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# समाचार पत्रों से चयित अंश Newspapers Clippings

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology

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## CONTENTS

S. No.	TITLE	Page No.
<b>DRDO News</b>		<b>1-5</b>
<b>DRDO Technology News</b>		<b>1-5</b>
1.	DRDO & Directorate of Defence R&D, Israel sign Bilateral Innovation Agreement for development of dual use technologies	1
2.	डीआरडीओ और इजराइल के रक्षा अनुसंधान एवं विकास निदेशालय ने दोहरे उपयोग वाली प्रौद्योगिकियों के विकास के लिए द्विपक्षीय नवाचार समझौते पर हस्ताक्षर किए	2
3.	India, Israel to jointly develop dual use tech for defence	3
4.	DRDO inks bilateral agreement with Israel for development of dual-use defence technology	4
5.	Defence Corridor project: Land allotted to Brahmos in Lucknow	5
<b>Defence News</b>		<b>6-20</b>
<b>Defence Strategic: National/International</b>		<b>6-20</b>
6.	Vice Admiral R Hari Kumar to be the next Chief of the Naval Staff	6
7.	Delivery of fourth Scorpene Submarine 'VELA' to Indian Navy	7
8.	भारतीय नौसेना को चौथी स्कॉर्पिन पनडुब्बी 'वेला' सौंपी गई	8
9.	Indian Army signs MOU with Rashtriya Raksha University (RRU)	9
10.	Indian Army signs MOU with Bhaskaracharya National Institute for Space Applications and Geo-Informatics (BISAG-N)	10
11.	भारतीय सेना ने भास्कराचार्य राष्ट्रीय अंतरिक्ष अनुप्रयोग और भू-सूचना संस्थान (बीआईएसएजी-एन) के साथ समझौता ज्ञापन पर हस्ताक्षर किए	11
12.	Monitoring Chinese assets in Indian Ocean Region: Navy Chief	12
13.	Capability development of India's armed forces a national imperative: Naravane	17
14.	Army Chief Gen Naravane holds talks with his Nepalese counterpart	18
15.	With an eye on Indian Ocean, China delivers largest, most advanced warship to Pakistan	19
<b>Science &amp; Technology News</b>		<b>21-26</b>
16.	3D printing nanoresonators: Towards miniaturized and multifunctional sensors	21
17.	How monitoring a quantum Otto engine affects its performance	22
18.	Using new quantum computing architectures to create time crystals	23
<b>COVID-19 Research News</b>		<b>25-26</b>
19.	Antidepressant may prevent severe COVID-19, follow-up study indicates	25



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Ministry of Defence

Tue, 09 Nov 2021 5:12PM

### **DRDO & Directorate of Defence R&D, Israel sign Bilateral Innovation Agreement for development of dual use technologies**

*Key highlights:*

- *Agreement to promote innovation in startups & MSMEs of both countries for development of dual use technologies*
- *Startups & industry to bring out next generation technologies & products in areas such as Drones, Robotics & Artificial Intelligence*
- *Development efforts to be jointly funded by DRDO & DDR&D, Israel*

As a tangible demonstration of the growing Indo–Israeli technological cooperation, Defence Research and Development Organisation (DRDO) and Directorate of Defence Research and Development (DDR&D), Ministry of Defence, Israel have entered into a Bilateral Innovation Agreement (BIA) to promote innovation and accelerated R&D in startups and MSMEs of both countries for the development of dual use technologies. The agreement was signed between Secretary, Department of Defence, R&D & Chairman DRDO Dr G Satheesh Reddy and Head of DDR&D, Israel BG (Retd) Dr Daniel Gold in New Delhi on November 09, 2021.



Under the agreement, startups and industry of both countries will work together to bring out next generation technologies and products in the areas such as Drones, Robotics, Artificial Intelligence, Quantum technology, Photonics, Biosensing, Brain-Machine Interface, Energy Storage, Wearable Devices, Natural Language Processing, etc. Products and technologies will be customised to meet unique requirements of both the countries. The development efforts will be jointly funded by DRDO and DDR&D, Israel. The technologies developed under BIA will be available to both countries for their domestic applications.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1770299>



पत्र सूचना कार्यालय  
भारत सरकार  
रक्षा मंत्रालय

Tue, 09 Nov 2021 5:12PM

## डीआरडीओ और इजराइल के रक्षा अनुसंधान एवं विकास निदेशालय ने दोहरे उपयोग वाली प्रौद्योगिकियों के विकास के लिए द्विपक्षीय नवाचार समझौते पर हस्ताक्षर किए

### प्रमुख बिंदु:

- दोहरे उपयोग वाली प्रौद्योगिकियों के विकास के लिए दोनों देशों के स्टार्ट-अप्स और एमएसएमई में नवाचार को बढ़ावा देने के लिए समझौता
- ड्रोन, रोबोटिक्स और आर्टिफिशियल इंटेलिजेंस जैसे क्षेत्रों में अगली पीढ़ी की तकनीकों और उत्पादों को लाने के लिए स्टार्ट-अप्स और उद्योग काम करेंगे
- डीआरडीओ और इजराइल के डीडीआरएंडडी द्वारा विकास के लिए संयुक्त रूप से वित्त पोषण के प्रयास

भारत और इजरायल के बीच बढ़ती हुई तकनीकी सहयोग के एक ठोस प्रमाण के रूप में, दोहरे उपयोग वाली प्रौद्योगिकियों के विकास के लिए दोनों देशों के स्टार्ट-अप्स व एमएसएमई में नवाचार और त्वरित अनुसंधान एवं विकास को बढ़ावा देने के लिए रक्षा अनुसंधान और विकास संगठन (डीआरडीओ) और इजराइल के रक्षा मंत्रालय के रक्षा अनुसंधान एवं विकास निदेशालय (डीडीआरएंडडी) ने एक द्विपक्षीय नवाचार समझौते (बीआईए) पर हस्ताक्षर किए हैं। 9 नवंबर, 2021 को नई दिल्ली में रक्षा अनुसंधान एवं विकास विभाग के सचिव व डीआरडीओ के अध्यक्ष डॉ. जी सतीश रेड्डी और इजराइल के डीडीआरएंडडी के प्रमुख बीजी (सेवानिवृत्त) डॉ. डैनियल गोल्ड के बीच समझौते पर हस्ताक्षर किए गए।

इस समझौते के तहत, दोनों देशों के स्टार्ट-अप्स और उद्योग अगली पीढ़ी की प्रौद्योगिकियों व उत्पादों को कई क्षेत्रों में लाने के लिए एक साथ मिलकर काम करेंगे। इन क्षेत्रों में ड्रॉन्स, रोबोटिक्स, आर्टिफिशियल इंटेलिजेंस (कृत्रिम बुद्धिमत्ता), क्वांटम टेक्नोलॉजी, फोटोनिक्स, बायो सेंसिंग, ब्रेन-मशीन इंटरफेस, ऊर्जा भंडारण, पहनने योग्य उपकरण और प्राकृतिक भाषा प्रोसेसिंग आदि शामिल हैं। उत्पाद और प्रौद्योगिकियों को दोनों देशों की अद्वितीय जरूरतों को पूरा करने के लिए अनुकूलित किया जाएगा। विकास के लिए इन प्रयासों का वित्त पोषण संयुक्त रूप से डीआरडीओ और इजराइल के डीडीआरएंडडी करेंगे। वहीं, बीआईए के तहत विकसित प्रौद्योगिकियां दोनों देशों को उनके घरेलू अनुप्रयोगों के लिए उपलब्ध होंगी।



<https://pib.gov.in/PressReleasePage.aspx?PRID=1770370>

## India, Israel to jointly develop dual use tech for defence

New Delhi: India and Israel on Tuesday signed a pact aimed at spurring innovation and speeding up the development of dual use technologies by small and medium sized firms in both countries.

India's Defence Research and Development Organisation (DRDO) and Israel's Directorate of Defence Research and Development (DDR&D), have entered into the agreement to promote innovation and accelerated research and development in start-ups and MSMEs of both countries for the advancement of dual use technologies, a statement said.

The signatories of the pact were G Satheesh Reddy, Secretary, Department of Defence, R&D and Chairman DRDO and Daniel Gold, Head of DDR&D, a statement from the Indian defence ministry said.

The agreement – known as the Bilateral Innovation Agreement – will “promote innovation and accelerated R&D in startups and MSMEs of both countries for the development of dual use technologies.”

Under the agreement, start-ups and industry of both countries will work together to bring out next generation technologies and products in the areas such as drones, robotics, artificial intelligence, quantum technology, photonics, biosensing, brain-machine interface, energy storage, wearable devices, natural language processing and others, it said in the statement.

The signing of the pact comes after two high level visits to Israel from India recently. India's foreign minister S Jaishankar had travelled to Israel as had India's defence secretary Ajay Kumar.

The development efforts will be jointly funded by DRDO and DDR&D, Israel. The technologies developed under BIA will be available to both countries for their domestic applications.

The two sides had reviewed the progress made in military engagements including exercises and industry cooperation. (With inputs from agencies)

<https://timesofindia.indiatimes.com/india/india-israel-to-jointly-develop-dual-use-tech-for-defence/articleshow/87610524.cms>



**DRDO signs Bilateral Innovation Agreement with Israel for development of dual-use technologies. (Credits: ANI)**

*Wed, 10 Nov 2021*

## **DRDO inks bilateral agreement with Israel for development of dual-use defence technology**

*The deal was signed to promote innovation and accelerated Research and Development in startups and MSMEs for the development of dual-use technologies.*

*By Anurag Roushan*

On Tuesday, the Indian Defence Research and Development Organisation (DRDO) and Israel's Ministry of Defense's Directorate of Defence Research and Development (DDR&D) have inked a Bilateral Innovation Agreement (BIA) in a bid to promote innovation and accelerated R&D in startups and MSMEs in both countries for the development of dual-use technologies. The deal was inked between Chairman of DRDO Dr G Satheesh Reddy and Head of DDR&D, Israel BG (Retd) Dr Daniel Gold, stated a press release by the Ministry of Defence.



Image: Twitter/@DRDO

Under the terms of the agreement, both countries' startups and industries will collaborate to develop next-generation technology and products in several fields.

These include Robotics, Drones, Quantum technology, Artificial Intelligence, Biosensing, Brain-Machine Interface, Photonics, Energy Storage, Natural Language Processing, Wearable Devices, etc. According to the ministry's release, products and technologies will be tailored to satisfy the pertaining needs of both countries. The development activities will be supported jointly by the DRDO and Israel's DDR&D. Besides, both countries will be permitted to use the technologies developed under BIA for domestic purposes.

### **India-Israel agree to form task force to develop a 10-year strategy**

Meanwhile, on October 29, the Ministry of Defence stated that India and Israel have agreed to form a task force to develop a 10-year strategy for exploring new areas of cooperation. The India-Israel Joint Working Group (JWG) on Bilateral Defense Cooperation held its 15th meeting on October 27 in Tel Aviv. The conference was co-chaired by Dr Ajay Kumar, the Defence Secretary, and Major General (Retired) Amir Eshel, the Director-General of Israel's Ministry of Defense.

It is significant to mention here that with annual military supplies worth around \$1 billion, Israel has been one of India's top four arms suppliers for nearly two decades, along with the US, Russia, and France. The Indian military forces are now receiving the next-generation Barak-8 surface-to-air missile systems as part of three joint DRDO-Israeli Aerospace Industries (IAI) contracts for over Rs 30,000 crore. The Joint Working Group (JWG) is the top committee between India's Ministry of Defence and Israel's Ministry of Defense, tasked with reviewing and guiding all aspects of bilateral defence cooperation. India has previously purchased a range of Israeli weapon systems such as the Phalcon AWACS, Heron, Searcher-II, and Harop drones, as well as Barak anti-missile defence systems and Spyder quick-reaction anti-aircraft missile systems.

(With ANI inputs)

<https://www.republicworld.com/world-news/rest-of-the-world-news/drdo-inks-bilateral-agreement-with-israel-for-development-of-dual-use-defence-technology.html>

## Defence Corridor project: Land allotted to Brahmos in Lucknow

*The Brahmos Aerospace is a joint venture of the Indian and the Russian governments for manufacturing Brahmos missiles*

Lucknow: The state government has allotted land in the state capital to Brahmos Aerospace and in Jhansi to Bharat Dynamics Limited under the Defence Corridor project of the Centre, said UP industrial development minister Satish Mahana in a statement.

The Brahmos Aerospace is a joint venture of the Indian and the Russian governments for manufacturing Brahmos missiles. On the other hand, the Bharat Dynamics Limited is a government of India enterprise which manufactures guided missile system and allied equipment for the armed forces. Both these projects will come up under the Defence Corridor project of the Centre.



The Brahmos Aerospace is a joint venture of the Indian and the Russian governments for manufacturing Brahmos missiles (HT file photo)

“All land in Aligarh node of the Defence Corridor has been allotted to 19 companies,” the minister said. These companies will invest ₹1245.75 crore. In addition to this, Agristo Masa Pvt Ltd will start production at its ₹600 crore food processing unit in Bijnor from March next year.

Mahana also said Pepsico and Britannia had started the process to set up their units. Also, the Hiranandani Group has started the process to set up its data centre in Noida, said the state government.

The Defence Corridor would come up in Bundelkhand region and is expected to generate more than one lakh jobs. The corridor has six nodes, including Aligarh, Agra, Jhansi, Chitrakoot, Kanpur and Lucknow.

On February 21, 2018, PM Narendra Modi had announced ₹20,000 crore Defence Industrial Corridor in Bundelkhand region which is considered as one of the most backward regions in the state. The UP Expressways Industrial Development Authority (UPEIDA) will execute the project.

As the project is aimed at generating more jobs for drought-hit Bundelkhand region, the Yogi government has offered capital subsidy for such industrialists who are willing to invest up to ₹10 crore.

<https://www.hindustantimes.com/cities/lucknow-news/defence-corridor-project-land-allotted-to-brahmos-in-lucknow-101636472708021.html>



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*Tue, 09 Nov 2021 10:30PM*

## **Vice Admiral R Hari Kumar to be the next Chief of the Naval Staff**

The Government have appointed Vice Admiral R Hari Kumar, PVSM, AVSM, VSM, ADC presently Flag Officer Commanding-in-Chief Western Naval Command as the next Chief of the Naval Staff with effect from the afternoon of 30th November 2021. The present Chief of the Naval Staff, Admiral Karambir Singh, PVSM, AVSM, ADC, retires from service on 30th November, 2021.

Born on 12th April, 1962 Vice Admiral R Hari Kumar, PVSM, AVSM, VSM, ADC was commissioned on 1st January, 1983 in to the Executive Branch of the Indian Navy.

During his long and distinguished service spanning nearly 39 years, he has served in a variety of Command, Staff and Instructional appointments. Vice Admiral R. Hari Kumar's Sea Command includes INS Nishank, Missile Corvette, INS Kora and Guided Missile Destroyer INS Ranvir. He also commanded Indian Navy's Aircraft Carrier INS Viraat. He served as Fleet Operations Officer of the Western Fleet. Before taking over as FOC-in-C Western Naval Command, he was Chief of Integrated Defence Staff to the Chairman, Chiefs of Staff Committee.

Vice Admiral R. Hari Kumar has undergone courses at the Naval War College, US, Army War College, Mhow and Royal College of Defence Studies, UK.

Vice Admiral R. Hari Kumar has been decorated with the Param Vishist Seva Medal (PVSM), the AtiVishist Seva Medal (AVSM) and Vishist Seva Medal(VSM)..

<https://pib.gov.in/PressReleasePage.aspx?PRID=1770412>





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*Tue, 09 Nov 2021 5:37PM*

## **Delivery of fourth Scorpene Submarine 'VELA' to Indian Navy**

The fourth submarine of the Project – 75, Yard 11878 was delivered to the Indian Navy today, 09 November 2021. Project – 75 includes construction of six submarines of Scorpene design. These submarines are being constructed at Mazagon Dock Shipbuilders Limited (MDL) Mumbai, under collaboration with M/s Naval Group, France. Christened 'Vela', the submarine was launched on 06 May 19, and has completed all major harbour and sea trials including weapon and sensor trials despite COVID restrictions. Three of these submarines are already in commission with the Indian Navy.

Submarine construction is an intricate activity as the difficulty is compounded when all equipment are required to be miniaturised and are subject to stringent quality requirements. Construction of these submarines in an Indian yard is yet another step towards 'AatmaNirbhar Bharat'.

The submarine would soon be commissioned into the Indian Navy and enhance the Indian Navies capability.



<https://pib.gov.in/PressReleasePage.aspx?PRID=1770323>



पत्र सूचना कार्यालय  
भारत सरकार  
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Tue, 09 Nov 2021 5:37PM

## भारतीय नौसेना को चौथी स्कॉर्पीन पनडुब्बी 'वेला' सौंपी गई

भारतीय नौसेना को परियोजना-75 की चौथी पनडुब्बी, यार्ड 11878 को 09 नवंबर, 2021 को सौंपी गई। परियोजना-75 में स्कॉर्पीन डिजाइन की छह पनडुब्बियों का निर्माण शामिल है। इन पनडुब्बियों का निर्माण फ्रांस के मेसर्स नेवल ग्रुप के सहयोग से मुंबई स्थित मझगांव डॉक शिपबिल्डर्स लिमिटेड (एमडीएल) में किया जा रहा है। 06 मई, 2019 को पनडुब्बी 'वेला' का जलावतरण किया गया था। इसने कोविड प्रतिबंधों के बावजूद हथियार और सेंसर परीक्षणों सहित सभी प्रमुख पत्तन और समुद्री परीक्षणों को पूरा कर लिया है। इन पनडुब्बियों में से तीन पहले से ही भारतीय नौसेना के अभियान में शामिल हैं।

पनडुब्बी निर्माण एक जटिल गतिविधि है, क्योंकि सख्त गुणवत्ता की जरूरत वाले सभी उपकरणों को छोटा करने की आवश्यकता होती है। इससे पनडुब्बी निर्माण में कठिनाइयां बढ़ जाती हैं। एक भारतीय यार्ड में इन पनडुब्बियों का निर्माण 'आत्मनिर्भर भारत' की दिशा में एक और कदम है।

जल्द ही इस पनडुब्बी को भारतीय नौसेना में शामिल किया जाएगा व भारतीय नौसेना की क्षमता को और बढ़ाया जाएगा।



<https://pib.gov.in/PressReleasePage.aspx?PRID=1770375>



## Indian Army signs MOU with Rashtriya Raksha University (RRU)

During a brief ceremony conducted at Rashtriya Raksha University (RRU), Gandhinagar on 09 November 2021, Indian Army entered into a Memorandum of Understanding with Rashtriya Raksha University (RRU) to synergise innovations, research, technology incubation, joint projects, publication & patents, training, higher learning and distance education in the Army.

Rashtriya Raksha University (RRU) is an Institute of National importance established under the Ministry of Home Affairs, Govt of India. RRU is committed to identify, prepare and sustain statecraft of national, strategic and security culture through continuous enhancement and development of innovation, education, research and training cadres from the security, military and civilian society.

General MM Naravane, COAS addressed the gathering through virtual platform in which he emphasised that signing of this MoU is a path breaking initiative towards enhancing the interaction of Indian Army with academia. Army Chief highlighted that the demands of future warfare mandates Indian Army officers and men to be educated in niche domains of warfare to include Artificial Intelligence, Machine Learning, Data Science, Cyber warfare, robotics and aerospace that have potential military applications and a disruptive impact on modern-day warfare.

The event was presided over by Lt Gen Raj Shukla, GOC-in-C Army Training Command. He stressed that this is a step towards strengthening the linkages between academia and the Indian Military. He laid specific emphasis on 'Civil-Military Relations', and expounded multifaceted aspects pertaining to mutual cooperation.

Prof. (Dr.) Bimal N. Patel, Vice Chancellor, RRU underlined that RRU is a model security of India and an institute of national importance. The university will focus on meeting specific requirements of Indian Army in emerging and contemporary technologies in the field of Artificial Intelligence, disruptive military technologies, cyber and information warfare, aerospace capabilities and will provide certification for the institutionalised training undertaken at this institute. 'Chanakya' a biannual publication of RRU on National Security was also launched during the event.

The landmark MoU will facilitate and strengthen institutional cooperation between the Centre of Excellence and the Indian Army towards strategising and implementing programmes pertaining to training, research and capability development.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1770292>





Tue, 09 Nov 2021 5:01PM

## Indian Army signs MOU with Bhaskaracharya National Institute for Space Applications and Geo-Informatics (BISAG-N)

The Indian Army has inked a Memorandum of Understanding with the Bhaskaracharya National Institute for Space Applications and Geo-Informatics (BISAG-N), Gandhinagar, Gujarat. This MoU will facilitate exchange of knowledge and collaboration in the fields emerging technologies for development of GIS and IT based Enterprise Resource Planning Software, Training Content, Telecasting of Audio-Visual Content, Research and Knowledge Partnership, Technical Support and Upgradation for Resources Developed under a holistic partnership for projects which have the prior approval of Army Management Studies Board (AMSB) or approved on case-to-case basis. The MOU will leverage the relative advantage of BISAG-N to support training and evolving innovative solutions to boost operational capabilities of the Indian Armed Forces.

BISAG-N which is an autonomous scientific society under the Ministry of Electronics and Information Technology, Government of India will act as a medium of exchange of knowledge and collaboration in the fields of emerging technologies.

General MM Naravane, COAS addressed the gathering through virtual platform in which he emphasized that signing of this MoU is a path breaking initiative towards enhancing the interaction of Indian Army with academia. The Army Chief stated that 'Atmanirbharta' is the key to staying ahead of technological curve over our adversaries for which the Learning Management System projects for Map Reading, IT training and Geo-spatial Information system with BISAG-N are a great beginning in which the joint collaboration is already showing a promising beginning.

The event was presided over by Lt Gen Raj Shukla, GOC-in-C Army Training Command. He stressed that this is a step towards strengthening the linkages between academia and the Indian Military. He laid specific emphasis on 'Civil-Military Relations', and expounded multifaceted aspects pertaining to mutual cooperation. These MoUs will act as catalyst and enabler for orienting academia towards strengthening the nation's defence and capability enhancement.

Shri T. P. Singh, DG, BISAG-N, highlighted that with signing of this MoU, BISAG-N will act as a medium of exchange of knowledge and collaboration in the fields of emerging technology for development of GIS and IT based software, generation of customised training content, telecasting audio-visual training content, develop specific projects required by Indian Army in the fields of IT and AI. BISAG-N dedicated the Learning Management System (LMS) developed for ARTRAC and its affiliated institutes, during the event.

The landmark MoU will facilitate and strengthen institutional cooperation between the Indian Army and BISAG-N towards strategising and implementing programmes pertaining to training, research and capability development.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1770294>





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## भारतीय सेना ने भास्कराचार्य राष्ट्रीय अंतरिक्ष अनुप्रयोग और भू-सूचना संस्थान (बीआईएसएजी-एन) के साथ समझौता ज्ञापन पर हस्ताक्षर किए

भारतीय सेना ने गुजरात में गांधीनगर के भास्कराचार्य राष्ट्रीय अंतरिक्ष अनुप्रयोग और भू-सूचना संस्थान (बीआईएसएजी-एन) के साथ एक समझौता ज्ञापन पर हस्ताक्षर किए हैं। यह समझौता ज्ञापन भौगोलिक सूचना प्रणाली-जीआईएस और सूचना प्रौद्योगिकी- आईटी आधारित उद्यम संसाधन योजना सॉफ्टवेयर, प्रशिक्षण सामग्री, ऑडियो-विजुअल सामग्री का प्रसारण, अनुसंधान एवं ज्ञान भागीदारी, तकनीकी सहायता में विकास तथा एक समग्र साझेदारी के तहत विकसित संसाधनों के उन्नयन के लिए उभरती प्रौद्योगिकियों के क्षेत्र में ज्ञान और सहयोग के आदान-प्रदान की सुविधा प्रदान करेगा। यह उन परियोजनाओं के लिए सहायक है, जिन्हें समग्र भागीदारी के अंतर्गत सेना प्रबंधन अध्ययन बोर्ड (एएमएसबी) की पूर्व स्वीकृति प्राप्त है या जो स्थितियों व मामलों के आधार पर अनुमोदित हैं। यह समझौता ज्ञापन भारतीय सशस्त्र बलों की परिचालन क्षमताओं में वृद्धि करने के लिए प्रशिक्षण में सहायता पहुंचाने और अभिनव समाधान विकसित करने हेतु बीआईएसएजी-एन के सापेक्ष अनुकूल परिस्थिति में अवसरों का लाभ उठाने में मदद करेगा।

बीआईएसएजी-एन भारत सरकार के इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय के तहत कार्यरत एक स्वायत्त वैज्ञानिक संस्था है, जो उभरती हुई प्रौद्योगिकियों के क्षेत्र में ज्ञान के आदान-प्रदान और सहयोग के माध्यम के रूप में कार्य करेगा।

थल सेना प्रमुख- सीओएस जनरल एमएम नरवणे ने वर्चुअल प्लेटफॉर्म के माध्यम से कार्यक्रम को संबोधित किया, जिसमें उन्होंने इस बात पर जोर दिया कि इस समझौता ज्ञापन पर हस्ताक्षर करना भारतीय सेना की शिक्षाविदों के साथ संपर्क बढ़ाने की दिशा में एक महत्वपूर्ण पहल है। सेना प्रमुख ने कहा कि 'आत्मनिर्भरता' हमारे विरोधियों से तकनीकी क्षेत्र में आगे बने रहने की कुंजी है, जिसके लिए बीआईएसएजी-एन के साथ मानचित्र को पढ़ने व समझने, सूचना प्रौद्योगिकी प्रशिक्षण और भू-स्थानिक सूचना प्रणाली के लिए लर्निंग मैनेजमेंट सिस्टम परियोजनाएं उत्कृष्ट शुरुआत हैं, जिसमें संयुक्त सहयोग पहले से ही एक आशाजनक शुरुआत को दिखा रहा है।

इस कार्यक्रम की अध्यक्षता सेना प्रशिक्षण कमान के जीओसी-इन-सी लेफ्टिनेंट जनरल राज शुक्ला ने की। उन्होंने जोर देकर कहा कि यह शिक्षा जगत और भारतीय सेना के बीच संबंधों को मजबूत करने की दिशा में एक महत्वपूर्ण कदम है। उन्होंने 'नागरिक-सैन्य संबंधों' पर विशेष जोर दिया तथा आपसी सहयोग से संबंधित बहुआयामी पहलुओं की व्याख्या की। ये समझौता ज्ञापन देश की रक्षा एवं क्षमता वृद्धि को मजबूत करने के क्षेत्र में शिक्षाविदों को उन्मुख करने के लिए उत्प्रेरक तथा प्रवर्तक के रूप में कार्य करेंगे।

बीआईएसएजी-एन के महानिदेशक श्री टी.पी. सिंह ने इस बात का जिक्र किया कि इस समझौता ज्ञापन पर हस्ताक्षर होने से बीआईएसएजी-एन भौगोलिक सूचना प्रणाली- जीआईएस और सूचना प्रौद्योगिकी- आईटी आधारित सॉफ्टवेयर के विकास के लिए उभरती प्रौद्योगिकी के क्षेत्र में ज्ञान के आदान-प्रदान तथा सहयोग के माध्यम के रूप में कार्य करेगा। जिसमें प्रशिक्षण सामग्री, श्रव्य-दृश्य प्रशिक्षण सामग्री का प्रसारण, सूचना प्रौद्योगिकी और कृत्रिम बुद्धिमत्ता के क्षेत्र में भारतीय सेना द्वारा आवश्यक विशिष्ट परियोजनाओं का विकास करना शामिल है। कार्यक्रम के दौरान बीआईएसएजी-एन ने एआरटीआरएसी और उससे संबद्ध संस्थानों के लिए विकसित लर्निंग मैनेजमेंट सिस्टम (एलएमएस) को समर्पित किया।

यह ऐतिहासिक समझौता ज्ञापन भारतीय सेना और बीआईएसएजी-एन के बीच प्रशिक्षण, अनुसंधान एवं क्षमता विकास से संबंधित कार्यक्रमों की रणनीति बनाने तथा उन्हें लागू करने की दिशा में संस्थागत सहयोग को सुगम व मजबूत करेगा।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1770377>



## Monitoring Chinese assets in Indian Ocean Region: Navy Chief

*There is a need to differentiate between Malabar exercise and Quad, says Admiral Karambir Singh*

*By Dinakar Peri*

Dona Paula (Goa): Chief of the Naval Staff Admiral Karambir Singh said the Navy was monitoring the Chinese naval and maritime assets deployed in the Indian Ocean Region (IOR) for any activities “inimical to our interests”.

In an exclusive conversation with *The Hindu* on the sidelines of the Goa Maritime Conclave (GMC), Admiral Singh spoke on issues across the maritime domain covering increasing cooperation in the IOR to tackle non-traditional threats, efforts for information exchange and capacity-building, Malabar exercise, Quad grouping, China’s growing presence in the IOR, naval modernisation among others.

The third edition of GMC 2021, being hosted by the Indian Navy, has the participation of Navy Chiefs and heads of maritime forces from 12 Indian Ocean nations.

*Full text of the interview:*

**‘Goa Maritime Conclave for looking at common challenges and forging tangible solutions to key issues’**

**The GMC has grown as a platform. In the backdrop of developments in the region what is the focus of this edition? What are the outcomes you are looking at going forward?**

The aim of the conclave is to bring together a smaller group of navies in the immediate neighbourhood, look at the common challenges that we face, and forge tangible solutions to key issues. We bring together practitioners and scholars to discuss these challenges. Thereafter, we have an exclusive session wherein the naval heads will discuss one-on-one the way forward to these challenges. This year, the theme is ‘Maritime Security and Emerging Non Traditional Threats: The Case for Proactive Role for Indian Ocean Region Navies’. We will examine information sharing, hydrographic cooperation, maritime law enforcement, training, opportunities in disaster response, crisis management etc. Each GMC is followed by a Goa Maritime Symposium (GMS). During the GMS, we follow up discussions that have happened during the GMC and work to bring them to fruition through an action plan that will be presented back again to the heads of navies. And since we are a smaller grouping, it will be easier for us to do that.

**So in the four years so far, what have been the outcomes?**

Some of the outcomes feed into certain other constructs such as the Colombo Security Conclave. Focused Operations is another outcome we are looking at. So, there have been outcomes which have come through. It has also given us greater visibility on some issues like Information Fusion Centre for Indian Ocean Region (IFC-IOR), wherein we have now got better participation from the countries around us.

**How do you see the Indo-Pacific architecture shaping up in the backdrop of recent developments and how do you see the GMC plugging into it?**

The general idea, whether it is Indo-Pacific or the GMC, is that we have to keep our seas open. Seas permit free flow of commerce and ideas. Ideas, because 99% of our communications are running through undersea cables, and commerce, because 90% of our trade is through the seas, is 70% by value and 90% by volume. If you look at the Indo-Pacific, it’s basically a maritime orientation and that’s why we hear words like free, open, inclusive, because seas connect, they don’t divide. The constructs of Indo-Pacific or the GMC are all meant to handle the challenges

together, so that we keep the seas free, open and inclusive, for free flow of commerce and ideas, and finally leading to the prosperity of the citizens of our countries.

As far as Indo-Pacific is concerned, there are several articulations by various countries, but I quite like the articulation by India. Initially, it was based on what the Prime Minister said during the Shangri La dialogue. Thereafter, we actually brought it to a much more firm footing by articulating the Indo-Pacific Oceans Initiative (IPOI), which is based on seven pillars - Maritime Security, Ecology, Maritime Resources, Capacity Building, Disaster Risk Reduction, Trade and Connectivity. Thus all issues that are linked to the prosperity of the region, and they are all being put together under this construct.

**Addressing GMC 2019, National Security Adviser (NSA) Ajit Doval had offered India's facilities to littoral states for information sharing as well as offered assistance in capacity-building. How has that progressed?**

What the NSA has mentioned has been a very important line of effort that the Navy has adopted, and we are working hard on both these fronts, information exchange and capacity-building. As far as information sharing is concerned, building a comprehensive Maritime Domain Awareness (MDA) is a focus area for us. Because information leads to awareness and awareness leads to understanding. It's very important considering the expanse of the IOR and the limited resources that we have. In this endeavour, the IFC-IOR was launched in December 2018. The aim was to pool information and promote maritime security and safety in the region. We already have nine International Liaison Officers who have joined since the last edition of the GMC and three more would be joining very shortly. We also got the Cabinet Committee on Security (CCS) mandate for white shipping agreements with 36 countries, of which 22 have been already concluded. Aim is to progress the white shipping information exchange with remaining countries, and as we build more trust, to get into exchange of information on Vessels of Interest and Dark Shipping etc. That is as far as information sharing is concerned. As far as capacity enhancement is concerned, India has been firmly engaged with its neighbours and we've been forward leaning as a country. You are aware that we work with several countries in terms of capacity-building. The advantage we have of geographic location is used to offer capacities to neighbours to take on repair and refit of these platforms. We also send mobile training teams in order to keep these platforms operational.

And the whole aim is to not only to have capacity, but something we call 'Collective Maritime Competence'. Each country around us has expertise in something that they can bring to the table, whether it is their geographic location or expertise in a particular area. Our aim is to work together and build this collective maritime competence so that we can handle all the challenges in our region together.

**Of late you had referred to joint development of capacities with neighbouring countries. What is the status and what is interest to it from the littoral states, who are part of the GMC?**

We've been working towards it and it is being discussed within the Government of India and we hope to find an answer to this. We have the Navy's design Directorate since 1964 and have good competence in designing ships of various tonnages and requirements and we are keen to share the expertise. There have been teams which have visited the Directorate of Naval Design. We've got an MoU for instance, between the GRSE and Khulna shipyard (Bangladesh) for joint development and production of ships.

**What were the top challenges during your tenure at the helm? Since the developments in Afghanistan, there have been apprehensions of possible smuggling of weapons via the sea route in addition to narcotics. What is your assessment?**

Narco-terrorism is a real threat that we envisage. There is a connection between drug trafficking and arms trafficking. Organisations like ISIS Khorasan depend a fair amount on the money that they make out of drugs. We have intelligence that indicates that there is a flow of drugs from the Makran coast, down to the East coast of Africa from where it moves to the island nations, which are tourism dependent economies, and then to Sri Lanka and India and also across the world. This is a threat that we are aware of, and we have initiatives such as the Colombo Security Conclave,

wherein we want to do certain Focused Operations with countries that are affected by challenges such as drug trafficking to put an end to this scourge.

**Is there any assessment on arms flowing out of Afghanistan?**

There isn't any specific intelligence but there is a known linkage between drug trafficking and arms trafficking.

**What is your assessment of the concept of Mission Based Deployments (MBD) that began five years back?**

Mission Based Deployments, which started in 2017, have been of significant utility to us. First, when ships are on regular deployment in key areas in the IOR, they increase their familiarity with the area of operation. We are also available for response in any situation. For instance when cyclone Idai hit Mozambique, our ships were at hand. They all carry Humanitarian Assistance and Disaster Relief (HADR) bricks, and were immediately deployed to provide assistance and succour. Next year, in Madagascar, we had a similar situation, our ships on MBD were available. So, that establishes our credibility and assures friendly nations that we are ready to assist anytime.

Also, when we talk of our endeavour to be a Preferred Security Partner, we have to be around to come to assistance, or to understand the area. MBD has actually transformed the Navy from a deployment-ready Navy to a deployed Navy. The intention is to continue with this particular method of deployment.

**Any changes you are looking at in MBDs?**

We are constantly analysing the gains that we make in various areas and what are the challenges being faced. For example, when we realise that there is a problem or danger to our shipping in the Straits of Hormuz... 60% of our crude comes from the Gulf, 50% of our oil comes from the Gulf, we have a diaspora of approximately 8 million people, we have remittances up to \$40 bn coming from there, a large amount of shipping is passing through, carrying resources. If the problems get worse and our shipping gets effected, there is an associated problem of insurance. A \$1 increase in per barrel cost of crude insurance drains our Exchequer by about ₹10,000 crore. We realised that and promptly deployed our ships on Op Sankalp which is also a mission based deployment to provide some kind of assurance to our ships coming through that area. That's how we constantly re-evaluate based on the threats and based on our understanding of the area. MBDs are not static in one place, they are constantly analysed and reviewed.

**What is the way forward for Quad as well the Malabar exercise, given the growing interest in the region?**

I think we need to differentiate Malabar and Quad. Malabar precedes Quad. It was in 1992 that we started Malabar with the U.S. Navy and thereafter, it has grown over a period of time to include Japan and Australia. What we are achieving in Malabar is that we are continuously increasing the scope and complexity of the exercise so that we are able to seamlessly operate with each other. And if required, for any contingency or any challenge. we can easily come in a plug and play format and operate.

As for Quad, it is basically a Ministry of External Affairs' (MEA) construct. It has again grown organically based on the challenges. It started with secretary-level talks then ministerial level talks, then moved to videoconferencing between heads of state and recently we had all the heads of state meeting face to face. So they are engaged in a construct, which is responding to challenges like climate change, critical infrastructure and supply chain resilience. So these two, I think. need to be envisioned at different levels.

**Do you see Malabar expanding in the near future, given the interest from so many countries?**

It's a decision of the government.



**India has signed all the foundational agreements with the U.S. and logistics support agreements with several countries, including Australia and Japan. How has the Navy benefited from these agreements?**

These are all important agreements that we've signed. When we sign these agreements, say LEMOA (Logistics Exchange Memorandum of Agreement), and our ships are deployed off Guam, we are able to take fuel from their tankers. Or when we are operating off Australia we will be able to take fuel from their tanker. The main thing that navies require is 'Reach and Sustainance'. These are two very important principles on which any Navy operates. The agreements that we have, including foundational agreements, have helped us in being able to achieve this 'Reach and Sustainance', which is very important for us.

**There is huge interest in trilaterals and minilaterals with the Indian Navy. How are you prioritising it and what are the major ones that are in the pipeline?**

We would like to engage with more like-minded navies who agree with us on the requirement for a free, open and inclusive Indo-Pacific region. When I say inclusive, it means everybody is in it and it's not a prohibitive or elitist. There will be different kinds of formats -bilateral, trilateral or multilateral. We are doing trilateral now with Singapore and Thailand and a trilateral construct with Australia and Indonesia is being worked upon. So we are open to different formats as long as the intent is to reach the common vision of being a free, open and inclusive Indo-Pacific.

**In addition to increased forays into the IOR, PLA Navy now has a base in Djibouti and are building ships faster than anyone else. In this backdrop, how are you prioritising your modernisation as well as operational philosophy?**

As a Navy, we are monitoring the Chinese Navy and Chinese maritime assets that are deployed in the IOR, including Chinese research vessels to watch out for any activities inimical to our interests. It is true that the Chinese have a presence in the IOR. And whatever you said, bases and presence is a fact.

**And how are you prioritising your force modernisation, given the rapid force accretion by PLA Navy?**

We have the Maritime Capability Perspective Plan (MCPPE). We are focusing on acquisition of capability to protect our national interests in the maritime domain. That is balanced against the budget and other issues such as indigenous production. We have to intelligently use our money, so that we are able to have effective capability to protect our national interests. Here, we are focusing a lot on issues like unmanned systems, force multipliers, networking and all technologies that sort of enable these particular force multipliers. That is the way to go, given the budgetary constraints that we have and the realities that we face.

**Is there any revision of your current plan given recent developments?**

There has been some change now in the MCPPE with the Department of Military Affairs (DMA) coming in, who are looking into the joint aspects. There is now the Integrated Capability Development Plan (ICDP). They are doing a proper assessment of the security scenario, where we want to head in the future and the capabilities required by the three Services. Based on it the MCPPE will flow from the ICDP. The process is underway. It should be done in 3-5 months.

**The submarine arm of the Navy is a matter of concern with series of delays in modernisation. What are the immediate steps the Navy is looking at to address the dwindling fleet?**

We have the 30-year submarine programme and in that the Project-75 is now moving on track. We will commission the fourth Scorpene submarine *Vela* by month-end. And thereafter, in short succession, the fifth and sixth Scorpene will join. They bring with them quite a good capability, a modern submarine with good armament. Meanwhile, the SSKs - 209s (German HDWs) and EKMs (Russian Kilo) are being put through the Medium Refit Life Certification (MRLC) process which will give them an additional life of 10 to 15 years. For Project-75I, we have issued the Request For Proposal (RFP) and not in a decade and a half, but well before that, we will start constructing very

modern submarines. This is going to be maybe the last time that we will take any outside assistance; henceforth we will design and build our own submarines.

**There was a plan for a Project-76 to build an indigenous conventional submarine based on the learning from Project 75 and 75I. Is that still on board?**

Yes, that should be the next logical step.

**The Navy recently unveiled the unmanned road map. Can you give the salient features of it and how it fits in your long-term planning?**

Unmanned is definitely the future. Of course, there will be a transition phase where we will first shift from manned to optimally manned, then a manned-unmanned hybrid kind of concept and then in certain disciplines, we will move to fully unmanned. The road map is actually talking about that - how the phased transition is going to be, both in size and the degree of autonomy. This unmanned is very intimately wedded to the Indian Navy's concept of operations and most importantly, we have looked at how we balance this fleet of manned and unmanned, including manned unmanned teaming. Thereafter, we also looked at what are the Technology Readiness Levels (TRL) because it's not just the platform, but unmanned systems will have to be part of the entire philosophy of operations. So they require a certain enabling system. The road map has also looked at the present TRL levels in the country, see if we require technology infusion from abroad and where do we get the technology which is already resident. Timelines are mentioned for each activity, and a plan of action has been mentioned.

I want to tell you that the road map is already underway. We are very heartened to note that a lot of start-ups in the country have a tremendous amount of capability. And as we move around and interact with more of them, it gives us a lot of hope that we'll be able to transition in fairly quick time, which is much cheaper, inexpensive, and it is capable of doing the four Ds. - Dirty, Dull, Dear and Dangerous.

**Has the Navy finalised the contours of the second Indigenous Aircraft Carrier (IAC-II)? When do you expect to approach the government for a formal sanction?**

Our thinking caps are constantly on as to how we want the configuration, because in the Navy, planning is long term. There are several options, like a 65,000 tonne electric propelled IAC, which would have a combination of manned aircraft and unmanned aircraft. So there are various combinations on the table, which we are discussing before we go in for Acceptance of Necessity (AoN) of IAC-II. The heartening part is that Cochin Shipyard Limited (CSL) built the *Vikrant* and has performed exceedingly well. So, we now have the capability to build carriers up to 65,000 tonnes within the country. Once we firm up on this, we will go to the government. So, there is constant thinking on how we can get the best value for money and future proof our platforms.

**Any road map for developing the islands especially the Andaman and Nicobar chain?**

Islands like the Andaman and Nicobar give us much strategic reach. And they are capable of acting as a springboard for operations when required and, therefore, infrastructure development in these islands is a prime focus. We have been working at it for sometime and we've got plans to develop these islands for air operations and for operational turnaround facilities of our ships and submarines.

<https://www.thehindu.com/news/national/interview-with-chief-of-the-naval-staff-admiral-karambir-singh/article37396255.ece>

## Capability development of India's armed forces a national imperative: Naravane

*At the event, the Army Training Command (ARTRAC) entered into a Memorandum of Understanding (MoU) with Gandhinagar-based Rashtriya Raksha University (RRU) and Bhaskaracharya National Institute of Space Applications and Geo-Informatics (BISAG-N).*

With disputed borders in the North and East, capability development of India's armed forces remains a national imperative, said Chief of Army Staff General MM Naravane on Tuesday.

Virtually addressing an event at the Rashtriya Raksha University campus near Dahegam, Naravane said, "Disruptive technologies are transforming the character of modern world, faster than ever before. We have seen the impact of these technologies in the recent conflicts around the world. Given our active borders and disputed borders in the North and East with our two neighbours, capability development remains a national imperative."

At the event, the Army Training Command (ARTRAC) entered into a Memorandum of Understanding (MoU) with Gandhinagar-based Rashtriya Raksha University (RRU) and Bhaskaracharya National Institute of Space Applications and Geo-Informatics (BISAG-N).

"Dependence for niche technologies on other countries creates significant vulnerability, especially in times of conflict," the Army chief said adding that Indian Army's collaboration with BISAG-N will go a long way to address these challenges by developing "in-house" solutions.

"The signing of two MoUs with Rashtriya Raksha University and BISAG-N is a landmark occasion for the Indian Army..." General Naravane said.

As per the MoU, the university will focus on meeting specific requirements of the Indian Army in emerging contemporary technologies in the field of artificial intelligence, disruptive military technologies, cyber and information warfare, air and space capabilities and will provide certification for all training undertaken at the institute.

Meanwhile, BISAG-N will develop specific projects required by the Indian Army in fields of information technology and artificial intelligence and help generate customised training content, telecasting audio-visual training content, among others.

Lieutenant General Raj Shukla, General Officer Commanding-in-Chief (GOC-in-C) of ARTRAC, who presided over the event emphasised the need for civil-military fusion. "The domain of national security is increasingly one of great complexity, growing sophistication and humongous change," he said.

Talking about importance of Artificial Intelligence and China's recent testing of hypersonic missiles, Lieutenant General Shukla said, "Today if you have a hypersonic missile with speeds of Mach 7-20, the responses to these missiles, either in terms of missile defence or interception, cannot be at the rate of human reaction. The responses have to be at the rate of machine level. So unless the Indian Army embraces artificial intelligence and the entire gamut of relative technologies, our responses will be feeble."

Adding ARTRAC has outstanding success with start-up firms, he said, "In the past two years, the Indian Army, more particularly ARTRAC, has invested close to Rs 260 crore to drive technological endeavours. Within nine months, we developed swarm drones with combat potential."

RRU vice-chancellor Dr Bimal Patel and Director General of BISAG-N, TP Singh, were also present.

<https://indianexpress.com/article/cities/ahmedabad/capability-development-of-indias-armed-forces-a-national-imperative-naravane-7615008/lite/>

## Army Chief Gen Naravane holds talks with his Nepalese counterpart

New Delhi: Army chief Gen MM Naravane on Tuesday held extensive talks with his Nepalese counterpart Gen Prabhu Ram Sharma, focusing on ways to expand bilateral military cooperation in the backdrop of evolving security scenario in the region.

Gen Sharma's four-day visit to India comes amid increasing concerns over the possible impact of the Taliban's takeover of Afghanistan on the regional security scenario.

Officials said Gen Naravane and Gen Sharma exchanged views on further strengthening defence cooperation between the two countries besides deliberating on the regional security scenario.

Ahead of the talks, the Nepalese Army Chief laid a wreath at the National War Memorial.

He was also given a Guard of Honour at the South Block lawns.

Gen Sharma also separately met Defence Secretary Ajay Kumar and Chief of Air Staff Air Chief Marshal VR Chaudhari with a broad focus on further boosting bilateral defence cooperation, the officials said.

The Indian Air Force tweeted that issues of mutual interest and ways to enhance avenues for bilateral defence cooperation were discussed by the two chiefs.

In continuation of an age-old tradition that started in 1950, Gen Sharma is set to be conferred with the honorary rank of 'General of the Indian Army'.

Nepal conferred the honorary rank of 'General of Nepal Army' to Gen Naravane during his visit to Kathmandu in November last year.

Nepal is important for India in the context of its overall strategic interests in the region, and leaders of the two countries have often noted the age-old "Roti Beti" relationship.

Land-locked Nepal relies heavily on India for the transportation of goods and services. Nepal's access to the sea is through India, and it imports a predominant proportion of its requirements from and through India.

<https://timesofindia.indiatimes.com/india/army-chief-gen-naravane-holds-talks-with-his-nepalese-counterpart/articleshow/87612585.cms>



## With an eye on Indian Ocean, China delivers largest, most advanced warship to Pakistan

Beijing: China has delivered its largest and most advanced warship to Pakistan as it seeks to beef up the navy of its all-weather ally in the Arabian Sea and the Indian Ocean, where it has increased its own naval presence in recent years.

Designed and built by China State Shipbuilding Corporation Limited (CSSC), the frigate was delivered to the Pakistan Navy in a commissioning ceremony in Shanghai, the CSSC announced in a statement on Monday.

The Type 054A/P frigate was named the PNS Tughril, state-run Global Times reported on Tuesday.



Image is for representative purpose only.

Pakistani ambassador to China Moin ul Haque said that the commissioning of the PNS Tughril ensures balance of power in the Indian Ocean.

In the context of the overall security paradigm of the region, Tughril-class frigates will strengthen Pakistan Navy's capabilities to respond to maritime challenges to ensure seaward defence, maintain peace, stability and balance of power in the Indian Ocean region, he said, according to the Global Times report.

The PNS Tughril is the first hull of four Type 054 frigates being constructed for the Pakistan Navy and the vessel is a technologically advanced and highly capable platform with enormous surface-to-surface, surface-to-air and underwater firepower, besides extensive surveillance potentials, the daily quoted a Pakistan Navy's statement.

Being equipped with state-of-the-art combat management and an electronic warfare system along with modern self-defence capabilities, the Type 054A/P frigate can simultaneously execute a number of naval warfare missions in a highly intense multi-threat environment, it said.

The frigate is the largest and most advanced warship China has ever exported, CSSC said.

China which shares all-weather strategic ties with Pakistan has emerged as the biggest weapons supplier for the Pakistani military. Besides the advanced naval ships, China also partners with the Pakistan Air Force to build JF-17 Thunder fighter aircraft.

Observers say the military cooperation in recent years focussed more on the as China gradually stepped up its naval presence in India's backyard, the Indian Ocean.

Besides building its first military base in Djibouti in the Horn of Africa in the Indian Ocean, China has acquired Pakistan's Gwadar port in the Arabian Sea which connects with China's Xinjiang province by land in the USD 60 billion China Pakistan Economic Corridor (CPEC).

China is also developing Sri Lanka's Hambantota port after it acquired it on 99 years' lease.

The modernisation of the Pakistan Navy coupled with the acquisition of the naval bases was expected to shore up the Chinese Navy's presence in the Indian Ocean and the Arabian Sea.

Besides acquiring four modern naval frigates from China, Pakistan will also be getting eight Chinese submarines as part of the modernisation of Pakistan Navy, its Chief Admiral M Amjad Khan Niazi told the daily in February this year.

The Pakistan Navy has contracted the construction of four Type 054A/P frigates from China since 2017.

The head of the Pakistan Navy Mission overseeing construction of the 054A/P frigate, Commodore Rashid Mehmood Sheikh, said that the PNS Tughril, being a multi-mission capable frigate, will form the mainstay of the Pakistan Navy fleet while bolstering the Pakistan Navy's maritime defence capabilities.

Zhang Junshe, a senior research fellow at the PLA Naval Research Academy, told the Global Times earlier that Type 054A, on which the Type 054A/P is based, is China's most advanced frigate.

Compared to previous Chinese frigates, the new ship has better air defence capability, as it is equipped with an improved radar system and a larger number of missiles with a longer range, Zhang said, noting that the Type 054A frigate also has world-class stealth capability.

<https://timesofindia.indiatimes.com/world/pakistan/with-an-eye-on-indian-ocean-china-delivers-largest-most-advanced-warship-to-pakistan/articleshow/87603380.cms>

## 3D printing nanoresonators: Towards miniaturized and multifunctional sensors

Micro-electro-mechanical devices (MEMS) are based on the integration of mechanical and electrical components on a micrometer scale. We all use them continuously in our everyday life: For example, in our mobile phones there are at least a dozen MEMS that regulate different activities ranging from motion, position, and inclination monitoring of the phone; active filters for the different transmission bands, and the microphone itself.

Even more interesting is the extreme nanoscale miniaturization of these devices (NEMS), because it offers the possibility of creating inertial, mass and force sensors with such sensitivity that they can interact with single molecules.

However, the diffusion of NEMS sensors is still limited by the high manufacturing cost of traditional silicon-based technologies. Conversely, new technologies such as 3D printing have shown that similar structures can be created at low cost and with interesting intrinsic functionalities, but to date the performance as mass sensors are poor.

The article "Reaching silicon-based NEMS performances with 3D printer nanomechanical resonators" published in *Nature Communications* shows how it is possible to obtain mechanical nanoresonators from 3D printing with figures of merit such as quality factor, published stability, mass sensitivity and strength comparable to those of silicon resonators. The research is the result of the collaboration between the Politecnico di Torino (Stefano Stassi and Carlo Ricciardi from the Department of Applied Science and Technology; and Mauro Tortello and Fabrizio Pirri from the NAMES and MPNMT groups) and the Hebrew University of Jerusalem, with the research of Ido Cooperstein and Shlomo Magdassi.

The different nanodevices (membranes, cantilever, bridges) were obtained by two-photon polymerization on new liquid compositions, followed by a thermal process that removes the organic content, leaving a ceramic structure with high rigidity and low internal dissipation. The samples thus obtained are then characterized by laser Doppler vibrometry.

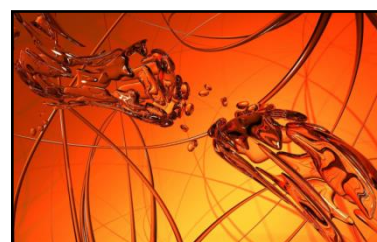
"The NEMS that we have fabricated and characterized," explains Stefano Stassi, "have mechanical performances in line with current silicon devices, but they are obtained through a simpler, faster and more versatile process, thanks to which it is also possible to add new chemical-physical functionalities. For example, the material used in the article is Nd: YAG, normally used as a solid-state laser source in the infrared range."

"The ability to fabricate complex and miniature devices that have performance similar to silicon ones," says Shlomo Magdassi, "by a quick and simple 3D printing process, brings new horizons to the field of additive manufacturing and rapid manufacturing."

**More information:** Stefano Stassi et al, Reaching silicon-based NEMS performances with 3D printed nanomechanical resonators, *Nature Communications* (2021). [DOI: 10.1038/s41467-021-26353-1](https://doi.org/10.1038/s41467-021-26353-1)

**Journal information:** [Nature Communications](https://www.nature.com)

<https://phys.org/news/2021-11-3d-nanoresonators-miniaturized-multifunctional-sensors.html>



Credit: Pixabay/CC0 Public Domain

# How monitoring a quantum Otto engine affects its performance

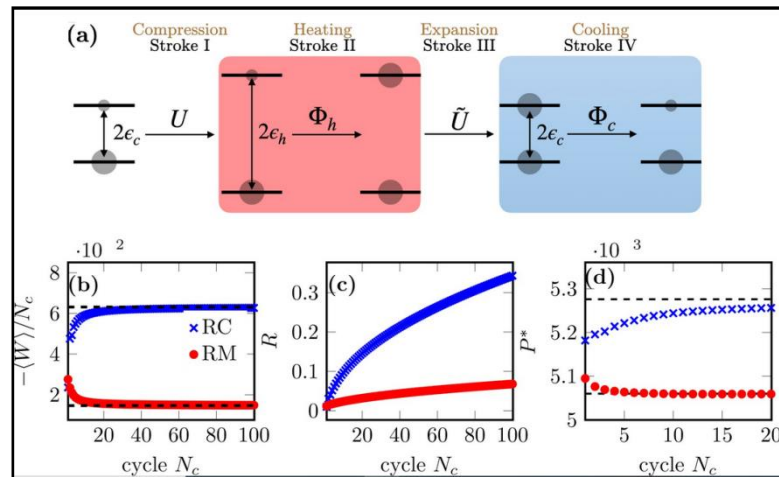
Heat engines are devices that use waste heat to perform mechanical work and generate power. The invention of heat engines ushered in an era of the industrial revolution 250 years ago. The Otto engine, which uses distinct heat and work strokes, powers nearly all automobiles and is an industry standard due to its relatively high power and efficiency. In an Otto engine, a working substance is typically a gas confined to a piston, which undergoes four subsequent strokes: It is first compressed, then heated up, expanded, and finally cooled down to its initial temperature.

Today, significant advancements in nano-fabrication bring quantum heat engines into the limelight. Like their classical counterparts, quantum heat engines could be operated in contexts which might be continuous or cyclic. Unlike classical engines, which use a macroscopic amount of the working substance, the working substance of a quantum engine has pronounced quantum features. The most prominent of these is the discreteness of the possible energies it can take. Even more outlandish from the classical point of view is the fact that a quantum system may exist in two or more of its allowed energies at the same time. This property, which has no classical analog, is known as quantum coherence. Otherwise, a quantum Otto engine is also characterized by four strokes like its classical counterpart.

Determining the quantum Otto engine's performance metrics, such as power output or efficiency, is the key to improving design and tailoring better working substances. A direct diagnosis of such metrics requires measuring the energies of the engine at the beginning and end of each stroke. While a classical engine is only negligibly affected by measurements, in quantum engines, the act of the measurement itself causes a bizarre measurement effect in which the engine's quantum state is severely affected via quantum mechanics. Most importantly, any coherence in the system at the end of the cycle would be completely removed by the measurement effect.

It has long been believed that these strange measurement-induced effects are irrelevant for the understanding of quantum engines and hence have been neglected in traditional quantum thermodynamics. Moreover, not much thought has been put into the design of monitoring protocols that yield a reliable diagnosis of the engine's performance while minimally altering it.

However, novel breakthrough research performed at the Center for Theoretical Physics of Complex Systems within the Institute for Basic Science, South Korea, may change this rigid perspective. The researchers investigated the impact of different measurement-based diagnostic schemes on the performance of a quantum Otto engine. In addition, they discovered a minimally invasive measurement method that preserves coherence across the cycles.



**Figure 1.** (a) Schematic of a single cycle ( $N_c = 1$ ) of an Otto cycle undergoing four strokes. The working substance is a qubit undergoing imperfect thermalizing heat (heating and cooling) strokes and finite-time work (compression and expansion) strokes. (b) Work output per cycle of the finite-time quantum Otto engine, (c) Reliability of the engine, and (d) The maximum power output. The engine operates for  $N_c$  cycles. In all cases, the repeated contacts (RC, blue crosses) scheme that preserves coherence outperforms the repeated measurements (RM, red filled circles) that kill all coherences. Credit: Institute for Basic Science



The researchers utilized the so-called repeated contacts scheme, where they record the engine's states using an ancillary probe, and measurements of the probe are performed only at the end of the engine's working cycles. This bypasses the need to measure the engine repeatedly after each stroke and avoids undesirable measurement-induced quantum effects such as the removal of any coherence that was built up during the cycle.

The preservation of coherence throughout the engine's lifetime enhanced critical performance metrics like the maximum power output and reliability, making the engine more capable and dependable. Prof. Thingna says, "This is the first example in which the influence of an experimenter, who wants to know whether the engine does what it is designed to do, has been properly considered."

Covering a broad spectrum of different modes of operations of engines with a working substance having just two quantum states, the researchers found that for idealized cycles that perform infinitely slowly, it makes no difference which monitoring scheme is applied. But all engines that run in finite time and hence are of practical interest, work considerably better for their power output and reliability when they are monitored according to the repeated contact scheme.

Overall, the researchers concluded that the nature of the measurement techniques can bring theory closer to experimental data. Hence, it is vital to take these factors into account when monitoring and testing quantum heat engines. This research was published in the *Physical Review X Quantum*.

**More information:** *Monitoring Quantum Otto Engines, Physical Review X Quantum. (2021) DOI: [10.1103/PRXQuantum.2.040328](https://doi.org/10.1103/PRXQuantum.2.040328)*  
<https://phys.org/news/2021-11-quantum-otto-affects.html>



Wed, 10 Nov 2021

## Using new quantum computing architectures to create time crystals

By Robert Sanders

UC Berkeley physicist Norman Yao first described five years ago how to make a time crystal—a new form of matter whose patterns repeat in time instead of space. Unlike crystals of emerald or ruby, however, those time crystals existed for only a fraction of a second.

But the time has arrived for time crystals. Since Yao's original proposal, new insights have led to the discovery that time crystals come in many different forms, each stabilized by its own distinct mechanism.

Using new quantum computing architectures, several labs have come close to creating a many-body localized version of a time crystal, which uses disorder to keep periodically-driven quantum qubits in a continual state of subharmonic jiggling—the qubits oscillate, but only every other period of the drive.

In a paper published in the journal *Science* last week, Yao and colleagues at QuTech—a collaboration between Delft University of Technology and TNO, an independent research group in the Netherlands—reported the creation of a many-body localized discrete time crystal that lasted for about eight seconds, corresponding to 800 oscillation periods. They used a quantum computer based upon a diamond, where the qubits—quantum bits, the analog of binary bits in digital computers—are the nuclear spins of carbon-13 atoms embedded inside the diamond.

"While a perfectly isolated time crystal can, in principle, live forever, any real experimental implementation will decay due to interactions with the environment," said QuTech's Joe Randall. "Further extending the lifetime is the next frontier."

The results, first posted this summer on arXiv, were replicated in a near-simultaneous experiment by researchers from Google, Stanford and Princeton, using Google's superconducting quantum computer, Sycamore. That demonstration employed 20 qubits made of superconducting aluminum strips and lasted for about eight-tenths of a second. Both Google's and QuTech's time crystals are referred to as Floquet phases of matter, which are a type of non-equilibrium material.

"It is extremely exciting that multiple experimental breakthroughs are happening simultaneously," says Tim Taminiau, lead investigator at QuTech. "All these different platforms complement each other. The Google experiment uses two times more qubits; our time crystal lives about 10 times longer."

Qutech's team manipulated the nine carbon-13 qubits in just the right way to satisfy the criteria to form a many-body localized time crystal.

"A time crystal is perhaps the simplest example of a non-equilibrium phase of matter," said Yao, UC Berkeley associate professor of physics. "The QuTech system is perfectly poised to explore other out-of-equilibrium phenomena including, for example, Floquet topological phases."

These results follow on the heels of another time crystal sighting, also involving Yao's group, published in *Science* several months ago. There, researchers observed a so-called prethermal time crystal, where the subharmonic oscillations are stabilized via high-frequency driving. The experiments were performed in Monroe's lab at the University of Maryland using a one-dimensional chain of trapped atomic ions, the same system that observed the first signatures of time crystalline dynamics over five years ago. Interestingly, unlike the many-body localized time crystal, which represents an innately quantum Floquet phase, prethermal time crystals can exist as either quantum or classical phases of matter.

Many open questions remain. Are there practical applications for time crystals? Can dissipation help to extend a time crystal's lifetimes? And, more generally, how and when do driven quantum systems equilibrate? The reported results demonstrate that spin defects in solids are a flexible platform for experimentally studying these important open questions in statistical physics.

"The ability to isolate the spins from their environment while still being able to control their interactions offers an amazing opportunity to study how information is preserved or lost," said UC Berkeley graduate student Francisco Machado. "It will be fascinating to see what comes next."

**More information:** J. Randall et al, Many-body-localized discrete time crystal with a programmable spin-based quantum simulator, *Science* (2021). DOI: [10.1126/science.abk0603](https://doi.org/10.1126/science.abk0603)

A. Kyprianidis et al, Observation of a prethermal discrete time crystal, *Science* (2021). DOI: [10.1126/science.abg8102](https://doi.org/10.1126/science.abg8102)

Norman Y. Yao et al, Time crystals in periodically driven systems, *Physics Today* (2018). DOI: [10.1063/PT.3.4020](https://doi.org/10.1063/PT.3.4020)

**Journal information:** *Science*, *Physics Today*  
<https://phys.org/news/2021-11-quantum-architectures-crystals.html>



An artist's impression of a discrete time crystal composed of nine qubits represented by the nuclear spins of nine carbon-13 atoms in diamond. The chain of connected spins is locked in a phase where they periodically invert their states. Credit: Joe Randall and Tim Taminiau, courtesy of QuTech

## Antidepressant may prevent severe COVID-19, follow-up study indicates

*Low-cost drug lowers risk of hospitalizations, deaths*

*By Jim Dryden*

In the largest study yet to evaluate a common, low-cost antidepressant as a treatment for COVID-19, researchers from Washington University School of Medicine in St. Louis and from Canada and Brazil have found that the drug fluvoxamine prevents some of the most serious complications of COVID-19, sharply reducing the risk of hospitalization and death.

The study's results were published recently in the journal *The Lancet Global Health*.

This trial, conducted in Brazil, confirms results from the first trial of fluvoxamine for COVID-19, which was launched in early 2020 and led by Eric J. Lenze, MD, and Angela M. Reiersen, MD, both psychiatrists at the School of Medicine. Results of that trial were published in *JAMA* one year ago. The two were interested in the antidepressant because of its anti-inflammatory properties. They also are co-authors on the new study.

The Brazilian study followed about 1,500 patients newly diagnosed with COVID-19. Of them, 741 people received the drug — a 100 mg tablet of fluvoxamine twice a day for 10 days — while 756 received a placebo twice daily. The trial was halted early because those taking the fluvoxamine experienced far better outcomes than those taking a placebo.

Of those taking fluvoxamine, 11% became sick enough to require an extended stay at a COVID-19 emergency facility or be admitted to a hospital, compared with 16% of people who received a placebo.

In a secondary analysis of participants who took at least 80% of their pills, the findings were even more striking: Risk of hospitalization or extended emergency care was reduced by two-thirds, and there was one death among those taking fluvoxamine compared with 12 deaths in the placebo group, a reduction in mortality risk of 91%.

“These numbers may represent the optimal benefit that can be achieved when patients adhere to the treatment regimen,” said Reiersen, an associate professor of psychiatry.

“Based on this replication of our findings in such a large study, we believe fluvoxamine should be considered as a treatment for patients at high risk for serious illness or death,” said Lenze, the Wallace and Lucille Renard Professor of Psychiatry and director of the Healthy Mind Lab at Washington University. “Unlike other therapies being developed to treat COVID-19, this drug has a long and well-established record of safety, and doctors could choose to prescribe it off-label for COVID-19 immediately.”

Lenze said vaccines are extremely good at preventing serious illness but that many countries have had difficulty vaccinating their citizens, and even some vaccinated people may still be at risk for serious COVID-19 symptoms due to underlying medical illness or reduced immunity over time.



Leonard Imbula of the Healthy Mind Lab at Washington University School of Medicine in St. Louis holds a bottle of fluvoxamine, a psychiatric drug that has been shown, in a pair of studies conducted on two continents, to be an effective treatment for people sick with COVID-19.

Fluvoxamine provides a low-cost treatment option for newly diagnosed patients and appears to be highly effective in reducing severe disease.

“As COVID-19 spread rapidly around the globe, there have been many attempts to repurpose existing drugs that might have anti-viral and/or anti-inflammatory effects; fluvoxamine is the only drug in this category that has shown promising efficacy to date,” said David H. Perlmutter, MD, executive vice chancellor for medical affairs and the George and Carol Bauer Dean of Washington University School of Medicine in St. Louis. “The original hypothesis for testing this drug and the rapid deployment methods used for the initial clinical trial represent truly remarkable ingenuity by the team of Drs. Reiersen and Lenze and, most importantly, the results point us in the direction of a safe and inexpensive oral agent to reduce hospitalizations and save lives.”

Unlike newer antiviral drugs that are reportedly promising against COVID-19, fluvoxamine would not require emergency use authorization before it could be prescribed. That’s because it already is approved by the U.S. Food and Drug Administration for treatment of obsessive-compulsive disorder (OCD) and has been prescribed for more than three decades to treat OCD, anxiety disorders and depression. It belongs to a class of drugs known as selective serotonin-reuptake inhibitors (SSRIs). But unlike other SSRIs, fluvoxamine interacts strongly with the sigma-1 receptor, a protein inside cells that helps regulate the body’s inflammatory response.

“We believe this drug most likely is interacting with the sigma-1 receptor to reduce the production of inflammatory molecules in the body,” said Reiersen. “That represents an interesting difference from other SSRIs when it comes to the treatment of psychiatric illness, but it appears to be vital to fluvoxamine’s effects in patients with COVID-19.”

The new findings come from a study known as the TOGETHER Trial — a large, adaptive platform trial that has randomized more than 4,000 patients worldwide into trials evaluating existing drugs for their ability to effectively treat COVID-19. Fluvoxamine is the first one of the potential treatments to be found effective.

“And it costs about \$4 for a course of treatment, so it also can be cost-effective, unlike other, newer COVID-19 therapies,” Lenze said. “It may be particularly useful in countries where vaccination rates remain low.”

The study’s senior author, Edward J. Mills, PhD, who is a professor of health research methods, evidence and impact at McMaster University in Hamilton, Ontario, said it is important to get the drug out to hard-hit countries as soon as possible. Mills, also a vice president and senior principal scientist at Cytel, a company that makes statistical software and provides analytics for clinical trials, called fluvoxamine one of the best tools available to minimize the danger for people infected with COVID-19 around the world.

<https://medicine.wustl.edu/news/antidepressant-may-prevent-severe-covid-19-follow-up-study-indicates/>

