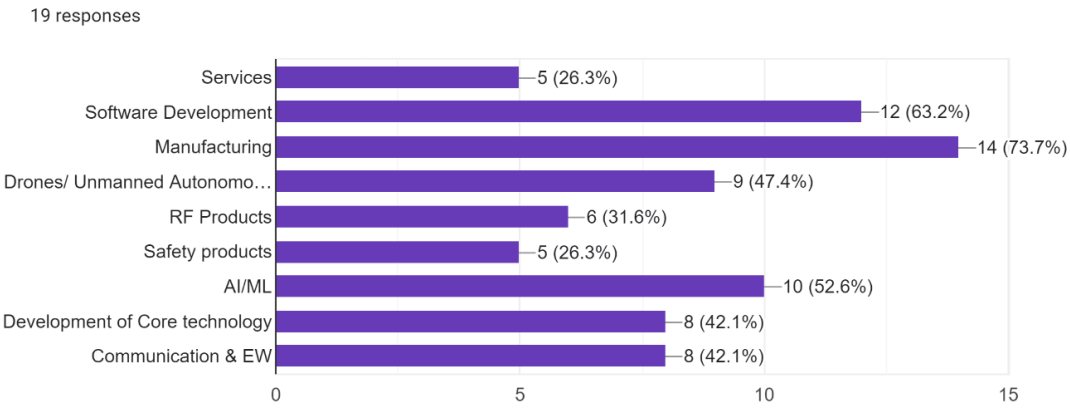
(ii) Moreover, investment in defence technology is paramount, necessitating adequate funding and resources to foster innovation effectively. Simultaneously, streamlining application processes and providing comprehensive support throughout are critical for ensuring widespread participation and engagement. The involvement of startups and governmental support further

catalyses innovation efforts, promoting a vibrant ecosystem conducive to technological advancement. Additionally, recognizing the importance of small-scale innovation and providing guidance for newcomers without compromising defence requirements is vital for fostering a diverse and dynamic innovation landscape.

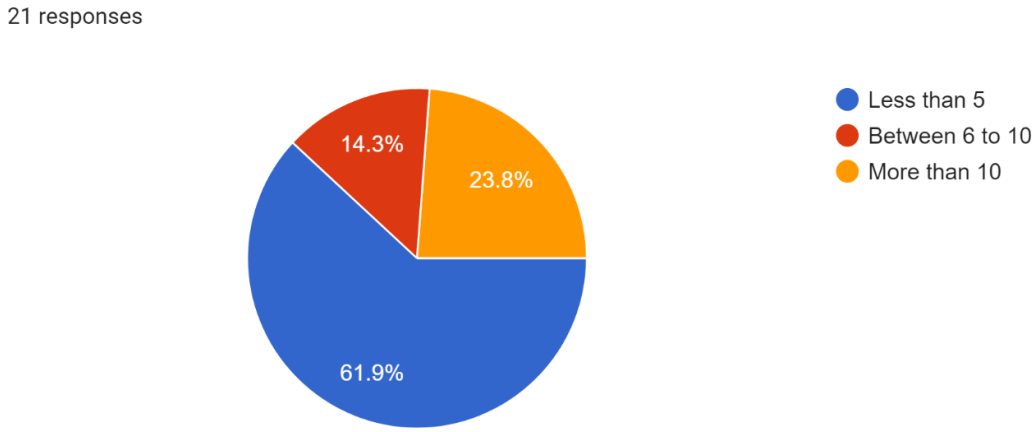
(g) Has your Department/ Directorate utilised the IDEX platform for product development/ indigenisation? 91% of the respondents stated that their Department/ Directorate have used the iDEX platform for indigenisation. This is also borne out from the data obtained from the Indigenisation Directorates of the Army and the Navy, a summary of which is enumerated later in the chapter.



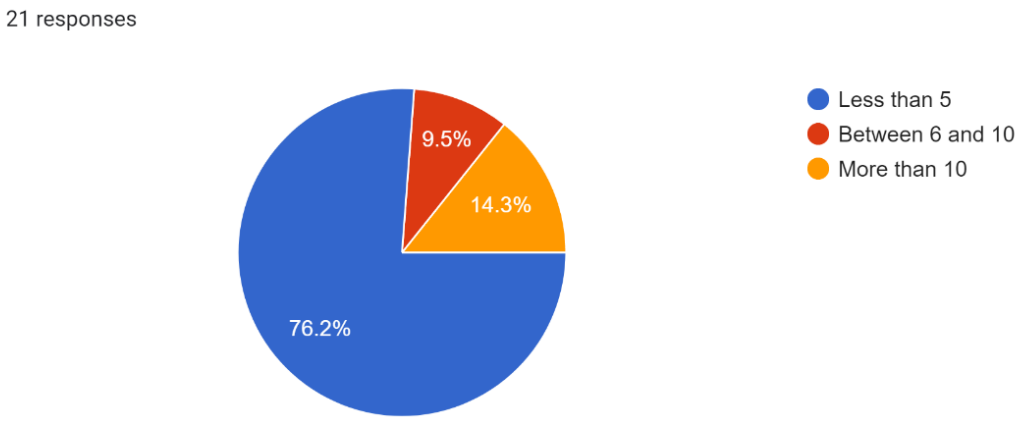
(h) What are the type of challenges has your Department/ Directorate given? (check more than one box if applicable) The data obtained from the Users is in consonance with the responses of the start-ups/ innovators.



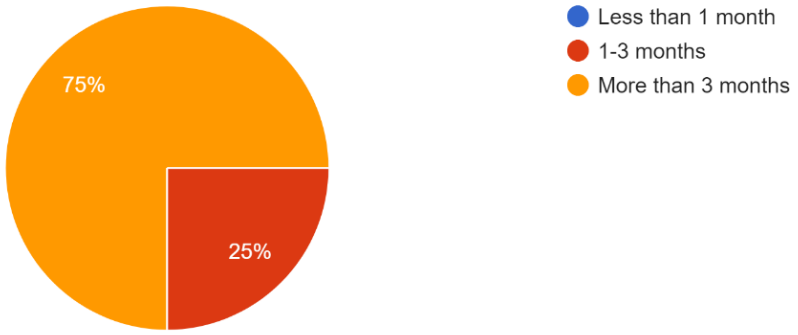
(i) How many problem statements/ challenges have you routed through the IDEX scheme? 60% of the respondents indicated that they have sought solutions for 10 or more challenges. It may be noted that in addition to the challenge statements issued by the Directorates, the services have also processed 'suo-moto' proposals through the Open challenge route.



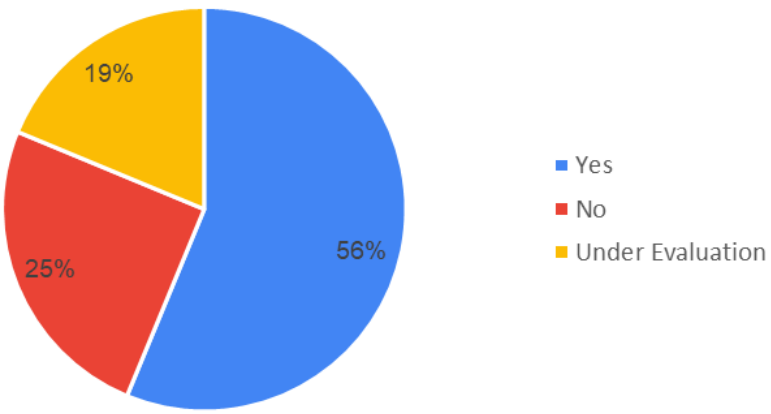
(j) How many challenges were successfully completed? This data is borne out from the interaction with the Indigenisation Directorates. A large number of challenges have been successfully completed.



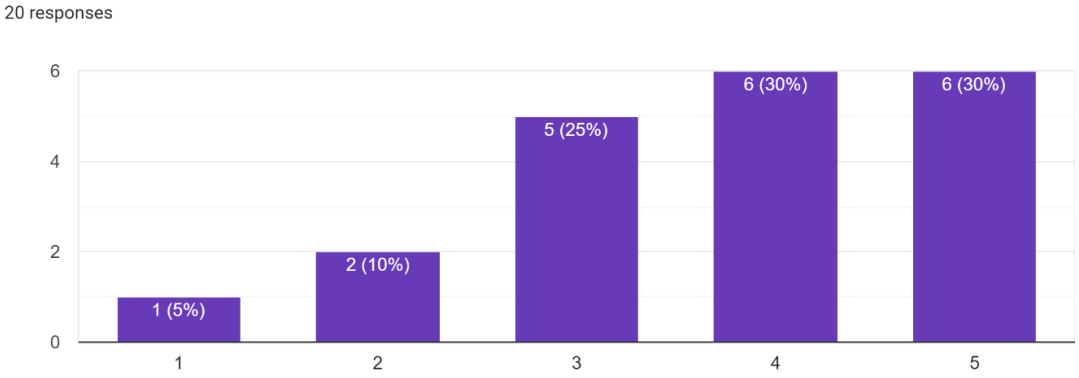
(k) On average what were the timelines for evaluation of projects? These timelines are in consonance with the feedback obtained from the innovators/ start-ups/ DAs, though they are not entirely aligned with the timelines prescribed in the DAP. This is a point which would need further consideration with all the stakeholders aligned to the bigger picture.



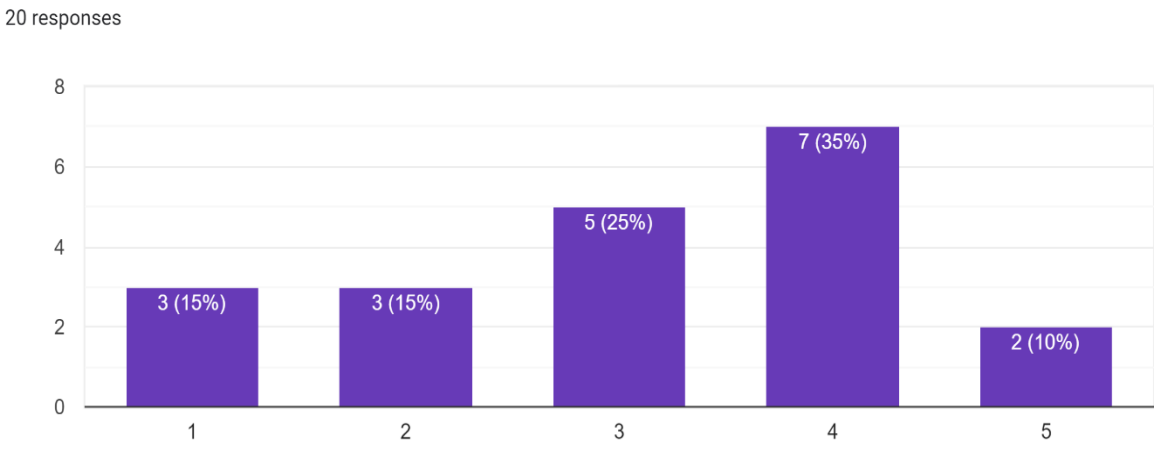
(l) Did the prototypes / Proof of Concept meet the QRs specified in the problem statement? Some of the respondents have stated that the prototypes largely met the QRs (without quantifying). Innovation/ indigenisation is an iterative process. The QRs are specified such that some of the requirements are vital to operational, while some desirable (which does not affect the operational effectiveness). So long as the prototypes are meeting the vital objectives, it should be considered a success.



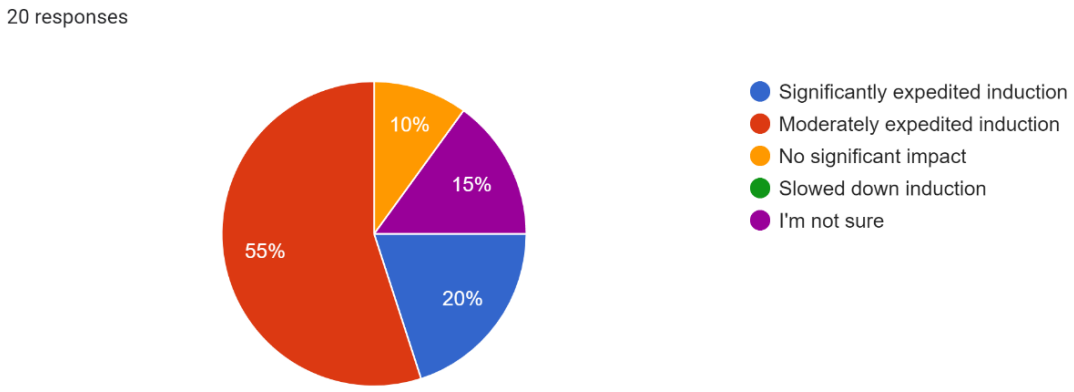
(m) Please rate the effectiveness of innovation challenges in accelerating system development and induction into the services (Scale: 1 - Not effective at all, 5 - Very effective). This response is also in consonance with the views expressed by the respondents earlier.



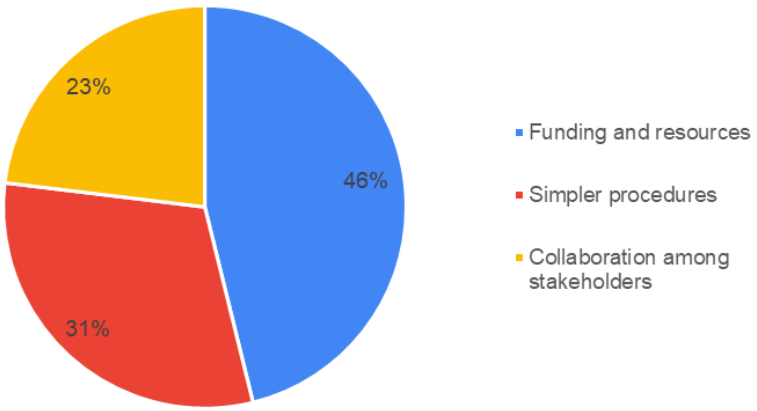
(n) Have these initiatives impacted the cost-effectiveness of integrating the latest technologies in defence applications? (Scale: 1 - Not effective at all, 5 - Very effective). The users have a more nuanced view when it comes to the impact on cost-effectiveness. This can be attributed to the fact that the country does not have good RF and semiconductor manufacturing facilities within the country. Thus, firms still have to import some critical components which would not really enable them to bring down their costs. This factor should change in a few years as the eco-system grows.



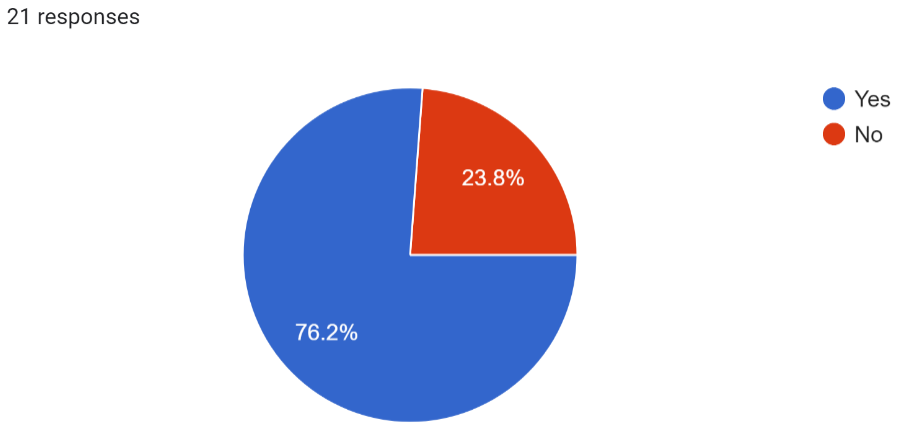
(o) How have defence innovation challenges affected the successful induction of systems into the defence services? 70% of the respondents believe that these innovation challenges have expedited induction of systems, which is a very positive response to the concept of 'Open Innovation'.



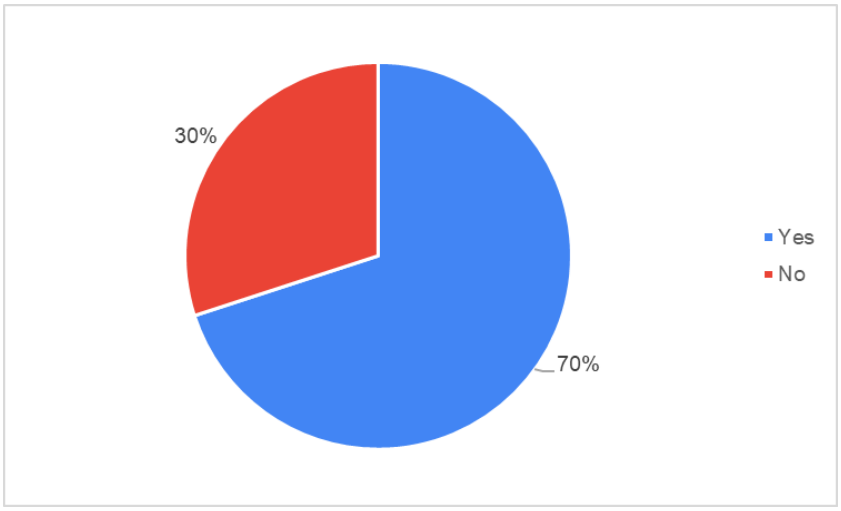
(p) What, in your opinion, are the key success factors for defence innovation challenges in expediting system induction? A majority of the respondents believe that the funding and resources are among the key factors which have enabled defence innovation challenges to expedite system induction.



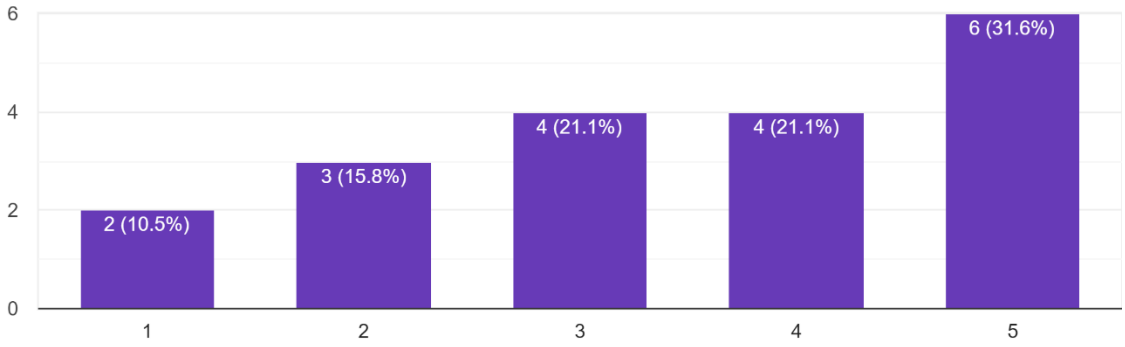
(q) Do you think innovation challenges help in identifying systems that are more aligned with the needs of the defence services? 76% of the users believe that innovation challenges have identified the needs which are more aligned with the service requirements. This is a reasonable conclusion, since the origin of the problem statements is the field units themselves. This is also a different approach from the traditional indigenisation programs where the system QRs are drawn out at the SHQs in consultation with the scientific community/DA.



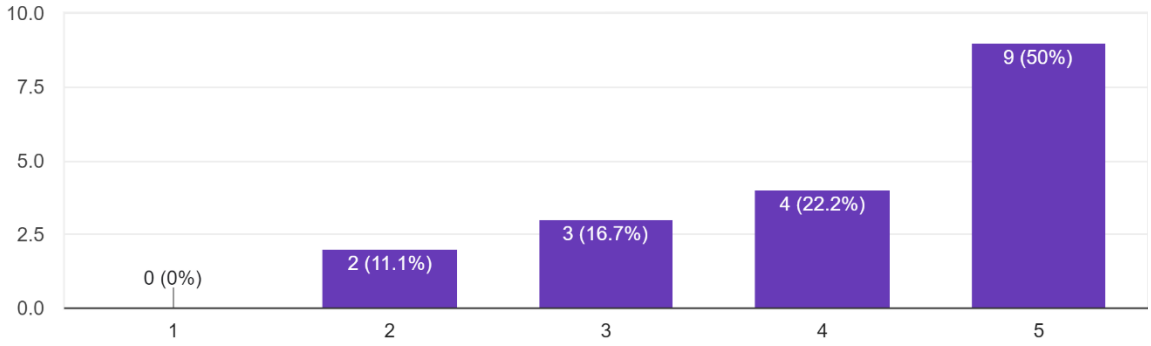
(r) In your opinion, do you think that the iDEX can be leveraged into developing larger systems (like Radars, Weapon Systems, Combat Management Systems, Control Systems) or limited to developing smaller products which are used in a standalone mode? 70% of the respondents believe that the iDEX route can be used to develop larger systems (which requires a more multi-disciplinary approach). However, one respondent articulated the concerns very clearly. He states that "*iDEX for major weapon systems will result in diversification of inventory. Though, it may include cost competitiveness, but it will adversely affect standardisation and inventory management. For weapon systems, strategic partnership model with only one or two tried and tested firms should be pursued*".



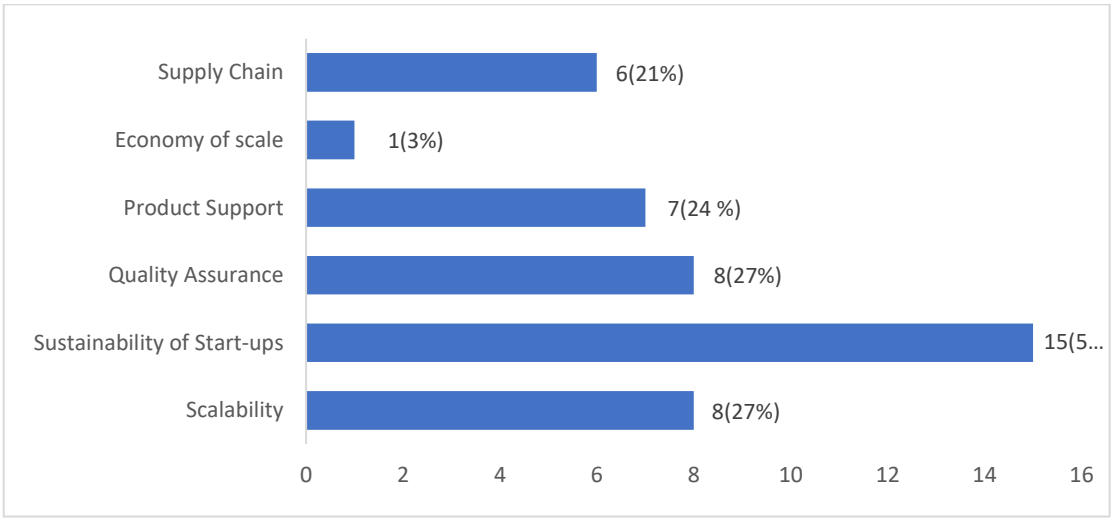
(s) How has the level of collaboration and engagement among defence stakeholders (e.g., government, industry, academia) influenced the effectiveness of innovation challenges in system development and induction? (Scale: 1 - Not effective at all, 5 - Very effective)



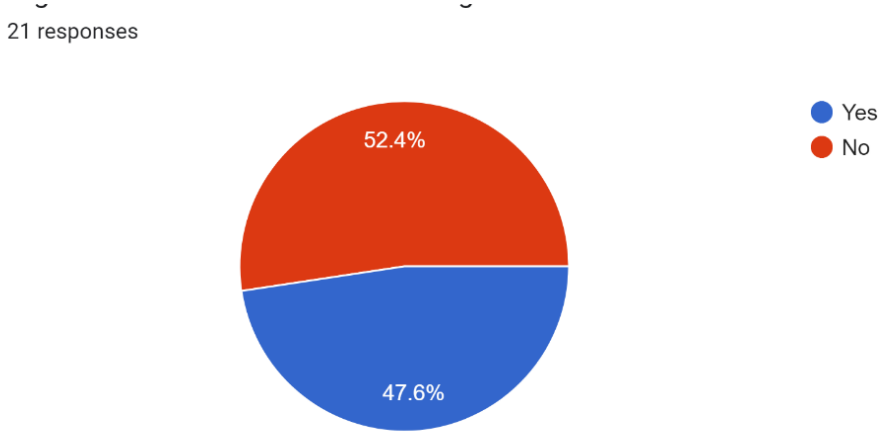
(t) How effective as your interaction with the innovator/start-up during the development of prototype and its evaluation? This is validated by the feedback from the start-ups/innovators as well.



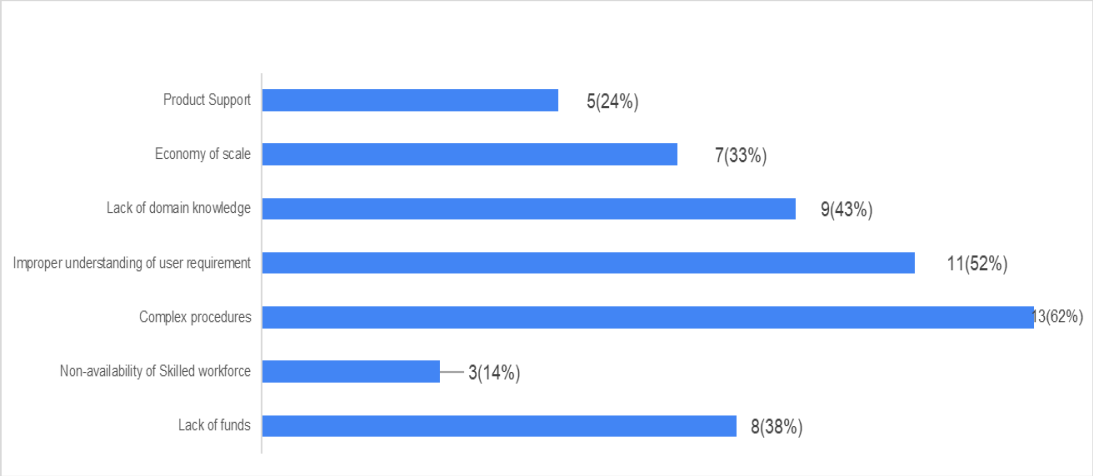
(u) <u>What are the challenges you foresee in leveraging when trying to induct systems through the iDEX / crowdsourcing route?</u> (select more than one if applicable) The respondents saw the following 6 factors as challenges whilst leveraging system inductions through the 'Open innovation' route. 51% of the users saw 'Sustainability of start-ups' as a major challenge. Scalability, Quality Assurance, product support and supply chain vulnerabilities were other challenges identified by the users.



(v) Do concerns related to intellectual property and security hinder the participation of defence organisations in innovation challenges?



(w) What (in your opinion) are the biggest impediments to business growth in the defence sector (why private sector participation is less)? [select more than one option if relevant]. The users' response to this question is in consonance with the response from the innovators/start-ups. With the exception of one major factor, the innovators/start-ups identified about 'Time Constraint' being an important impediment to business growth in the defence sector; whereas the users identified 'improper understanding of the user requirements' as an impediment. This bears out with the recommendations of the start-ups/ innovators for a enhance user interaction right from the beginning.



(x) What are your thoughts on the long-term sustainability and scalability of innovation challenges and crowdsourcing efforts in the defence sector, and how do they evolve over time? [*The responses to this question were subjective. The responses as received are reproduced ad verbatim at Appendix 'D'. A summary of the responses is given below*]

(i) The recommendations emphasize the importance of long-term support and continuous efforts to foster innovation within the defence sector. They suggest that innovation should primarily be driven by well-funded organizations like DRDO, focusing on niche technologies, with products subsequently evaluated by the services for field performance. Additionally, there is a call to promote such schemes widely to encourage more innovations and strengthen the ecosystem. Suggestions include increasing funding, providing assurances of orders to committed startups, and ensuring rigorous vetting of participants.

(ii) Moreover, there is an emphasis on the need for experienced professionals to lead innovation efforts, tailoring policies to support prototype-to-production transitions, linking innovation with procurement, and progressively expanding innovation challenges from smaller to larger products. Overall, while the approach is seen as robust, there is recognition of the

need for continuous evolution and improvement to realize the full potential of innovation initiatives within the defence sector.

(y) Do you have any other comments or insights related to the use of innovation challenges and crowdsourcing in defence technology assimilation that you would like to share? [*The responses to this question were subjective. The responses as received are reproduced ad verbatim at* ***Appendix 'D'****. A summary of the responses is given below*]

The respondents underscore the importance of fostering innovation within the defence sector while highlighting key considerations for the success of initiatives like iDEX. Embracing an open-minded approach to innovation and simplifying processes are emphasized, along with a focus on integrating niche technologies rather than simply replacing low-end imports. There's a call for careful evaluation of innovations to ensure genuine advancements and acknowledgment of challenges such as intellectual property rights and compatibility issues. Additionally, suggestions include the need for dedicated in-house innovators, government support, and dynamic approaches to issuing challenges. Finally, advocating for an environment that accepts failure, increasing funding limits, and implementing preferential export policies are seen as crucial for advancing defence technology through initiatives like iDEX.

Dashboard Data

5. In addition to the responses sought from the stakeholders, dashboard data was sought from the SHQs (Directorates dealing with iDEX). Responses were received from the Army Design Bureau, Naval Indigenisation and Innovation Organisation (DoI and TDAC). The same is shown in the table below[58].

[58] It may be noted that while Directorate of Indigenisation handles the iDEX cases for the Navy, in case of DISC 7 (SPRINT) challenges, TDAC was the single point of responsibility. Accordingly, data was sourced from both agencies and presented separately.

	ADB	DoI	TDAC
• *No of Challenges*	20	56	75
• *No of Responses*	348	550	1106
• *Winners declared*	31	71	118
• *Open Challenges received*	474	--	15
• *Selected*	26	--	15
• *Proof of Concept/ Prototypes Developed*	10	07	76
• *User trials completed*	04	07	40
• *Contracts for Production Orders*	04	02	16
• *Timeline for placement of order*	26 weeks (average)	20 weeks	22 weeks

Observations & Analysis

6. The surveys covered a broad spectrum of start-ups, innovators, MSMEs and government officials who together form an integral part of the defence innovation ecosystem. This spectrum covers the cyclic 'Demand and Supply' chain. The observations and analysis of the responses are enumerated in the succeeding paragraphs.

7. The survey participants included both owners and employees, all occupying positions in either top or senior management roles. Likewise, the respondents from the SHQs were senior officials or officers directly handling iDEX and were therefore the best placed to give feedback. This diverse respondent profile ensures a well-rounded and nuanced perspective on the subject matter. They represented a wide range of operations related to iDEX, spanning across multiple sectors. Notably, these sectors included Manufacturing, Software (encompassing AI/ML/Data Analytics), and RF Engineering, the latter being particularly pertinent to the defence and aerospace industry.

8. 68% of the respondents participated in iDEX, indicating a substantial engagement with the program. However, 30% of the respondents did not participate, with some unaware of iDEX and seeking interaction with relevant departments, suggesting a need for better branding. Among the participants, 76%

won less than 5 challenges, with only 7% winning more than five challenges due to iDEX rules. Additionally, 17% participated but never won a challenge. Approximately 62% of the winning proposals were accepted by the MoD/PSU, highlighting a favourable acceptance rate.

9. Funding emerges as a critical issue for sustaining the defence innovation ecosystem, despite 55% of respondents having annual turnovers between ₹1 – 50 Cr. Notably, many face difficulties in raising funds, indicating a need for intervention. Furthermore, 48% of respondents delivered prototypes within stipulated timelines, while the use of commercial off-the-shelf (COTS) components offers advantages in cost and time efficiency but may pose challenges for mass production orders.

10. Foreign collaborations and transfer of technology (ToT) arrangements are limited, with 82% of respondents having none, aligning well with 'Make in India' initiatives. Most respondents maintain indigenous content above 50%, complying with DAP 2020 requirements for processing iDEX cases under the Buy (IDDM) category.

11. The use of COTS components (especially core chips/ motherboards/ drone motors and RF components) being imported is a grey area that needs to be addressed. Supply chain vulnerability has been greatly highlighted in the last few years (be it COVID-19, the Russia-Ukraine or Israel-Hamas conflicts). The need to have a reliable and sustainable supply chain in today’s highly interconnected world is a key factor which drives defence innovation. This is an issue that not just India but almost all the world’s top military manufacturers are grappling with.

12. Respondents indicated that their systems underwent evaluation by the sponsoring organization, with most being provided a suitable trial platform if required, underscoring the seriousness of the iDEX program. While there was positive feedback on user interaction during trials, deeper engagement is desired from the outset.

13. Regarding trial processes, the time taken for evaluation often exceeded three months, reflecting challenges in the innovation process. Additionally, there was varied feedback on whether prototypes met specifier qualification requirements (QRs), highlighting the need for clarity and alignment between innovators and users.

14. Quality assurance (QA) plans were not always specified in the iDEX challenge statements, but most respondents tested their products to known standards, emphasizing the importance of QA in system induction. Approximately 54% of successfully evaluated products received production orders, indicating a positive outcome for the innovation ecosystem.

15. However, scaling up production remains a challenge for many firms, with more than 50% indicating a timeline of over six months, necessitating support and infrastructure development. Product support is crucial for system success, with 70% of respondents indicating the ability to provide on-site support, though further assessment is needed based on user feedback post-deployment. The issues of scaling up production and product support were highlighted by the user respondents as well.

16. Approximately 40% of respondents indicated limited understanding of accessing innovation funding opportunities from the GoI/MoD, suggesting a need for increased awareness programs, especially among companies embedded within the defence ecosystem. Onboarding such firms into iDEX could enhance the program's effectiveness.

17. Regarding the role of PSUs/larger industrial houses in promoting innovators, a majority of respondents acknowledged their potential impact, particularly in terms of financial support, partnerships, and extending production/testing facilities. Additionally, 70% believed that partnering with PSUs for scaling up production and providing life-cycle support would be favourable for start-ups/innovators.

18. Respondents identified several impediments to business growth in the defence sector:

(a) **Complex Procedures**. Despite improvements in the ease of doing business, 73% of start-ups/innovators and 63% of the users at the SHQ still found business procedures complex.

(b) **Lack of Funds**. 46% of the start-ups/ innovators highlighted this issue. They were particularly concerned about the funding pattern (especially the matching grants). 30% of the users at SHQ also indicated this issue as an impediment to business growth.

(c) **Time Constraint**. 20% cited challenges in delivering prototypes within stipulated timelines, aligning with respondents' struggles in completing evaluations and processing cases promptly.

(d) **Non-availability of Skilled Workforce**. 19% noted a lack of skilled workers, indicating a need for further emphasis on skilling individuals for the defence and aerospace industry.

(e) **Lack of Domain Knowledge**. Innovators/start-ups often face challenges operating in military environments despite seeking solutions from outside the industry.

(f) **Economy of Scale**. Only 6% identified this as a challenge, suggesting less concern about achieving higher levels of standardization and assimilating dual-use technologies.

(g) **User Requirements**. 52% of the users cited a lack of understanding of the User requirements as a major impediment, thus highlighting the need for a greater collaboration between the users and the innovators.

19. Respondents (start-ups and innovators) also gave suggestions as enumerated below.

(a) **Funding**. Respondents advocate for enhancing the efficiency of grant processing within the IDEX framework, proposing a shift to revenue-sharing models and simplifying financial diligence processes to alleviate fundraising burdens on startups. They recommend providing full grants akin to DARPA's approach and partnering with financial institutions for collateral-free funding.

(b) **User Interaction**. Despite positive user interaction during trials, respondents suggest further improving engagement and streamlining processes, emphasizing active collaboration between startups and established companies through MOUs and direct exposure to problem statements.

(c) **Testing & Trials**. Suggestions include greater involvement of testing agencies, clarity on testing requirements, and early engagement of regulatory bodies to expedite approval processes and ensure successful product induction.

(d) **Processes**. Advocacy for strategic funding, simplified execution processes, and better support for startups to navigate procurement procedures and address personnel turnover within the services.

(e) **Information, Training, and Awareness**. Recommendations focus on increasing awareness and engagement through programs and seminars, communication and training aimed at both defence personnel and SMEs, and government-led initiatives to support SMEs in leveraging iDEX opportunities effectively.

(f) **Orders**. Suggestions include incorporating MOQ criteria and assurances of further business opportunities for innovators upon successful

completion of challenges, providing tangible support and incentives for innovators.

(g) **Global Examples**. Highlighting alternative models for promoting innovation, respondents urge evaluating the iDEX process and exploring models prioritizing innovation and collaboration with smaller companies and startups in the defence sector, such as those seen in the United States, NATO, Israel, France, and other countries.

20. The responses from the users (Service Officers/ DPSUs) on iDEX has largely been positive. The respondents have appreciated the ability to swiftly introduce low-end technology products, often achieved through the customization of Commercial Off-The-Shelf (COTS) items for military applications. Additionally, iDEX challenges are lauded for facilitating the rapid integration of Dual Use Technology, which otherwise faces prolonged development and procurement processes. There is consensus on the importance of implementing faster absorption policies within the defence services to keep pace with the technological advancements spurred by iDEX. Moreover, the initiative is recognized for bridging the gap between industry/start-ups and the defence sector, offering opportunities for Micro, Small, and Medium Enterprises (MSMEs) to secure funding, transition to production, and enhance their technological capabilities.

21. Some of the issues highlighted by the officers are enumerated below.

(a) **Timeline for User Trials**. DAP-2020, specifies the timeline for ‘single-stage user trials and acceptance of trial report’ as 7 weeks. However, on average user trials are taking 3-6 months. Some reasons include, the iterative design process; availability of an operational trial platform; availability of user teams etc. Implementing a simple ‘GO-NO GO’ approach may not yield the desired results; a more pragmatic approach is required.

(b) A majority of the officers felt that a high level of collaboration between the User, academia and industry have greatly influenced the effectiveness of innovation challenges.

(c) The service officers identified 6 factors which are challenges when trying to induct systems through the iDEX route.

(i) Sustainability of start-ups
(ii) Product support
(iii) Quality assurance
(iv) Economy of scale
(v) Supply chain vulnerability
(vi) Scalability

(d) The respondents' recommendations also highlight the crucial need for sustained support and ongoing efforts to foster innovation within the defence sector, suggesting that innovation should primarily be driven by well-funded entities like DRDO, focusing on specialized technologies, with subsequent assessment by the services for operational efficacy. Emphasis is placed on promoting such programs widely to encourage more innovations and strengthen the ecosystem, with proposals for increased funding, assurances of orders to committed startups, and thorough evaluation of participants. Furthermore, there is a call for experienced professionals to lead innovation efforts, tailoring policies to facilitate transitions from prototype to production, integrating innovation with procurement processes, and expanding innovation challenges progressively. While the current approach is viewed as robust, there is recognition of the necessity for continuous refinement and evolution to fully realize the potential of innovation initiatives within the defence sector.

22. **SWOT Analysis**. Based on the analysis of the respondents inputs a SWOT analysis for both the Start-ups/ innovators and iDEX has been undertaken and is shown in figures 9 & 10 below.

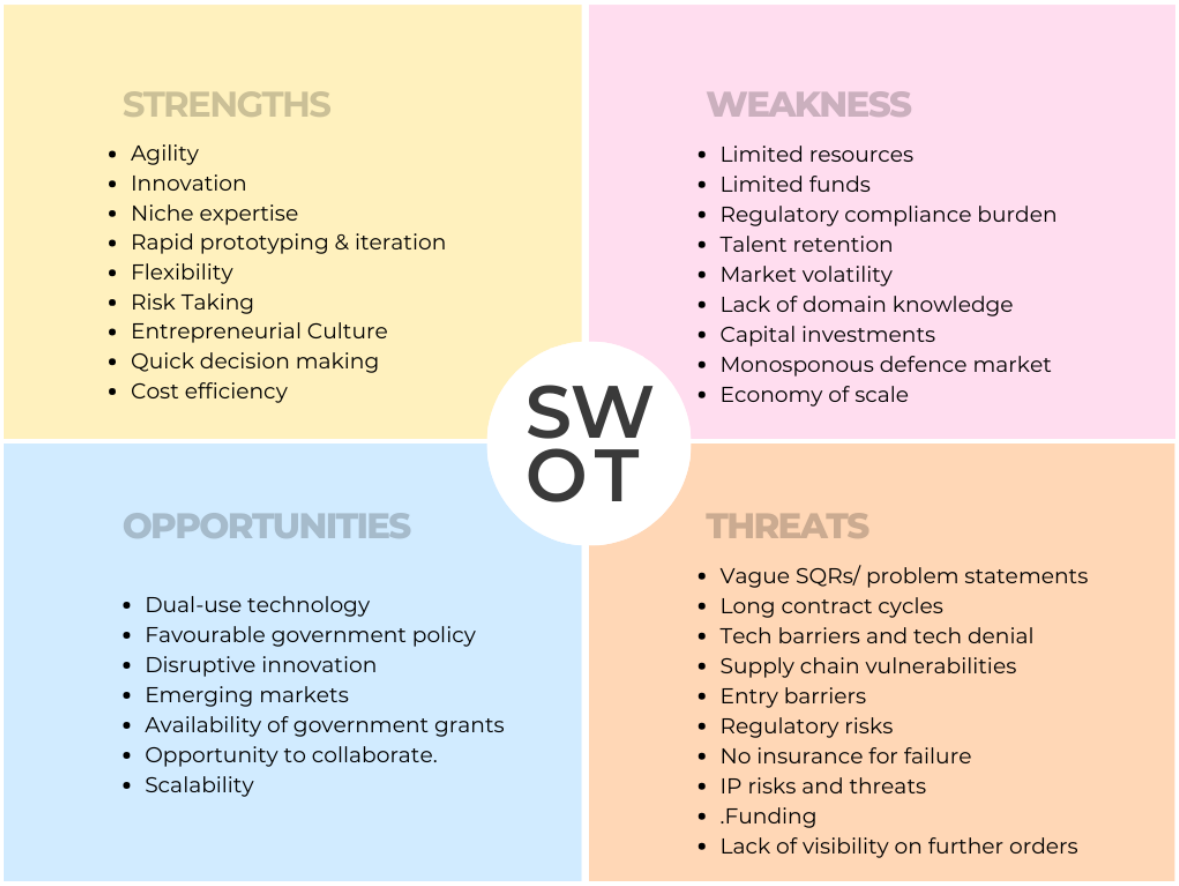


Figure 9: SWOT Analysis - Start-ups and Innovators

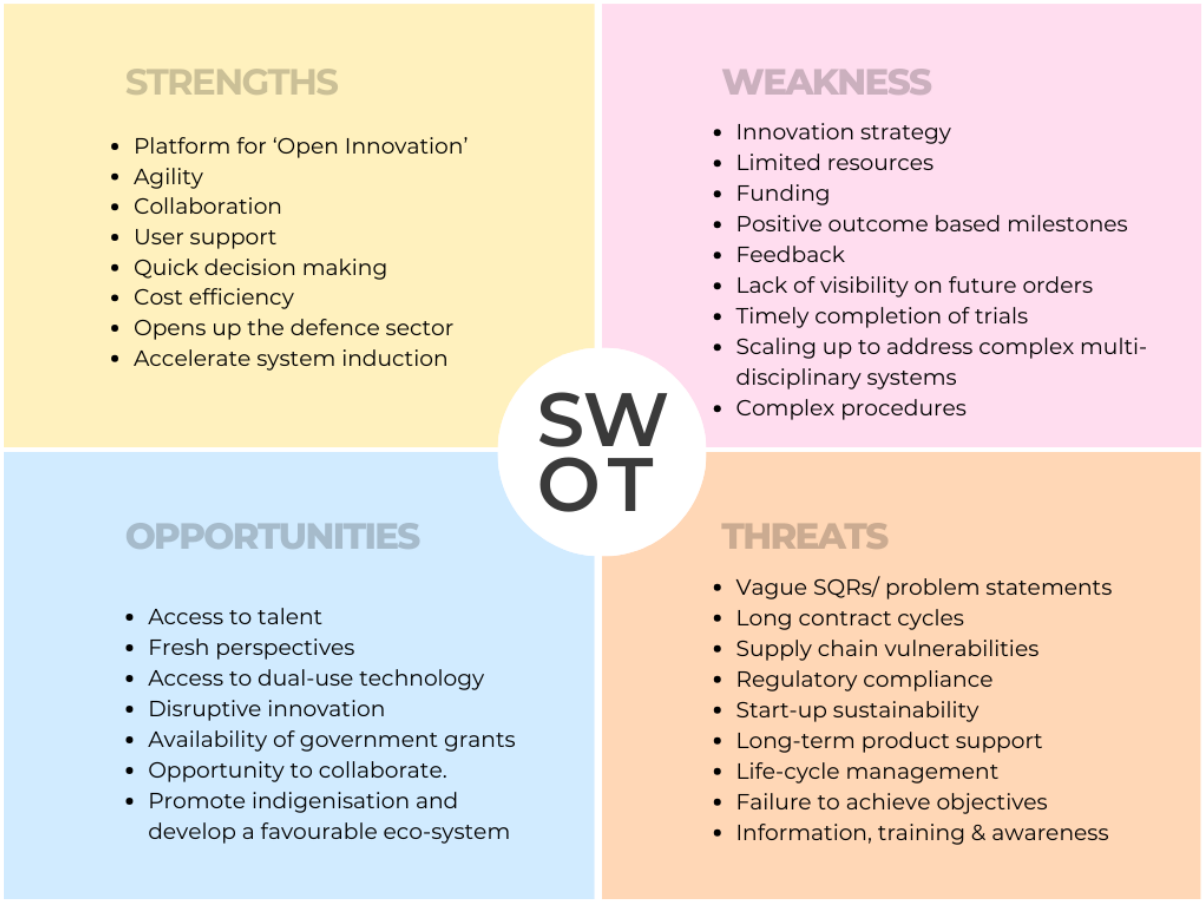


Figure 10: SWOT Analysis – iDEX

Chapter 6 – Recommendations and Conclusions

“A journey of a thousand miles, begins with a single step”

Lao-Tzu

1. The findings show a positive response to the iDEX from both the Users (Service HQs) and the Start-ups/Innovators/ MSMEs. A majority of the stakeholders agree that the iDEX program in its current form is a great first step in what is a long journey ahead. As a nation, we have over the years been tenacious in developing self-reliance for our military capabilities. The challenges the country has faced in terms of political will, financial muscle, denial of technology and a brain drain has not deterred the nations resolve to become self-reliant. The Naval ship-building program which started with the manufacture of the old Nilgiri class ships in the ‘70s, to the indigenously designed Godavari class in the 80’s, to building an indigenous nuclear submarine in the 2000s and an aircraft carrier in 2020s is a testament to this tenacity. The Integrated Guided Missile Development Program (IGMDP) born under the guidance of Dr. APJ Abdul Kalam; the LCA project led to the development of Tejas; the Arjun MBT and Pinaka systems are all examples of systems designed and developed indigenously with a defence manufacturing eco-system being developed simultaneously. Defence apart, ISROs successes in developing an eco-system which has helped India put a lander on the moon needs to be seen as a beacon for the potential of indigenous design and development.

2. The success of these programs doesn’t always show the behind the scenes struggles or failures. They do not reflect the evolution of the policy decisions implemented by the government/ organisation to facilitate success that we see today. It is imperative that as a public policy practitioner, we understand that policies need to continuously evolve in order to factor in the environmental changes. The successful projects mentioned above were a result of a slow and deliberate development process. Today however with technology changing at such a rapid pace, a globally interconnected supply chain, a slow and deliberate development process may not be the right fit. Systems development needs to be fast, agile and cost-effective. Gone are the days that spin-offs from military

technology make their way to the civilian domain. The adage ‘Tactical to Practical’ has reversed, today military’s world over is looking to leverage ‘Practical to Tactical’.

3. Covid-19 showed the world the vulnerability of an interconnected supply chain. The conflicts in Ukraine and Gaza have battle hardened dual-use technologies like drones, 3D mapping, cyberwarfare and use of AI. While the Ukraine and Gaza reflect a traditional battlespace, the attacks by the Houthi rebels on shipping in the Guld of Aden and Red Sea indicate a more real and non-traditional battlespace. If it is one lesson that has come out of all these events is that resilience requires an agile and adaptive response. Thus, the traditional development process for the military needs to be more agile and adaptive. It is in this context that programs like iDEX are important. It is also important for programs like iDEX to evolve based on stakeholder feedback in order to strengthen the process.

4. After engaging with start-ups and government officials who have utilized iDEX, as well as conducting a thorough analysis of global trends, several points warrant consideration for strengthening the iDEX process.

Strengthening the Process

5. **Innovation Strategy**. There is little doubt that the iDEX Program is going to play a pivotal role in India’s quest for self-reliance in the defence and aerospace sectors. However, there is a strong need to define a long-term strategy on what technologies are going to be leveraged for the Armed Forces through the iDEX program and how we are going to go about it. Presently, iDEX is to quote one of the respondents “a challenge factory”. An examination of the challenges shows extreme variance in the technology solutions sought. Some solutions address the future needs, whereas others address today’s problems. As a program, the Ministry of Defence in consultation with the Services and the PSUs need to clearly define priority areas keeping in view the changing threat scenario (both conventional and sub-conventional); which areas we can collaborate with friendly

foreign nations; and most importantly how we plan to develop the defence innovation eco-system to become a strategic asset.

6. **Processes**. There has been a great impetus in improving the processes and improving the 'Ease of Doing Business'. However, both the start-ups/ innovators as well as the Service Officers believe the processes are still complex and can be simplified further.

(a) **Timelines**. A rigourous examination of the existing process from the time that a challenge is published; to the development of prototype/ demonstration of proof of concept; to the conduct of trials and subsequent placement of order needs to be examined holistically. The timelines for processing innovation cases in DAP indicate a total period of 101 - 119 Weeks from AiP to Contract conclusion (which is almost 2 years), the production and delivery timelines start thereafter. The need for due diligence (both technical and financial) needs to be weighed against the operational needs (how soon can the man in the middle be equipped to fight the enemy).

(b) **Outcomes**. The existing process relies heavily on milestone-based payments (with success being the defined milestone). One of the points which came up from the respondents is that all prototypes/ POC need not be successful. R&D is an iterative process, failure needs to be factored in. Inability to deliver a successful prototype result in non-release of grants, which in turn burdens the start-up/innovator. Therefore, the processes need to factor the work done by the innovator/ start-up and not look at a positive result-based outcome. Both timelines and funding should be provided accordingly after genuinely assessing the start-up/MSMEs effort to develop a good product.

(c) **Feedback**. A feedback mechanism on what were the shortcomings due to which a proposal was rejected could be considered. After all R&D is an iterative process which requires feedback.

7. **Funding**. Funding stands out as one of the most significant challenges for innovators and start-ups in the defence sector. It's arguably the key determinant of project sustainability and outcomes. While constraints on funding are inevitable, it's crucial to scrutinize the funding patterns to ensure that fledgling start-ups and cash-strapped SMEs remain financially viable and motivated to engage in the defence sector. Finding innovative ways to provide financial support, such as exploring alternative funding mechanisms or adjusting funding structures, can help lighten this burden and foster greater participation and innovation within the defence industry.

Matching Grants

(a) Several respondents noted that securing the matching grant presents a significant challenge. Respondents proposed various models to address this issue. One suggested model is a gradient-based matching contribution, which involves starting with a smaller contribution from MSMEs at the project's outset and gradually increasing it as different stages progress. The rationale behind this approach is that during later stages of the project, when the prototype/POC is being developed, investors and funding institutions may be more inclined to invest as they can see a tangible product rather than just an idea. Another potential recommendation to address the challenge of securing the matching grant could involve exploring alternative funding mechanisms or financial instruments tailored to the needs of MSMEs and start-ups. This could include creating dedicated funds or venture capital pools specifically aimed at supporting innovation and technology development in defence-related sectors. Additionally, providing targeted financial assistance or incentives for MSMEs and start-ups that participate in open innovation initiatives could help alleviate the burden of raising matching funds. Moreover, enhancing access to mentorship, advisory services, and networking opportunities for MSMEs and start-ups seeking funding could facilitate their engagement in such initiatives and improve their chances of securing the necessary matching grants.

Orders

(b) The sustainability of start-ups heavily relies on revenue generation. Without a guaranteed order for the challenge winner or a minimal Minimum Order Quantity (MOQ) after prototype acceptance, there is insufficient incentive for start-ups/SMEs to invest both time and money in the defence sector. Merely awarding a certificate, such as 'Fit for Military Use' or 'iDEX Challenge Winner,' does not ensure the survival of a fledgling company or foster ecosystem growth. Considering the economy of scale is crucial to project viability and start-up sustainability. Therefore, providing visibility on future procurements to start-ups/innovators is essential.

8. **User Interaction**. The process of ‘open innovation’ has two important components, one is the technology itself (which is the domain of the start-up/innovator/SME) and the other the need for the technology (the solution sought by the user). The user therefore plays an important role and this has been one of the important points received as feedback. User involvement should not be limited to sending a problem statement to the steering directorate. Once the challenge is published and responses received, the originator of the problem statement must be made to interact with the respondents’ prior submission of the proposals. At this time, the trial agencies must also interact with the respondent and indicate the type of qualification testing expected and how to go about that prior deploying the product in the field.

9. **Trials**. The trials of the prototype/ POC forms an important part of the innovation process.

(a) One often sees that there is a concept-capability gap between the development agency and the trial agency. Prior trials, all stakeholders (development agency, user, trial team and nodal directorate) should be brought on the same page by the Nodal agency as to what are the expected outcomes, what results can be considered acceptable and what is a NO-GO. It must be clearly understood by all parties that design and

development is an iterative process and it is unlikely that a successful lab prototype will clear the field trials in the first shot.

(b) The timelines outlined in the DAP process require reassessment. The stipulated seven weeks for single-stage composite trials, including the acceptance of trial reports, are deemed unrealistic. Evidence suggests that average timelines typically range between 3 to 6 months, with some cases extending up to 12 months. It is recommended that a comprehensive review be conducted involving key stakeholders, including representatives from the industry, testing agencies, and SHQs. Based on the findings of the review, adjustments can be made to streamline the trial process, optimize resource allocation, and establish more realistic timelines that account for the complexities and requirements of the trials.

(c) Start-ups also need to be educated that field units undertaking the trials are operational units with a specific mandate. The priority for a field unit is its operation, facilitating trials, while important, may not get priority at all times. Thus, a symbiotic relationship between the stakeholders needs to be generated in order to facilitate faster execution of trials. Establishing clear communication channels and coordination mechanisms among stakeholders can help ensure smoother and more efficient trial execution.

10. **Supply Chain Vulnerability**. During the evaluation of the proposal and the subsequent prototype, it's essential for the Defense Innovation Organization (DIO) and the Nodal Directorate to tackle the challenges posed by supply chain vulnerability. It's crucial to have a clear understanding of how the supply chain for critical components will affect the scalability and long-term support of the product if a production order is awarded to the firm.

11. **Lack of Domain Knowledge**. A common challenge faced by many innovators and start-ups is the lack of domain knowledge, which is understandable given their departure from conventional ecosystems for solutions. Conversely, service officers often express frustration over a lack of understanding of user requirements. One potential solution could involve engaging the large pool

of qualified workforce members, including officers and PBORs, who retire annually. Upon retirement, these individuals disperse throughout the country, bringing with them valuable functional knowledge of systems, operational and maintenance paradigms, as well as insights into trials and testing requirements. Given their widespread settlement, they could also be tapped to provide customer support as start-ups scale up. However, a mechanism to harness this extensive knowledge base needs to be developed in consultation with development agencies. These agencies could recommend specific skill upgrades required for these retirees to seamlessly integrate into their setups. This approach not only bridges the civil-military gap but also fosters the growth of innovators and start-ups in the defence ecosystem. To facilitate this process, start-ups and innovators could interact with service directorates responsible for ex-servicemen affairs (e.g., IHQ MoD(N)/DESA for the Navy) on a bi-annual basis. The Defense Innovation Organization (DIO) could play a role in facilitating these interactions, allowing service directorates to update their databases on potential job opportunities and coordinate downstream to ensure that development agencies have access to appropriately skilled personnel.

12. **Collaboration**. One potential approach to tackling scalability, product support, and lifecycle issues is to facilitate partnerships between innovators/start-ups and Public Sector Undertakings (PSUs) or larger industrial entities. Such collaborations offer start-ups access to established production lines, supply chain networks, testing facilities, and experienced personnel familiar with the defence ecosystem. However, it's crucial to ensure the protection of intellectual property rights (IPR) and the preservation of the start-ups' company identity. These partnerships should be facilitated by entities like the Defense Innovation Organization (DIO) or the Ministry of Defence (MoD), particularly for critical technologies or systems.

iDEX – Accelerating Timelines for System Induction

11. After a rigourous study of the iDEX process, examining global trends, interviewing innovators/ start-ups/ MSMEs and service personnel one can conclude the following.

(a) While the thrust on indigenisation has been there, iDEX has given an impetus to the indigenisation process.

(b) The data shows that iDEX has introduced many young innovators/ entrepreneurs/ start-ups and MSMEs into the defence eco-system.

(c) It has enabled the faster assimilation of newer technologies into the Armed Forces.

(d) As on date, iDEX has been leveraged to introduce smaller, stand-alone auxiliary systems into the Armed Forces. However, in order that iDEX can be used to develop larger Sensors (like Radars/ Sonars/ EW systems); Combat Management Systems or Weapon systems the processes need to be refined further. As these systems require multi-disciplinary specialities, lead program integrators need to be designated and the innovation eco-system needs to be strengthened further to be able to work in such a collaborative environment.

(e) The timelines for processing cases, despite the enablers in the DAP-2020 have not reduced significantly, insofar as system induction is concerned.

(f) Funding, complex procedures, lack of guarantees of production orders, lack of domain expertise are some of the challenges faced by the start-ups/ innovators.

(g) On the service side, sustainability of start-ups, supply chain vulnerabilities, long term product support and quality assurance are challenges which need to be addressed to strengthen the eco-system.

Conclusion

12. In summary, iDEX, in its current iteration, marks a significant initial stride along a lengthy path. The agility it injects into the indigenization process and its swift integration of numerous entrepreneurs into the defence ecosystem within a short span deserve recognition. iDEX holds the promise of revitalizing a stagnant defence-industrial complex and facilitating the provision of the Armed Forces with cutting-edge, domestically designed and developed military equipment. To realize this potential, it's imperative to continually solicit feedback from stakeholders and refine processes for greater efficacy. Additionally, as a nation, we ought to delineate a 'defence innovation strategy' outlining the priority areas iDEX will tackle versus those addressed by conventional establishments. This strategic delineation will channel efforts toward new and niche technologies, expediting the timeline for system induction.

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Appendix 'A'
Refers to Chapter 5 Para 1(a)

INNOVATIONS IN DEFENCE EXCELLENCE

Questionnaire survey for Start-Ups/ Innovators/ MSMEs

Dear Innovator/Start-up/MSME,

At the outset, thank you for being part of my academic journey. This study is being undertaken as part of my dissertation on the effectiveness of *Innovation Challenges (IDEX) in accelerating system inductions into the Armed Force* as part of the ten-month full-time program at IIPA under the guidance of Prof. (Dr.) Charru Malhotra.

For the purposes of analysis, the questionnaire has been divided into 5 sections.

- Introduce yourself (company profile)
- Innovations in Defence Excellence (IDEX)
- Prototyping
- Testing and acceptance
- Taking it forward

Thank you for sparing your valuable time and inputs.

- Please feel free to share as much (or as little) as you want to.
- Please feel free to incorporate any additional data, case studies you feel relevant to the study.
- The data collated will be used only for academic purposes.
- The finding of the study will be shared with the concerned Department/ Service HQs.

Regards

Arvind Chari

Section I: Introduce Yourself

This section of the tool seeks to know more about you. Let us know who you are as a respondent and what is your engagement with the defence and aerospace industry.

1. Your Name (optional)

2. Your Firm (optional)

3. Your designation

4. Sector of Operations (you can choose more than one)

Check all that apply.

- [ ] Services
- [ ] Software Development
- [ ] Manufacturing
- [ ] Heavy Engineering
- [ ] Drones
- [ ] AI/ ML
- [ ] Data Analytics
- [ ] RF Engineering

5. Annual turnover of your firm for the last financial year

Mark only one oval.

- ◯ Less than 1 Cr
- ◯ Between 1 Cr and 50 Cr
- ◯ More than 50 Cr

Section II - Innovations in Defence Excellence (IDEX)

This section of the tool is to assess your firms engagement with the IDEX program.

6. Has your firm participated in IDEX challenges? (If your answer is NO, please proceed directly to Section V)

Mark only one oval.

- ◯ Yes
- ◯ No

7. How many IDEX challenges has your firm won?

Mark only one oval.

- ◯ None
- ◯ Less than 5
- ◯ More than 5

8. How many challenges have you successfully completed?

Mark only one oval.

- ◯ None
- ◯ Less than 5
- ◯ More than 5
- ◯ Won the challenge recently (less than 3months ago)

9. How many challenges have been accepted by the MoD/PSU?

Mark only one oval.

- ◯ None
- ◯ Less than 5
- ◯ More than 5

10. Was the funding amount through IDEX adequate for system/prototype development?

Mark only one oval.

- ◯ Yes
- ◯ No

Section III - Prototyping

This section of the tool seeks to understand the issues and challenges faced during the prototyping of the product.

11. Was your firm able to deliver the prototype within the stipulated timelines?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Prefer not to reply

12. Did your firm use Commercial-Off-The-Shelf (COTS) sub-systems/ products to realise the prototype?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Prefer not to reply

13. Does your firm have any foreign collaboration/ ToT agreements?

Mark only one oval.

- ◯ Yes
- ◯ No

14. What is the indigenous content in your prototype?

Mark only one oval.

- ◯ 25%
- ◯ 25 - 50%
- ◯ Greater than 50%

15. What components/sub-systems do you import (choose more than one if applicable)

Check all that apply.

- [ ] Motherboard/ CPU
- [ ] RF Components
- [ ] Software
- [ ] Core chips
- [ ] Cables/ harnesses
- [ ] Power supplies
- [ ] Other: _____

16. Which countries do you source your import components/sub-systems from (choose more than one if applicable)

Check all that apply.

- [ ] USA
- [ ] China
- [ ] Taiwan
- [ ] Singapore
- [ ] Russia
- [ ] France
- [ ] Spain
- [ ] Italy
- [ ] Israel
- [ ] Other: _____

Section IV - Support from the Sponsoring Organisation for Testing and Acceptance

This section of the tool seeks to understand the challenges your firm faced during the testing and acceptance phase of your product.

17. Has your prototype been evaluated by the sponsoring organisation?

Mark only one oval.

- ◯ Yes
- ◯ No

18. Was a suitable trial platform (if required) provided?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not applicable

19. Were you able to interact with the end users during the trials/evaluation process?

Mark only one oval.

- ◯ Yes
- ◯ No

20. Were the trials conducted as per the Approved Test Plans (ATPs)

Mark only one oval.

- ◯ Yes
- ◯ No

21. Did the product meet the specified Qualification Requirements(QRs)

Mark only one oval.

- ◯ Yes
- ◯ No

22. What was the time taken to complete the evaluation?

Mark only one oval.

- ◯ Less than 1 month
- ◯ Between 1-3 months
- ◯ More than 3 months

23. Did the IDEX challenge specify the Quality Assurance Plan required for your product to be tested?

Mark only one oval.

- ◯ Yes
- ◯ No

24. What qualification standards is your prototype/product tested to?

Mark only one oval.

- ◯ Mil-Std
- ◯ JSS 55555
- ◯ BIS Standards
- ◯ European Standards
- ◯ Not Tested

25. If your product qualified the evaluation did you get a production order?

Mark only one oval.

- ◯ Yes
- ◯ No

26. How well is your firm geared to scale up production (if you get a production order)?

Mark only one oval.

- ◯ Within 6 months
- ◯ Between 6-12 months
- ◯ More than 12 months

27. How well is your firm geared up to provide product support if production orders are placed?

Mark only one oval.

- ◯ Can provide onsite support across the country
- ◯ Product has to be shipped back for repairs
- ◯ To early to say

Section V - Taking it Forward

This section seeks to assess what measures are required in order to strengthen the IDEX process in order to ensure faster assimilation of the products into the Armed Forces.

28. Does your firm have a current understanding of how to find, pursue, and win innovation funding opportunities within the GoI/MoD? (Only for those respondents who have jumped here directly from Section 2 / not participated in IDEX Challenges)

Mark only one oval.

	1	2	3	4	5	
Little	◯	◯	◯	◯	◯	Excellent Understanding

29. In your opinion, do you think that the PSUs/larger industrial houses can play a significant role in promoting innovators/ start-ups/ entrepreneurs?

Mark only one oval.

	1	2	3	4	5	
Stron	◯	◯	◯	◯	◯	Strongly agree

30. Do you think that partnering with a PSU/ Larger defence industrial houses is favouable to start-ups/ innovators to scale up production and provide life-cycle support?

Mark only one oval.

	1	2	3	4	5	
Stron	◯	◯	◯	◯	◯	Strongly agree

31. What (in your opinion) are the biggest impediments to business growth in the defence sector (select more than one option if relevant)

Check all that apply.

- [ ] Lack of funds
- [ ] Time constraint
- [ ] Lack of Domain knowledge
- [ ] Non-availability of Skilled workforce
- [ ] Complex procedures
- [ ] Other: _____

32. What else in your opinion would be needed to strengthen the IDEX process for faster assimilation/induction your ideas/innovations/products into the Armed Forces?

_____

_____

_____

_____

_____

33. If you wish to share any additional information/ relevant data, please enter your contact details and I will get back to you. Thank you for sparing your valuable time.

_____

_____

_____

_____

_____

Appendix 'B'
Refers to Chapter 5 Para 1(b)

Innovations in Defence Excellence -

Questionnaire survey for Service Officers/ Officials in PSUs working on Indigenisation in Defence

Dear Sir,
At the outset, thank you for being part of my academic journey. This study is being undertaken as part of my dissertation on the effectiveness of *Innovation Challenges (IDEX) in accelerating system inductions into the Armed Force* as part of the APPPA course at IIPA, New Delhi.

For the purposes of analysis, the questionnaire has been divided into 6 sections.

- Introduce yourself (your profile)
- General Perceptions
- IDEX
- Impact on Induction
- Collaboration & Stakeholder Engagement
- Challenges and Concerns and Way Forward

Thank you for sparing your valuable time and inputs.

- Please feel free to share as much (or as little) as you want to.
- Please feel free to incorporate any additional data, case studies you feel relevant to the study.
- The data collated will be used only for academic purposes.
- The finding of the study will be shared with the concerned Department/ Service HQs.
- In case, any question is not relevant/ not applicable please leave the answer blank.
- This questionnaire is exclusively for service officers/ officials in PSUs/ DRDO who have worked / working in the field of indigenisation. A separate questionnaire for the innovators/ start-ups/ MSMEs has been formulated and shared with them.

Regards

Commodore Arvind Chari

49 APPPA

Section 1: Introduce yourself

This section of the tool seeks to know more about you. Let us know who you are as a respondent.

1. Your Name (optional)

_____

2. Your Rank (preferable)

Check all that apply.

- [ ] Maj Gen/ Rear Admiral/ Air Vice Marshal
- [ ] Brig / Cmde/ Air Cmde
- [ ] Col/ Capt/ Gp Capt
- [ ] Lt Col/ Cdr/ Wg Cdr
- [ ] Prefer not to specify
- [ ] Other: _____

3. Your current designation (preferable)

_____

4. Are you involved with Indigenisation/ innovation in your current role or have been so in the last 5 years?

Mark only one oval.

- ◯ Yes
- ◯ No

Skip to question 5

Section 2 : General Perceptions

This section seeks to assess your awareness of innovation challenges (IDEX) and crowdsourcing initiatives in the defence industry.

5. Are you aware of the IDEX Scheme?

Mark only one oval.

- Yes
- No

6. To what extent do you believe innovation challenges and crowdsourcing initiatives (like IDEX) accelerate the assimilation of the latest technologies in the defence industry?

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very effective

7. In your opinion, how do innovation challenges and crowdsourcing impact the speed and efficiency of technology adoption in the defence sector?

8. What do you think are the key success factors for innovation challenges and crowdsourcing in defence technology assimilation?

Section 3 : IDEX

This section seeks inputs on your experience with the IDEX program. In case your Directorate/ Department has used IDEX, please continue. In case you have not been involved with IDEX please go to the next section.

9. Has your Dept/ Directorate utilised the IDEX platform for product development/ indigenisation?

Mark only one oval.

- ◯ Yes
- ◯ No

10. What type of problem statements/ challenges has your dept/ dte given (check more than one box if applicable)

Check all that apply.

- ☐ Services
- ☐ Software Development
- ☐ Manufacturing
- ☐ Drones/ Unmanned Autonomous Vehicles
- ☐ RF Products
- ☐ Safety products
- ☐ AI/ML
- ☐ Development of Core technology
- ☐ Communication & EW

11. How many challenges/ problem statements have you routed through the IDEX scheme?

Mark only one oval.

- ◯ Less than 5
- ◯ Between 6 to 10
- ◯ More than 10

12. How many challenges were successfully completed?

Mark only one oval.

- ◯ Less than 5
- ◯ Between 6 and 10
- ◯ More than 10

13. On average, what were the timelines for evaluation of prototypes?

Mark only one oval.

- ◯ Less than 1 month
- ◯ 1-3 months
- ◯ More than 3 months

14. Did the prototypes/ Proof of Concept meet the QRs specified in the problem statement.

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Option 3
- ◯ Other: _____

15. Please rate the effectiveness of innovation challenges in accelerating system development and induction into the services.

Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very effective

16. Have these initiatives impacted the cost-effectiveness of integrating the latest technologies in defence applications?

Mark only one oval.

	1	2	3	4	5	
No c	◯	◯	◯	◯	◯	Increased cost-effectiveness

Section 4: Impact on Induction

This section seeks your opinion on what impact such innovation challenges have had on system inductions.

17. How have defence innovation challenges affected the successful induction of systems into the defence services?

Mark only one oval.

- ◯ Significantly expedited induction
- ◯ Moderately expedited induction
- ◯ No significant impact
- ◯ Slowed down induction
- ◯ I'm not sure

18. What, in your opinion, are the key success factors for defence innovation challenges in expediting system induction?

Mark only one oval.

- ◯ Collaboration among stakeholders
- ◯ Funding and resources
- ◯ Clear problem statements
- ◯ Effective evaluation criteria
- ◯ Simpler procedures
- ◯ Other: _____

19. Do you think innovation challenges help in identifying systems that are more aligned with the needs of the defence services?

Mark only one oval.

- ◯ Yes
- ◯ No

20. In your opinion, do you think that the IDEX can be leveraged into developing larger systems (like Radars, Weapon Systems, Combat Management Systems, Control Systems) or limited to developing smaller products which are used in a standalone mode?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

Section 5: Collaboration and Stakeholder Engagement

21. How has the level of collaboration and engagement among defence stakeholders (e.g., government, industry, academia) influenced the effectiveness of innovation challenges in system development and induction?

Mark only one oval.

	1	2	3	4	5	
I'm r	◯	◯	◯	◯	◯	Highly effective

22. How effective as your interaction with the innovator/start-up during the development of prototype and its evaluation?

Mark only one oval.

	1	2	3	4	5	
No i	◯	◯	◯	◯	◯	Highly effective

Section 6: Challenges, Concerns and the Way Forward

23. What are the challenges you foresee in leveraging when trying to induct systems through the IDEX / crowdsourcing route. (select more than one if applicable)

Check all that apply.

- [ ] Scalability
- [ ] Product support
- [ ] Sustainability of Start-ups
- [ ] Supply-chain issues
- [ ] Quality Assurance
- [ ] Other: _____

24. Do concerns related to intellectual property and security hinder the participation of defence organizations in innovation challenges?

Mark only one oval.

- ◯ Yes
- ◯ No

25. What (in your opinion) are the biggest impediments to business growth in the defence sector (why private sector participation is less)? [select more than one option if relevant]

Check all that apply.

- ☐ Lack of domain knowledge
- ☐ Lack of funds
- ☐ Complex procedures
- ☐ Non-availability of skilled workforce
- ☐ Non-availability of technology
- ☐ Improper understanding of User requirements
- ☐ Other: _____

26. What are your thoughts on the long-term sustainability and scalability of innovation challenges and crowdsourcing efforts in the defence sector, and how do they evolve over time?

_____

_____

_____

_____

_____

27. Do you have any other comments or insights related to the use of innovation challenges and crowdsourcing in defence technology assimilation that you would like to share?

Appendix 'C'
(Refers to Chapter 5 Para 3(e))

UNFILTERED RESPONSES – SUBJECTIVE ANSWERS

QUESTIONNAIRE 1

1. The responses listed below are from the respondents and reproduced *ad verbatim*. The responses have been grouped based on the topic they are touching upon. A synthesised response is presented in the chapter.

2. **What else in your opinion would be needed to strengthen the IDEX process for faster assimilation/induction your ideas/innovations/products into the Armed Forces?**

3. **Funding**

(a) Faster processing more grants

(b) Timely release of grants

(c) Eliminate the matching grant component and add revenue share from sales of the innovative product developed

(d) Better understanding of monetary requirements for doing Innovation, acceptance that things can go wrong. R&D can fail, but in IDEX all payments are linked with Milestone, but no payment of failure happens. How will start up be able to take the cost of failure happens

(e) 70% of time spent by the startup is towards raising of matching grant for IDEX projects. Instead of forcing the firm for matching grant if full grant is given like DARPA does the firm will concentrate its forces on completing the project instead of scrambling for funds

(f) Exact process of funding and support needs to be objectively spelt out.

(g) Tie up with financial institutions for collateral free funding of Startups in terms of Matching Contributions and also for manufacturing post getting production orders

(h) “Matching contribution" is not friendly for startups. Go for gradient contribution instead: 1st MS 10% will be from firm and 90% from iDEX. Gradually, last MS will be 90% from firm and 10% from IDEX. A less load start on firm will ensure functional prototypes in place that will impress investors, banks, etc. that will support later MS. You will see world class products in record short timelines

(i) Less complex financial diligence during entire process

(j) Complex technology like 4G & 5G wireless is put under 1.5+1.5 Crore which demand investments more than 100 crore. Awareness is a big challenge. All type of products and companies are put in one basket but there is different support required companies in different stages and product maturity cycle. This needs a serious thinking

4. **User Interaction**

(a) Active user interaction

(b) Direct exposure of Start-ups to the problem statements from the user/customer,

(c) May be one to interactive session with the good companies who are strong in technologies, manpower and R&D facilities should form a MOU and they may be assured of Business once the product is ready

(d) A platform where this innovation to be presented with users and designers to make their life easier and with higher Reliability & Safety

(e) Clarity on the Acceptance tests at the beginning.

(f) More technical reviews with the user at each stage,

(g) **Some line of communication when our proposal is not selected and, if possible, feedback on why, so that we can improve next time.**

(h) Easy approach to communicate with the Concerned department/authorities

(i) Involving End User, Def PSU from beginning for finding and finalizing Problem Statements to overcome their problems

(j) Regular interaction and feedback.

(k) Availability of more tech specs once a firm shows keen interest to develop it. Only 2-3 lines of specs are uploaded

(l) Clarity of thought from user agency and availability of subject matter experts from day one

(m) Subject matter expertise (SME) needs to bought on board

5. **Orders**

(a) Inclusion of Minimum Order Quantity criteria if challenge is fulfilled is most imperative.

(b) Some form of guarantee of orders if the system is successful. As of today, all orders are placed on L1 basis discouraging innovations which increase costs

(c) Being an innovator, we need assurance of further business-like mass production of Prototypes

(d) PO released on MVP trials and/or assured MoQ order

6. **Information, Training and Awareness**

(a) We are busy with our regular production and other activities. Please arrange a program in Coimbatore and invite us to participate to know more about the IDEX opportunities

(b) Seminars, promotional letters

(c) Regular communication

(d) Training and Awareness Programs that percolate to the Small and Medium Scale industries are required. Awareness sessions for defence personnel to familiarize them with off the shelf innovative technologies and products and awareness session for the SMEs to familiarize them with the challenges and opportunities for better participation

(e) Increase awareness with the MSME companies by seminars and handholding by Govt

7. **Testing & Trials**

(a) Involvement of Testing agencies with the innovators so that the solutions can be optimized from the beginning of the process. Strong hand

holding required from Testing, QA agencies, not as customers but partners as most of the innovators I know are not aware of that domain

(b) Bringing more clarity on testing aspects and availability of suitable testing facilities within country

(c) Knowledge of Tests for Military standards - We do not have clear information which tests to conduct, which labs to use to comply the product for military standards. Other than this, nothing very specific

(d) Not all startups/innovators will be able to provide the matching contribution all the times. iDEX should give certain flexibility in terms of matching contribution based on the project

(e) Early involvement of DGQA and TGME for ATP and MET otherwise these processes are consuming huge time even after the product is ready for the trials

(f) Trial phases need more support from Nodal agencies, as per start up needs to actually bring the product induction fast. Just a lab rat will not succeed in field and for that need more and frequent field outings to perfect the products, particularly hardware systems

8. Processes

(a) Constant simplification of processes. Strategic funding for start-ups/MSMEs in defence & aerospace. An integrated team from 3 Services to handhold the companies. This has to be long duration

(b) Simple execution process required

(c) Making the process simpler and faster

(d) Proper understanding within the services on how they can procure iDEX process in accordance with the new DAP procedures. they cannot be got for age old practice of 3 quotes or open tender for iDEX and innovative products. further in the repeat order also forces go for open tender. these loop holes have to be sealed

(e) iDEX needs to have a process to handle churn of Defence personnel during project lifetime. Deadlines need to specified for the nodal office also.

(f) Start-ups have a HUGE role to play. Simplification of procedures and a leg-up to start-ups would boost the speed and output of iDEX projects massively.

(g) Simplified procedures

(h) My suggestion would be to execute the contract signing with the selected winner and the documentation evaluation process can take place parallelly. This will avoid time delay in development of prototype

(i) iDEX in its present form has become a repository of challenges, "challenge factory". It lacks the knowledge to assists innovators, MSME in getting licences etc.

(j) Failures faced in the developments and the transparency in the selection with minimal or No VQC

9. Miscellaneous – Process Related

(a) Fair chances to all DAs participating in the project evaluation, such that different variants of technologies can be available in the country and this will also reduce the dependency on one particular DA for supply

(b) The prototype is developed with 50% input from Vendor. Who is the owner of the prototype? In case it is MOD, the firm has to write-off their investment in prototype. I propose that once the prototype has been accepted, the firm be reimbursed their share and prototype handed over to MOD. As it is iDEX does not permute profits or establishment cost in prototype. In fact, the firm invests much more than 50%

(c) Limited companies in every sector if business is not going to be profitable then why big organization will do R&D work more

(d) Software Adaptation

(e) There is a need to publish the business opportunity associated with problem statements along with timeline. There are considerable delays in placing the bulk order which can fail the startups because of non-technical reasons.

(f) iDEX has a great philosophy. Implementation consistent with the character needs more reinforcement with an innovation driven mindset. We

need to together embrace failures as a stepping stone to success and support techno-perineurial initiatives

10. Global Trends

(a) In the US, companies winning large defence contracts have to as per contract, offload a sizeable percentage to smaller companies and startups. This is much better than IDEX or any such scheme. Look at Palantir. Incubated entirely by the CIA.

(b) The DMA, SHQ, and relevant agencies should evaluate the iDEX process critically and shun from offloading their strategic programs in the iDEX. The examples to get inspiration may be AFWERX, NATO DINA, ISRAEL MAFAT, AID France, DIUx USA, IN-Q-TEL etc

11. Any Other Information

(a) iDEX has facilitated R&D in Def Tech in a novel way and has opened vista for individuals and Startups

(b) If the idea is to have startups come up with innovative solutions in the defence sector, then minimize the touch points with the government.

(c) The documentation at the completion of the stages can be simplified,

(d) Our experience with DISC 1 challenge was after 5 years of R&D, field trials and meeting NSQR we are able to receive a sample order of 5 quantity with a delay of 2 years. The R&D investment make sense only with the bulk order. The cycle is too long and really hard for founders and companies to survive. Faster and better decision making will be a great support to the industry.

(e) We are doing 2 iDEX projects and might win another one shortly. The 1st 2 Projects are complete - but both are awaiting final trials as the process for this is extremely slow and tedious. Simplification of processes, and speeding them up to the speed at start-ups operate is crucial. Start-ups move much faster than govt procedures, which slow us down.

Appendix D
(Refers to Chapter 5 Para 4)

UNFILTERED RESPONSES – SUBJECTIVE ANSWERS
QUESTIONNAIRE 2

1. The unfiltered responses for Q 5,6, 24 & 25 from the respondents are reproduced *ad verbatim*. A synthesised response is presented in the chapter.

Response to Q7

2. In your opinion, how do innovation challenges and crowdsourcing impact the speed and efficiency of technology adoption in the defence sector?

(a) Large extent

(b) Rapidly

(c) These can bring in low end technology products, wherein COTS items are amenable to customisation for Military use.

(d) iDEX challenges promote quick absorption of Dual Use Technology, which would otherwise have a long lead time both in terms of development as well as procurement.

(e) Funding to innovators is the best part of the scheme

(f) The speed increases and the efforts lead to faster and better results.

(g) The startup and R&D verticals develop technologies in a catalysed manner. Technology leapfrogs faster than our procedures and policies. Hence Services must have faster absorption policies like EP to embrace the developments to the soldier on ground.

(h) It’s a very slow process, with too much of monitoring. Indigenisation can be achieved otherwise also. Focussed effort on indigenisation will deliver results in the long term. There is no short-term solution for indigenisation of high-end technologies.

(i) iDEX only mandates formulation of a prototype. Incorporation of a prototype technology in a defence system required application by the sponsoring directorate, followed by a case to be taken

(j) It will make a difference but will take time

(k) Though the latest in the market can be brought in and innovated to solve the statement of Problem... it requires two-way process of Defence dept and innovators to hand hold each other. Handholding

(l) It gives an opportunity to startup's and MSMEs

(m) Yes, it is bridging the gap between industry/start-ups, which are agile to requirements of services HQ and adapting technologies available commercially

(n) It helps MSMEs to get the needed funds for development and trials of new technologies. In addition, it provides a source for MSMEs to move into production on successful completion of trials

(o) Useful but will eventually depend on the users

(p) Economic Value, EOQ

(q) Particularly in Defence, earlier the option mostly was through import. With MII and iDEX the demand has increased and therefore it will promote the supply.

(r) Innovation challenges thrown at industry will force them to evolve and look at imbibing new technologies to create products which can replace obsolete systems and equipment. This challenge will force the industry to promote R&D divisions to create products which would have wide utility across the platforms.

(s) No correlation

Response to Q8

3. What do you think are the key success factors for innovation challenges and crowdsourcing in defence technology assimilation?

(a) Open mind

(b) Capital availability and knowledge

(c) Defining Firm Requirements form the basis of success of any project of iDEX nature.

(d) Defence Technology needs investment and needs to be funded for getting any niche product/ technology

(e) Ease of application and outreach to the correct office and handholding by service personnel throughout the process through a Nodal Officer is very important

(f) Participation of startups and support of govt

(g) Immense potential in the startup ecosystem

(h) Lack of opportunity provided before due to monopoly by Govt R&D agencies like DRDO, DPSUs

(i) Promise of Minimum Orders as a motivation in R&D projects

(j) The process has not been successful till now, as we are looking at short term results.

(k) The ability of start-ups and MSMEs to get an equal opportunity to participate in defence sector and development of a conducive environment for small scale innovation

(l) Being provided opportunities and creating the existing system for sustenance and growth

(m) Hand holding the newcomers without compromising the defence requirements

(n) Direct contact with the OEM

(o) Indian private sector realizing the growth potential in defence manufacturing

(p) Provision in DAP to buy products developed under iDEX

(q) Ease of procurement

(r) Sustenance

(s) By Funding, small players also participate. Partner incubators does the hand holding at all levels. Involvement of departments of armed forces can define the requirement at all levels. Freedom of technologies to be used till it meets the function. Adequate but specific time period for design and development. Efforts of firms participating but failing in producing the prototype are also recognised. Production of one type of item is given to multiple firms ensuring high probability of success.

(t) Industry willingness to participate and produce items expeditiously Generation of suitable projects for industry by all stakeholders in a time bound manner

(u) Willingness of government to shift the focus to standardise the production across all platforms to generate interest in the industrial sector. Promote start-ups to handle the software upgrades to break the shackles from the foreign OEMs. Allow the manufacturing hubs to export the products which will enable wide scale utility

(v) Quantum of funding, core competency of industry partner and progressive D&D.

Response to Q 26

4. What are your thoughts on the long-term sustainability and scalability of innovation challenges and crowdsourcing efforts in the defence sector, and how do they evolve over time?

(a) Long term hand holding required

(b) Innovation should be through DRDO (adequately funded) and for niche technology. The product should then be given to services for field evaluation at par with available global alternatives.

(c) Such schemes should be promoted to the mass as much as possible for discovering more innovations and developing our ecosystem and making it more robust

(d) The efforts need to be continuous and funding has to be increased

(e) Single Vendor Situation must be created for committed and performing startups by granting Proprietary Article Certificate assuring them orders post R&D. MOQ induction is still a great move but the real fruit for startups to scale up is when they get orders.

(f) These are good for small low technology items. Large high-tech items need to be indigenised through well-established firms, with deep pockets.

(g) Recommended. However, there is need for better vetting of start-ups and MSMEs participating in iDEX/ similar challenges to weed out non-serious contenders.

(h) Handholding, identifying technology which would be functional and sustainable for at least 5 years once the product is introduced.

(i) Highly qualified professionals to drive this change than just "senior bureaucrats or defence officers"

(j) Instead of listing down MOQ in innovation challenge, complete case for order placement for the MOQ should be concluded prior listing the challenge so that start-up are assured business and they can put in efforts based on the AON cost for that challenge.

(k) Policies have to be tailor-made to enable innovators to move from prototype to production

(l) Link innovation to procurement

(m) IDEX as a Model is a robust one. Innovation challenges are continued and increased in number progressively, from smaller products it will move on to sub-assemblies then assemblies and then systems

(n) We have to promote these innovation challenges. While we are still in the nascent stage I feel we should be able to enhance our defence sectors in times to come. The policy will evolve and it’s bound to bear the fruits of success.

(o) These are good for small low technology items. Large high-tech items need to be indigenised through well-established firms, with deep pockets.

(p) At nascent stage, nil comments

Response to Q27

5. Do you have any other comments or insights related to the use of innovation challenges and crowdsourcing in defence technology assimilation that you would like to share?

(a) Open mind

(b) Keep the process simple

(c) We should look for induction of niche technology solutions through innovation and not merely replacing low end import nature items which is presently the case.

(d) Most so-called innovations are just customisation of available COTS products/ technology and re-packed as innovation.

(e) IDEX is good for technology induction, wherein, import dependence can be reduced by defence PSUs/ major weapon manufacturers. Major weapon systems should be kept out of its purview. Also, IPR in case of system modules/ sub-systems is a major issue, thus, it is possible that an item is developed by a firm, but services are unable to integrate it with the system due to firmware/ software incompatibility with other system constituents

(f) Indian Army must have inhouse innovators as nodal officers to steer IDEX projects from ideation to induction. Frequent change of nodal officers has affected many projects from completion.

(g) It's a good format to get in niche technology. But needs to direct impetus and boost from the govt

(h) Instead of waiting for IDEX challenges to be published at specific times decided by DIO, Services should have option to upload challenges directly on the website of the IDEX throughout the year.

(i) If R & D has to be successful, failures need to be accepted. Funding limits are to be increased progressively. Government needs to formulate preferential policy for exports of products indigenised through IDEX and not be a worry

Annexure 1
(Refers to Chapter 3, Para 13)

The US Defence Innovation Mind Map

TO BE PRINTED SEPARETELY AND PASTED

Retrieved from *: https://acquisitiontalk.com/wp-content/uploads/2019/06/DOD-innovation-bureaucracy.pdf*

Annexure 2
(Refers to Chapter 4 Para 17)

EXTRACT OF DAP 2020 - CHAPTER III
Innovations for Defence Excellence (iDEX)

Amendment issued vide MoD ID No 1(18)/D(Acq)/21 dated 13.04.2022

67. Details of the programme through DISC, SPARK and other such frameworks would be uploaded on the iDEX website www.iDEX.gov.in from time to time. The procurement of the final product will be processed under the Buy (Indian-IDDM) category. However, quantity vetting and scaling will be dispensed with, in iDEX cases for initial procurement subject to the procurement value commensurate with delegated cases.

68. Like the Make-II category, Innovators/Industry/academia/start-ups can also forward Suo-moto proposals for innovation to SHQ/iDEX-DIO. These proposals will be examined by SHQ/iDEX-DIO in a time-bound manner, preferably within two months.

69. **Development of Prototype**. A Project Facilitation Team (PFT) or nodal officer will be nominated by the SHQs for each iDEX case. PFT/Nodal officer will act as the primary interface between the SHQ and the industry during the design and development stage. After the prototype has been developed, the PFT would carry out UTRR of the prototype before offering it for User Trials. as confirmed by the PFT in a collegiate manner, the PFT with requisite empowered members, would carry out the Single Stage Composite Trials of the prototype and ratify the same within one week of completion of composite trials. The Trial report will be accepted by the appropriate authority within the SHQs in three weeks. Project, where prototype of only a single firm/individual has cleared the trials, would also be progressed as resultant single vendor.

70. Prototypes that have been successfully developed through the iDEX framework will be taken up by the SHQs for grant of AoN after finalisation of SQRs as per procedure outlined in Chapter II of DAP. The SoC will be prepared by the SHQs, with the involvement of important stakeholders such as HQ IDS, DRDO, DDP, Advisor (Cost) and MoD (Fin)/ IFA. Since the development of prototypes under iDEX is based on the Project Definition Statements (PDS) and the Product Requirement Units (PRU), articulated by the Services, the PRUs will be converted to PSQRs prior to the ‘single stage composite trials’, dispensing the RFI based SQR formulation process detailed in the Chapter-II of DAP-2020. The ‘single stage composite trials’ will then be based on the PSQRs and if found acceptable, the PSQRs will be automatically converted to SQRs. SoC for accord of AoN by the respective AoN according authority, for successfully developed prototypes through the iDEX framework, will be taken up by the SHQs based on these SQRs.

The SoC will be prepared by the SHQs, within four weeks of successful trials, for approval by the AoN according authority. The requirement of obtaining comments of other agencies is dispensed with, to facilitate timely completion of SOC.

71. **Solicitation of Commercial Offers**. A commercial Request for Proposal (RFP) for 'Buy (Indian-IDDM) phase will be issued to all DAs (iDEX Winners who have successfully developed the prototypes) for submission of their commercial offer prior to commencement of User trials. RFP will be issued to the iDEX winners on clearing the ‘single stage composite trials’ under Buy (Indian-IDDM) category seeking commercial offer. Cases where more than one startup is participating, with the qualification of one of the startups in the ‘single stage composite trials’, the other (s) can continue their development but with no liability on the Service HQs to procure from them. All assistance will be provided by the Service HQs & DIO to evaluate their solution once ready and they will be given certification of ‘fit for military use’.

72. **FET**. FET will be carried out as per Chapter II of DAP 2020, in coordination with iDEX. Project, where prototype of only a single firm/individual clears the trials, will be progressed as resultant single vendor.

73. **Follow-on Procedures**. Subsequent procedures of Staff Evaluation, CNC and award of Contract will be same as for 'Buy (Indian- IDDM)' category, from the successful DA/DAs, in accordance with Chapter II of DAP. Post CNC, contract will be awarded with the approval of CFA. CNC will comprise of maximum five members including Reps of user Dte (Member- Secretary), Tech Dte, rep IFA, rep Advisor (Cost) and chaired by a designated authority at appropriate level. The negotiated cost and contract vetting is to be undertaken by CNC only and approval of CFA at SHQ is to be obtained. The CNC will be completed within 30 days of commencement of the same in a collegiate manner. Observations if any, will be resolved within this stipulated time & no extension will be granted. Post accord of CFA approval, the Contract will be signed within prescribed timelines.

(a) For cases under non-delegated powers, standard CNC composition as per Appendix H, Chapter II of DAP 2020 will continue and CFA approval will be obtained by MoD Acquisition. Rest of the procedure will be as per delegated power cases.

(b) The proposed timeline for Acquisition through iDEX will be as per freshly added Appendix M to Chapter III.

(c) The proposed amendments in Make-II process on similar lines are enumerated at Appendix L to Chapter III.

74. **Developmental Agencies (DA)**. All reference to the word DA in context of iDEX may be construed as referring to iDEX winners or iDEX fellows for iDEX

cases. IPR provisions will remain same as Make-II category. 32, 33, 34 & 35 Amendment issued vide MoD ID No 1(18)/D(Acq)/21 dated 13.04.2022

APPENDIX L to CHAPTER III

Ser	Stage of Procurement	Timeline as per DAP (in weeks)	Timeline as per DAP (Cumulative Time -in weeks)
PHASE I			
1	Accord of AIP by Collegiate	*T_0*	*T_0*
2	Completion of Feasibility Study	*12*	*T_0+12*
3	Preparation of PSQRs	*4*	*T_0+16*
4	Categorisation and Accord of AoN	*6*	*T_0+22*
5	Format of PFT	*4*	*T_0+26*
6	Issue of EoI	*8*	*T_0+34*
7	EoI Response submission	*8*	*T_0+42*
8	EoI Response evaluation	*6*	*T_0+48*
9	Issue of Project Sanction Order	*2*	*T_0+50*
	Total Time for Phase I	**50**	
PHASE II			
10	Prototype Development	*30-48*	*T_0+80/ T_0+98*
11	Single Stage Composite User trials & Acceptance of Trial Report	*7*	*T_0+87/ T_0+105*
12	Conversion of PSQRs to SQRs	*2*	*T_0+89/ T_0+107*
13	Issue of Commercial RFP	*2*	*T_0+91/ T_0+109*
14	Solicitation of Commercial offer	*4*	*T_0+95/ T_0+113*
15	Finalisation of CNC	*4*	*T_0+99/ T_0+117*
16	Signing of contract	*2*	*T_0+101/ T_0+119*
	Total time for Phase II	**51-69**	
	Time period from AIP to Contract	**101-119**	

Source: **Appendix 'L'** – **Chapter III**, **DAP 2020**
Amendment issued vide MoD ID No 1(18)/D(Acq)/21 dated 13.04.2022