

Innovations for Defence Excellence (iDEX)

**Operationalization Plan for
Defence Innovation Organization (DIO)
And
Defence Innovation Fund (DIF)**

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1. Introduction, Background, and Context

One of the first aims of India as a nation since Independence has been to achieve self-reliance in the field of defence and defence production. However, this goal is yet to be achieved. India is the world's largest defence equipment importer and is expected to spend around USD 220 Billion¹ in the coming decade to modernize its armed forces.

Around the world, recent years have been marked by rapid technological innovation, in a variety of sectors such as telecom, information technology & connectivity and their impacts are being seen in our daily lives.

In the recent years, the government of India has initiated various schemes like Make In India², Startup India³, Atal Innovation Mission (AIM)⁴, etc. to encourage innovation and entrepreneurship in the Indian commercial ecosystem, which includes higher manufacturing in defence. This has also made increasingly evident that achieving the goal of self-sufficiency for the Indian military will require a means to incorporate innovation rapidly in the weapons procurement process.

Ministry of Defence aims to create an ecosystem which fosters innovation and encourages technology development in Defence by engaging R&D institutes, academia, industries, start-ups and even individual innovators. For any corporate, government, or philanthropy, engaging with innovators has become an imperative in recent years, to avoid being disrupted by faster, more agile and responsive competitors. For State functions and public services, the risk of being outcompeted in the market is not as stark as in the private sector due to natural monopolies, but National Defence cannot afford to be behind the country's potential adversaries in capabilities, which are often multiplied by new technologies.

The rates of adoption of innovation for different sectors vary, due to several factors such as applicability, absorption capability of the systems, etc. A special effort is required to reach out and engage the smaller enterprises, start-ups and innovators, which have the flexibility and adaptability to supply the Indian military with innovative and ingenious technological solutions. Such a system will be needed to encourage development of innovative technologies for the defence sector by roping in the nation's industry, start-ups, MSMEs, R&D institutes, academia and even the individual inventors.

This document covers the objective and scope of the Defence Innovation Fund (DIF), steps involved in implementation of DIF and the roadmap for creating an innovation ecosystem for defence called the **Innovations for Defence Excellence (iDEX)**, through funding, guidance, handholding, customer engagement, and facilitation. The document in **Annexures A, B and C** gives a brief of the funding mechanism for the Organisation, the Fund, its Program Management and top level institutional arrangement at MoD for this initiative. Recent and

¹"India Plans Massive \$223 Billion Military Spending over next Decade," 2016, <http://www.ibtimes.co.in/india-plans-massive-223-billion-military-spending-over-next-decade-691055>.

²"Make In India," 2018, <http://www.makeinindia.com/home>.

³"Startup India," 2018, <https://www.startupindia.gov.in/>.

⁴"Atal Innovation Mission," 2018, <http://aim.gov.in/>.

historic global efforts to engage with startups and innovators in various fields, especially defence are summarized in **ANNEXURE D**.

2. Objectives, Functions, and Activities of DIO-iDEX

The establishment of Defence Innovation Fund (DIF) and iDEX is aimed at creation of an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging 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.

The **core objectives** of setting up the Defence Innovation Fund are to:

1. **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
2. **Create** a culture of engagement with innovative startups, to encourage co-creation for defence and aerospace sectors
3. **Empower** a culture of technology co-creation and co-innovation within the defence and aerospace sectors.

Adoption of innovation requires execution of **three critical functions**:

- **Co-Innovation/co-creation**⁵ - Discovery and exploration of existing technologies, or development of relevant technologies
- **Piloting** of candidate technologies in important platforms, with quick feedback to the innovators
- **Indigenization** of various defence and aerospace related platforms being manufactured in the country based on ToT

The iDEX structure will need to perform all these three functions, in partnership with other competent stakeholders. iDEX will function as the executive arm of DIO, carrying out all the required activities.

To execute the above functions, the iDEX team will need to undertake the following **activities**: -

- a) **Setting up and managing** of the iDEX network in form of **Independent Defence Innovation Hubs**.
- b) **Communicate with innovators/startups** through the Defence Innovation Hubs regarding defence and aerospace needs.
- c) **Organizing various challenges/hackathons** to shortlist potential technologies for defence and aerospace use.

⁵"Co-Creation Experiences: The next Practice in Value Creation," 2004, <http://onlinelibrary.wiley.com/doi/10.1002/dir.20015/full>.

- d) **Evaluate technologies and products** coming from innovators/startups in terms of their utility and impact on the Indian defence and aerospace setup.
- e) **Enable and fund pilots**, using innovation funds dedicated to the purpose.
- f) **Interface with the military (Army/Navy/Airforce) top brass** about key innovative technologies and encourage their adoption into the defence establishment with suitable assistance (financial if required).
- g) **Facilitate scale-up, indigenization and integration in manufacturing facilities** for successfully piloted technologies.

The Defence Innovation Organization with its iDEX team will enable creation of channels for innovators to engage and interact with the Indian defence production industry. The long-term effect to be realized by the group is establishment of a culture, where enlisting the effort of innovators by the Indian military is commonplace and frequent.

3. Pattern of Engagement

It is intended to create a ‘corporate VC’ for Indian defence needs. iDEX would be empowered to run challenges, hackathons, and several month-long accelerators that help the Services co-create technologies with innovators. Furthermore, iDEX will connect innovators to the different military entities that absorb technologies, to enable co-creation and co-innovation.

To achieve the above stated objectives, it is envisaged to engage with existing and create new Defence Innovation Hubs where innovators can get information about needs and feedback from the services directly and create solutions for India’s major defence platforms. This structure is also geared towards attracting more innovators to work for the defence sector in India. At the other end, this will enable the military to understand to concept of “Fail Fast and Recover Faster” in the technology domain and use it to its own benefit. With this paradigm, the military will be able to work with and incorporate smaller and faster moving entities in the defence domain.

4. Implementation Methodology

iDEX will be funded and managed by a ‘Defence Innovation Organisation (DIO)’ formed as a ‘not for profit’ company as per Section 8 of the Companies Act 2013 for this purpose. The constitution of DIO is described in **Annexure A**.

The modalities of implementation of DIF will be managed by a specialized team known as the Innovation for Defence Excellence (iDEX) within the DIO. DIO will provide high level policy guidance to iDEX. iDEX will have functional autonomy. The CEO of iDEX will be selected and recruited by the DIO and will be a professional person of sound technical, scientific and engineering background with divergent knowledge and experience in innovation and research. CEO of iDEX would also be CEO of DIO thereby providing the

linkage between the high level policy guidance given by DIO and its implementation in a professional manner through iDEX.

This iDEXteam would have the following composition:

1. **Tech experts** - The iDEX will create a roster of experts in core areas and engage them as per the requirement of Defence Innovation Hubs.
2. **Tech deployment experts** - Deployment of technologies is a growing discipline, with individuals who understand the dynamics of integrating tech in complex institutions and environments. These will include system integrators, user interface experts, design experts, etc.
3. **Innovation stakeholders** - Co-creation and adoption of innovation is now an advanced discipline and requires specialized skills. Experts with these skills will be an integral part of the team, to be able to successfully connect tech. innovators and users in the armed forces.

While iDEX will lead the overall effort to create an innovation ecosystem in the country, each Defence Innovation Hub would be independent financial viable unit functioning with the help of assistance provided by DIO under the guidance of iDEX. Through the network of Defence Innovation Hubs throughout the country, the iDEX will underpin an ecosystem of defence tech. and innovation stakeholders.

5. Funding of DIO

The DIO has been formed with a nominal capital under Sec 8 of the Companies Act by the two founder members i.e., HAL & BEL. It is proposed that other Defense PSUs will also be encouraged to join the DIO.

DIO will also have an initial corpus fund which will be utilized for funding iDEXprojects.

The funding for DIO will come from:

5.1. Initial Contribution from HAL and BEL

The corpus fund raised by HAL and BEL for DIO is presently conceived as Rs. 100 Crores, Rs. 50 Crores each from HAL and BEL. Over and above, the corpus fund may be increased subsequently depending upon the requirements and external donors'/contributors' interest through crowd funding. HAL & BEL being founder members will contribute to the initial corpus fund of Rs50 crores to start with.

5.2. Contribution from Defence PSUs

All Defence PSUs, namely HAL, BEL, BEML, BDL, MIDHANI, MDL, GRSE, GSL, HSL shall be encouraged to participate in the initiatives of iDEX through DIO. It is proposed that the DPSUs will be required to contribute an amount of 2% of their net profits to DIO for creating the innovation ecosystem in the country.

5.3. CSR Funds

Under guidelines for CSR, CSR funds can be used for eligible Incubators. Defence PSUs shall earmark 25% of their CSR funds for supporting iDEX in the country.

5.4. Funds from other PSUs/Government agencies/Departments

Several technologies developed in defence and aerospace have dual applications, both in Defence/Aerospace sector and/or in civil/commercial sectors. To name a few, Gallium Nitrite products, AI applications, UAVs are such technologies. It is expected that other PSUs/Government agencies/Departments may be interested in taking up development of such technologies. iDEX may approach such other PSUs/Government agencies/Government Departments to join iDEX initiative as long as such initiatives are within the broad mandate of iDEX. Such funds received would be through DIO.

5.5. Allocation of Funds by Ministry of Defence

Ministry of Defence may release funds to DIO. MoD if it is satisfied that such funding is required in furtherance of the objectives of Defence Production. Such funding from Government will be based on a request from iDEX/DIO and after due appraisal by MoD and approval of Competent Authority, on a case to case basis.

As each Defence Innovation Hub and each project will require different amounts of assistance in terms of time and funds, the exact amount and duration of funding will be decided on a case by case basis. This funding will be used only for piloting/prototyping and not for equity purchase.

6. IPR Management

- 6.1. The ownership of IPR generated under the program shall be owned by the company/institution/individual innovators who develop the IPR.
- 6.2. The Government may also put restrictions on transfer/licensing of technology/IPR developed under the program on considerations of national security or other strategic reasons.
- 6.3. Government will have Government Purpose Rights (GPRs) which will be non-exclusive, non-transferable irrevocable license to use the intellectual property for internal consumption or manufacture. The Government may use this right to manufacture either directly or through sub-contractor. The Government shall be liable to pay license fee/royalty fee for use of GPRs in intellectual property/technology/product. A royalty up to 2% on each manufactured unit with a cap on total maximum royalty payable will be included in the contract with innovator, if Government or its sub-contractor uses the intellectual property generated for defence manufacturing. The cap on total maximum royalty payable to the innovator shall be decided on a case-to-case basis.

- 6.4. The Government shall have ‘March-In’ rights for all items covered under its GPRs for reasons of national security and other strategic reasons. ‘March-In’ Rights shall include the right to work the patent, either by itself or by another entity on behalf of the Government, in cases where (i) the company/institution fails to work the patent on its own within a specified and reasonable period of time (ii) the effective management and control of the company/institution is taken over by a foreign company without the approval of the Government. The march in rights of the Government shall be subject to the payment of acquisition cost/licence fee/ royalty fee by the Government or the concerned production agency as per the terms stated in preceding paragraph.
- 6.5. The ownership of any rights by the contractor (entity receiving grants) does not include an absolute right to transfer of any software, product or documentation; and such transfer, including export thereof, shall continue to be governed by and be subjected to the export policy, export guidelines and all applicable laws, rules, regulations, orders and the instruction of the Government of India. Transfers and exports which require prior and explicit approval of the Ministry of Defence would require such approval to be taken.
- 6.6. In case of collaborative project, the ownership rights in the IP generated under project, upon dissolution of the collaboration, shall vest amongst the partners as per their agreement on the subject, without Government rights being adversely affected in any manner.
- 6.7. The company/institution/innovator (entity receiving support) shall be responsible for protecting and maintaining the IPs generated in the project.
- 6.8. The Government and the company/institution/innovator shall set aside a certain amount of royalty or the licence fee, payable by the government for utilization by the DIO in order to keep a track of the production out of the IPRs generated in the project. This royalty will be finalized on case to case basis and will be part of contract with innovator.
- 6.9. Export control regulations of Ministry of Defence will apply to the export of technology or product developed in the project.

7. Utilisation Certificate & Accounts

The entity receiving grant under this scheme will be required to maintain proper accounts and submit Utilisation Certificate, which shall be subject to verification/ audit by the DIO appointed agency.

8. Activities which cannot be funded

1. Cost overruns: The entity shall bear the additional cost in case of cost overruns.

2. Cost of land and buildings
3. Establishment of new R&D centers
4. Writing of books or reports or collection of statistics or service
5. Interest
6. Bad debts
7. Contributions or donations
8. Fines and penalties
9. Advocacy and business development
10. Loss of other contracts
11. Expenditure incurred by applicant before the approval of the project
12. Re-financing
13. Entertainment / Alcoholic beverages

i. Constitution of the DIO

a) Secretary (Defence Production)	:	Chairman
b) Secretary (R&D)	:	Member
c) Secretary (Def Fin)	:	Member
d) Additional Secretary (Defence)	:	Member
e) VCOAS	:	Member
f) VCAS	:	Member
g) VCNS	:	Member
h) CISC	:	Member
i) Representative, HAL	:	Member
j) Representative, BEL	:	Member
k) Representative, OtherDPSUs/OFB	:	Member
l) CEO, iDEX	:	CEO, DIO
m) <i>Representative, Dept of Science & Technology</i>	:	<i>Member</i>
n) <i>Representative, DIPP</i>	:	<i>Member</i>
o) <i>Representative, Atal Innovation Mission/ NITI Aayog</i>	:	<i>Member</i>

The main functions of the DIO will be:

- Receive periodic reports from iDEX team on the projects.
- Provide high level policy guidance regarding the effort's direction and execution.

ii. Role of SHQs & DPSU's

SHQs & DPSU's will play the primary role in identifying potential topics, problem statement/ project definition in a suitable format devised by the iDEX team. This will be a regular iterative process between the bodies with iDEX acting as the translator between the SHQs & DPSUs and the Indian innovation ecosystem.

iii. iDEX Model - Funding Innovation using Corp VC model

Corporate Venture Capital (VC)⁶ is a recent structure where large corporates engage with small startups and innovators to improve their own products and services. More than just products, these corporates also forsake their hierarchical structure to get the benefits of flat structures of startup culture. These projects are financed by innovation funds set aside by the companies, accepting higher risk.

The iDEX is envisaged as a 'corporate VC' for Indian Defence. VCs don't just invest in companies, but also nurture them with connections, advice and handholding, to help them meet their customers' needs and expand their markets. India's defence PSUs would pool and put aside resources to productise innovations. These funds would be assigned to and controlled by iDEX, which would have complete operational independence, but receive frequent guidance from the

⁶"Corporate Venture Capital," 2018, https://en.wikipedia.org/wiki/Corporate_venture_capital.

PSUs and Services. In India, international companies have run accelerator programs and corporate VCs with incubators to tap Indian talent in technologies. iDEX would learn from such leading-edge practices and run accelerator programs to promote innovation for defence needs

Independent Defence Innovation Hubs (Defence incubators): iDEX will work with India's innovation entities that have existing innovation hubs. Incubators such as CODISSIA, T-Hub⁷ (Hyderabad), FORGE⁸ (Coimbatore), SINE IIT Bombay⁹ and IIM Ahmedabad's CIIE¹⁰ would help in discovery and exploration of MSMEs, startups, performing the function of co-creation. iDEX would work with these hubs closely, tracking upcoming startups and innovators, and investing in the latter opportunistically, from the iDEX Fund.

iDEX will also engage with existing key players in the defence sphere like Defence PSUs and private sector to test pilots on existing platforms. These will act as the accretion points for innovators/startups with technologies and products for the defence sector. *A mechanism will be established to create a platform for knowledge sharing between incubators/startups and various DPSUs/ OFB to promote domestic manufacturing by helping/handholding the startups.*

iv. iDEX - Culture and Leadership

It is important to point out the differentiating factor of iDEX, in terms of the significant cultural and leadership paradigm shift that will make it work effectively. iDEX will have to work with minimal hierarchical control, embodying a flat structure and fostering a collaborative culture amongst the various stakeholders.

The Defence innovation hubs would have to be given operational autonomy to enable the deployment of defence innovation in a timely manner. This autonomy will also allow for the "Fail Fast, Recover Faster" policy - engage in multiple experiments, trying out existing and emerging platforms. Failures from these will be identified and weeded out early in the cycle, winnowing the successful pilots towards faster scaling up.

This attitude will only be established by visionary leadership for DIO(iDEX). The leaders of iDEX will need to have a fiercely independent mindset with the willingness to take on rigid bureaucracies to keep true to the vision of iDEX's role in making India's defence production establishment self-sufficient. They will need core technology adoption/commercialization experience from across sectors. Direct access and support from the MoD will be crucial for taking on high-return risky projects which require extensive discretion in decision making. Finally, the leaders will need to work with a startup mindset, initiating multiple pilot projects early and shutting down the failures without hesitation.

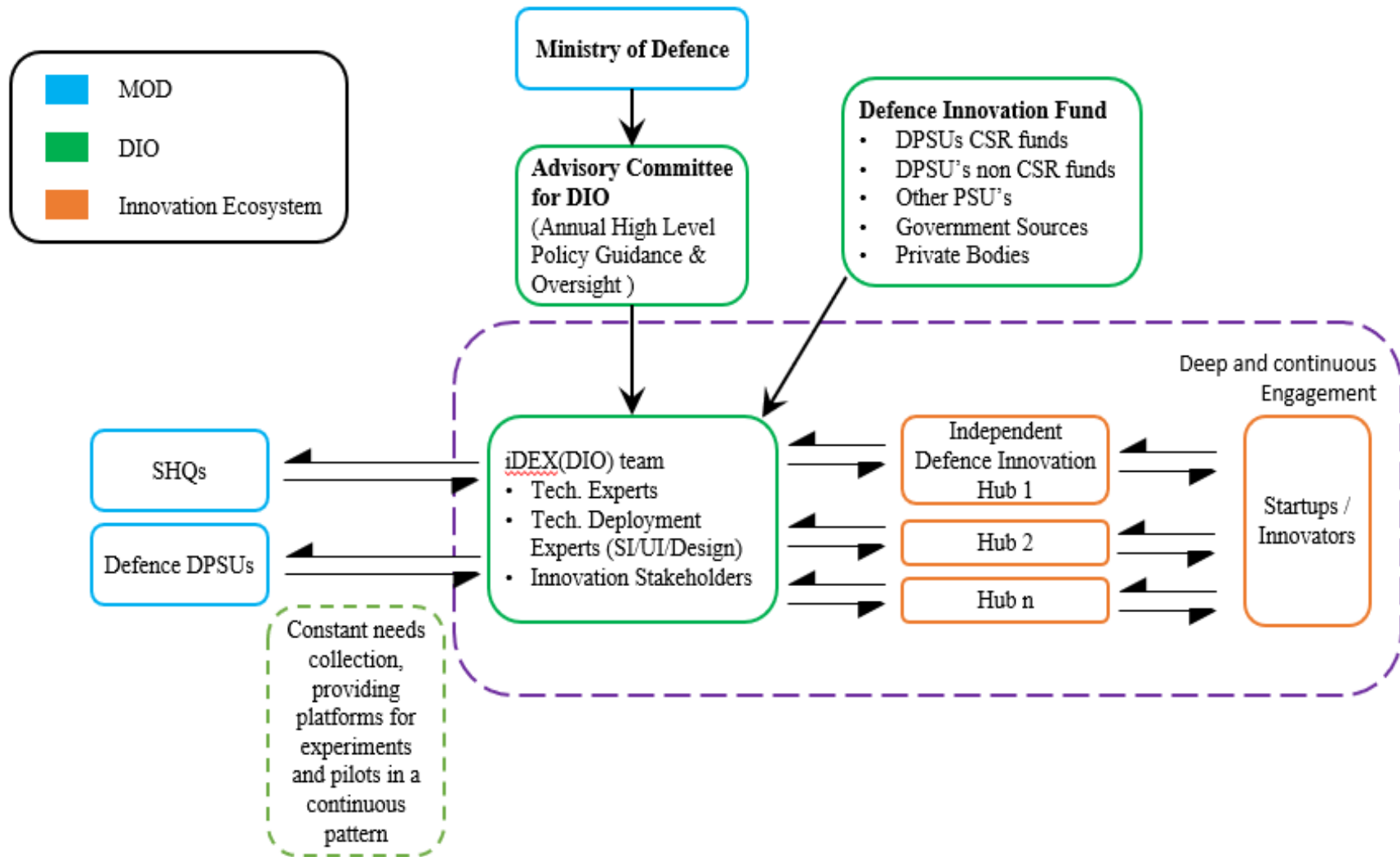
⁷"T - Hub," 2018, <https://t-hub.co/>.

⁸"Forge Accelerator," 2018, <http://www.forgeforward.in/>.

⁹"SINE IIT Bombay," 2018, <http://sineiitb.org/sine/home/>.

¹⁰"CIIE, IIM Ahmedabad," 2018, <http://www.ciie.co/>.

Structure of DIO(iDEX)



Steps of implementation and Responsibility Matrix

S. No.	Activity	DIO(iDEX) team	SHQs	DIO(AC)	HAL / BEL	Innovation Hubs	Remarks
A	Conceptualization and formation of DIO for implementation of DIF						
A1	Preparation and Submission of DIF proposal to MoD (Concept paper, AoA, MoA)				✓		
A2	Approval of DIF proposal		✓				
A3	Obtain approval of boards for incorporation of DIO and fund/grant allocation				✓		
A4	Registration and Incorporation of DIO				✓		
A5	Infusion of initial share capital to DIO				✓		
A6	Constitution of Advisory Committee		✓				
A7	Constitution of Board and Executive Management structure of DIO				✓		
A8	Submission of detailed process flow for implementation of DIF scheme to DIO AC	✓					
A9	Approve DIF scheme process flow with the recommendation of Advisory Committee			✓			
B	Engagement with Defence Innovation Hubs						

S. No.	Activity	DIO(iDEX) team	SHQs	DIO(AC)	HAL / BEL	Innovation Hubs	Remarks
B1	Creation of Technology Platform/Website	✓					
B2	Definition of problem statement and areas of innovation	✓	✓			✓	SHQs will play the primary role in identifying potential topics with help from iDEX. At the same time the Innovation Hubs will also present technologies or products which could be useful for the armed forces
B3	Selection of the topical areas from the list of potential topics identified	✓					
B4	Outreach activities to bring in awareness of the DIF scheme prospective innovators	✓				✓	E.g. Media advertisements, Road shows, Webinars, Seminars, etc.
B5	Call for proposals from prospective innovators through a competitive process like hackathons/challenges, etc.	✓				✓	
B6	Annual review of DIO(iDEX) with high level policy guidance and oversight			✓			
C	Project Management Activities						

S. No.	Activity	DIO(iDEX) team	SHQs	DIO(AC)	HAL / BEL	Innovation Hubs	Remarks
C1	Formation of Technical Screening Committees	✓					Separate Technical Screening Committees envisage for different domains of innovation within iDEX
C2	Receipt of applications (Online)	✓					
C3	Screening of proposals, face to face meetings with applicant innovators and final evaluation	✓					
C4	Short listing of ideas for granting of awards	✓					
C5	Prioritization and approval of ideas	✓					
C6	Approval of the shortlisted ideas for award of grants	✓					
C7	Announcement of shortlisted innovators on Technology Platform	✓					
C8	Signing of an agreement with shortlisted innovators	✓					
C9	Funding of DIO for grants / awards to innovators		✓		✓		HAL, BEL, other DPSUs and GoI. Crowd sourcing iDEX.
C10	Release of first tranche of funds/grants	✓					
D	Review & Monitoring mechanism						

S. No.	Activity	DIO/iDEX team	SHQs	DIO(AC)	HAL / BEL	Innovation Hubs	Remarks
D1	Half yearly/Annual project mentoring/monitoring	✓					iDEX will be assisted by chosen subject matter experts
D2	Submission of project progress report to DIO	✓					iDEX to recommend release of milestone-based grants or short closure of projects.
D3	Facilitating prototyping/piloting of projects with good potential	✓	✓			✓	
D4	Release of subsequent funds/grants as per milestones or short closure of project	✓					
D5	Facilitating scale-up manufacturing and indigenization of relevant projects	✓			✓	✓	
D6	Progress report on projects undertaken to DIO	✓					Posting of the status of projects on Technology Platform
D7	Submission of yearly progress report on implementation of DIF to Advisory Committee	✓					

Recent and historic international efforts to engage with startups and innovators

The concept of a small team, with external support, moving rapid for technological advancement and establishment is not a new one. There are many successful examples of such enterprises globally.

The most recent and relevant defence related illustration of this conceptual framework can be found in the United States of America. The US Secretary of Defense in 2015 realized the dangerous trend of commercial technology severely out-pacing the military and established the **Defense Innovation Unit experimental (DIUx)**¹¹ in the Silicon Valley to counter this. While the initial efforts of this organization were less than spectacular, they were able to adopt the Silicon Valley approach of “Fail fast and recover faster”. Learning from their initial mistakes, this small outfit, headed by a small group of technologists has gone on to give the US military 12 viable projects including autonomous indoor drones to support Special Forces, cyber security software and a novel way for soldiers to communicate over radio without loss of surrounding awareness. The group is known for cutting through the meeting culture of the bureaucracy, having a direct link with the top brass of the US military and having a favourable reputation in the Silicon Valley landscape.

Israel is another prime example of the entrepreneurship model in the defence establishment. An entire defence startup ecosystem exists in the country with the government, the military and the various defence companies and startups being stakeholders of the system. The three largest industrial entities in this ecosystem are the government-owned **Israeli Aerospace Industry**¹², **Israeli Military Industries**¹³ and the **Rafael Arms Development Authority**¹⁴. The **Maf’at**¹⁵, which is a joint administrative body of the **Israeli Ministry of Defense**¹⁶ and **Israel Defense Forces**¹⁷ coordinates between the Israeli MoD, the IDF and the military industries and startups. Israel also has the **Yozma**¹⁸ program, which is a fund of funds to invest in local venture capital funds. The Israeli Defense Forces (IDF) actively encourages innovation in its units. Military veterans of the IDF use their acquired experience to launch their own technology start-ups for defence sector. This essentially form “a feedback loop” in the entire Israeli defence sector.

Two prime examples of IDF divisions known for innovation are -

- **Lotem**¹⁹, which is the IDF’s largest technological unit and provides command and control (C2) systems for the armed forces.

¹¹“DIUx,” 2018, <https://www.diux.mil/>.

¹²“Israeli Aerospace Industry,” 2018, <http://www.iai.co.il/2013/22031-en/homepage.aspx>.

¹³“Israeli Military Industry,” 2018, <http://www.imisystems.com/>.

¹⁴“Rafael Arms Development Authority,” 2006, <http://www.internationalaerospaceindia.com/2006/septem/internationalaerospaceindia6.pdf>.

¹⁵“Maf’at,” 2011, <http://www.israeldefense.co.il/en/content/superpowers'-playing-field>.

¹⁶“Israeli Ministry of Defense,” 2018, <http://www.mod.gov.il/English/Pages/default.aspx>.

¹⁷“Israeli Defence Forces,” 2018, <https://www.idf.il/en/>.

¹⁸“Yozma,” 1993, <http://www.yozma.com/overview/>.

¹⁹“Lotem,” 2017, <https://www.haaretz.com/israel-news/tiny-idf-unit-is-brains-behind-israeli-army-artificial-intelligence-1.5442911>.

- **Unit 8200**²⁰, which provides cybersecurity and intelligence services to the IDF and whose alumni have launched so many startups, that the unit is nicknamed “the startup machine”.

Many defence startups, led by the veterans of these units have thrived and innovated in the Israeli defence ecosystem. Examples include **Team8**²¹, **Elbit Systems**²², **mPrest**²³, **Indegy**²⁴, etc.

Other countries are also wising up to this approach of including small to medium scale innovation in the military industrial complex. The **European Defense Action Plan, 2016**²⁵ lays a sharp focus on engagement with and investment in SME’s, startups and midcaps for the defence industry.

Historically, major defence innovations have been made by small, empowered teams. In 1940, the President of the United States received a plan for National Defense Research Council, which led to the creation of the **MIT Rad Lab**²⁶. This organization was a small research outfit with government support looking into development of technologies for detection of aircraft and ships. Over a period of the next five years, the Rad Lab developed and inducted into the US armed forces, ground breaking technologies like airborne bombing radars, shipboard search radars, harbor and coastal defence radars, gun-laying radars, ground-controlled approach radars for aircraft blind landing, interrogate-friend-or-foe beacon systems, and the long-range navigation (LORAN) system. The outfit is especially credited for the creation of the microwave early-warning (MEW) radars, which saved London from the V-1 threat and the air-to-surface vessel (ASV) radars, which helped protect Allied shipping from the U-boat menace.

The Xerox Corporation in 1970 established a smaller separate innovation center in Palo Alto, California with the aim of revitalizing the company’s product line. This **Xerox PARC**²⁷, as it came to be known became the birthplace of many key modern computing concepts and elements like the GUI with windows and icons, incorporating the mouse as an input device for the GUI, ethernet, the concept of objective oriented programming, etc. In fact, an indirect measure of its achievements came in the form of the number of its employees that were poached by companies like Apple. PARC now functions as a fully formed subsidiary of the Xerox Corporation with about four decades of innovations under its belt.

²⁰“Unit 8200,” 2016, <https://www.forbes.com/sites/richardbehar/2016/05/11/inside-israels-secret-startup-machine/#46a913301a51>.

²¹“Team8,” 2018, <https://www.team8.vc/>.

²²“Elbit Systems,” 2018, <http://elbitsystems.com/>.

²³“mPrest,” 2018, <https://www.mprest.com/>.

²⁴“Indegy,” 2018, <https://www.indegy.com/company/>.

²⁵“European Defence Action Plan,” 2016, http://europa.eu/rapid/press-release_IP-16-4088_en.htm.

²⁶“MIT Radiation Laboratory,” 1990, <https://www.ll.mit.edu/about/History/RadLab.html>.

²⁷“Xerox PARC,” 2018, <http://www.parc.com/about/>.