

Article **Technical-26**

Unmanned Aerial Vehicles

UAVs, better known as drones, are adding teeth to combat power of armies world over as well as aiding in humanitarian missions.

■ **by Wg Cdr (retd) DP Sabharwal**

"We have just won a war with a lot of heroes flying around in planes. The next war may be fought with airplanes with no men in them at all," prophesied General Henry Arnold, in 1945. Arnold was an aviation pioneer, the only Air Force General to hold 5-star rank, and the only person to hold a 5-star rank in two different US military services. The man, who was instructed in flying by the Wright brothers and was one of the first military pilots worldwide, obviously knew what he was talking about. The day proving his prophesy has come – perhaps, a bit late.

The type of aircraft that does not have a human pilot aboard and is capable of controlled, sustained-level flight, is termed as Unmanned Aerial Vehicle (UAV). It is powered by a jet, reciprocating, or an electric engine, and there are two ways of controlling the flight.

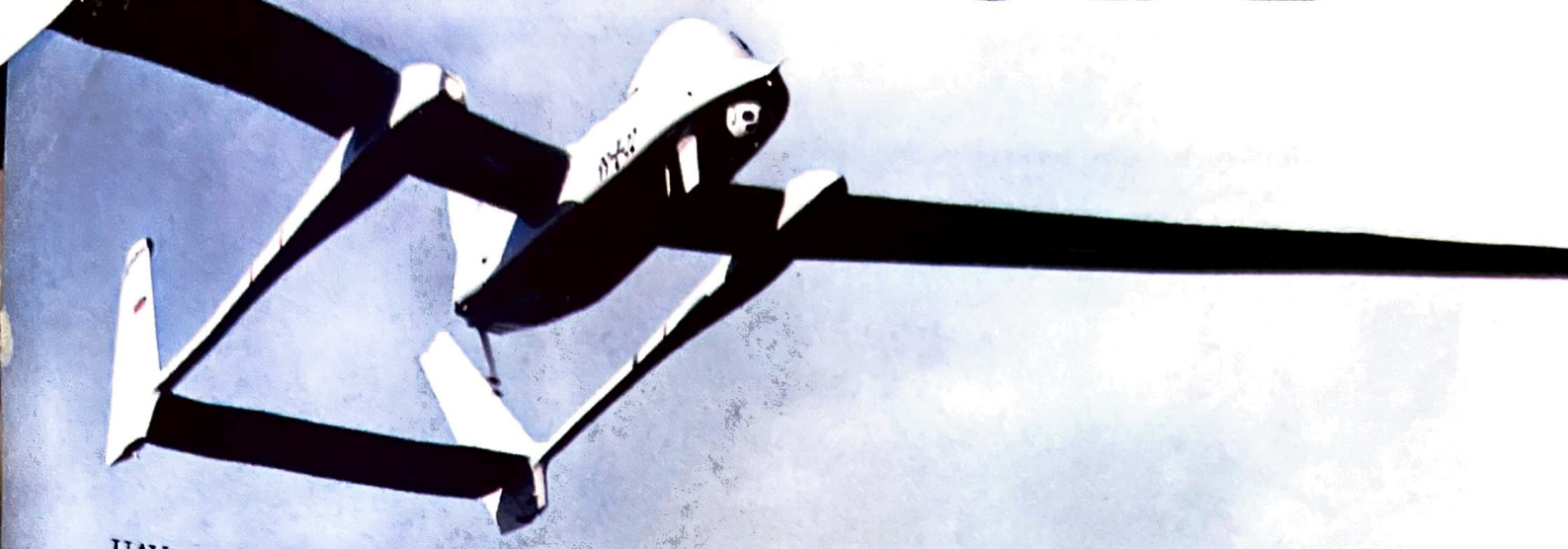
- Automatically, during the flight, by means of an autonomous software. These are known as drones.
- By remote-control in the hands of a pilot on the ground or in another aircraft. These are termed as Remotely Piloted Vehicles (RPVs).

History of UAVs

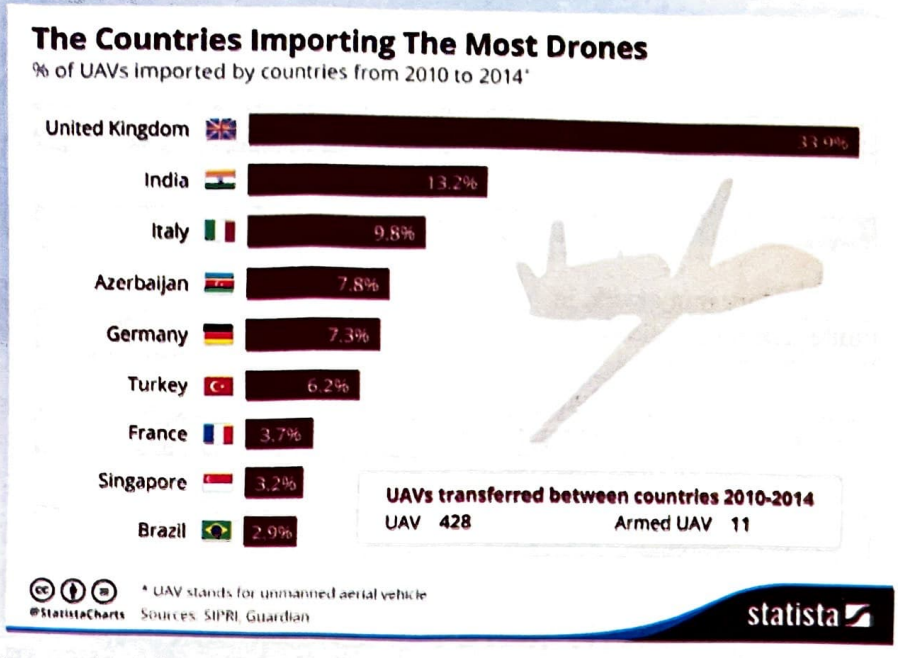
Though difficult to pinpoint, yet the credit for the first UAV can be given to the Austrians, who fired a balloon filled with bomb, to attack the Italian city of Venice on 22 August 1849. The concept of unmanned flying vehicles was put to practice in 1916, during World War I when A.M. Low's radio technology was used for the control of unmanned aircraft. In addition, Dayton Wright's airplane company came up with the idea of pilot-less aerial torpedo, that would drop and explode at a particular pre-set time.

After the war, much technological advancement took place, which led to the conversion of three Standard E-1s into drones. The success of these auto-piloted aircraft led to the radio-controlled pilot-less aircraft in Britain and the USA, during the 1930s, the most prominent being radio-controlled, target aircraft 'Fairy Queen'.

The last two decades have seen massive improvement and interest in



UAVs, primarily because these are available at a fraction of the cost of manned aircraft, with no risk to human lives. The so-called 'Golden Age' of UAV technology has arrived primarily due to massive expansion of communications bandwidth, combined with the ongoing miniaturisation of electronic components. As a result, their role has expanded and drones, once relegated to Intelligence, Surveillance, and Reconnaissance (ISR) missions, have become star players in the wars on terror. And these days, they play a critical role in the military establishments of many nations.



The four major nations in this regard are

USA, where thousands of UAVs are employed in conducting missions ranging from ISR to communications relay to strikes. The drone campaigns over Iraq, Afghanistan, Pakistan, Yemen and Somalia have earned much international criticism – next only to the use of B-52s over North Vietnam during the 1960s and early '70s.

Israel has used drones in an ISR capacity to keep close and constant tabs on Gaza, the West Bank, and southern Lebanon, as well as parts of Syria near the Golan Heights. The drones have also taken on a strike role, operating in Egypt and the occupied territories. Israel is the leading exporter of drones, accounting for almost 61 per cent of the worldwide sale.

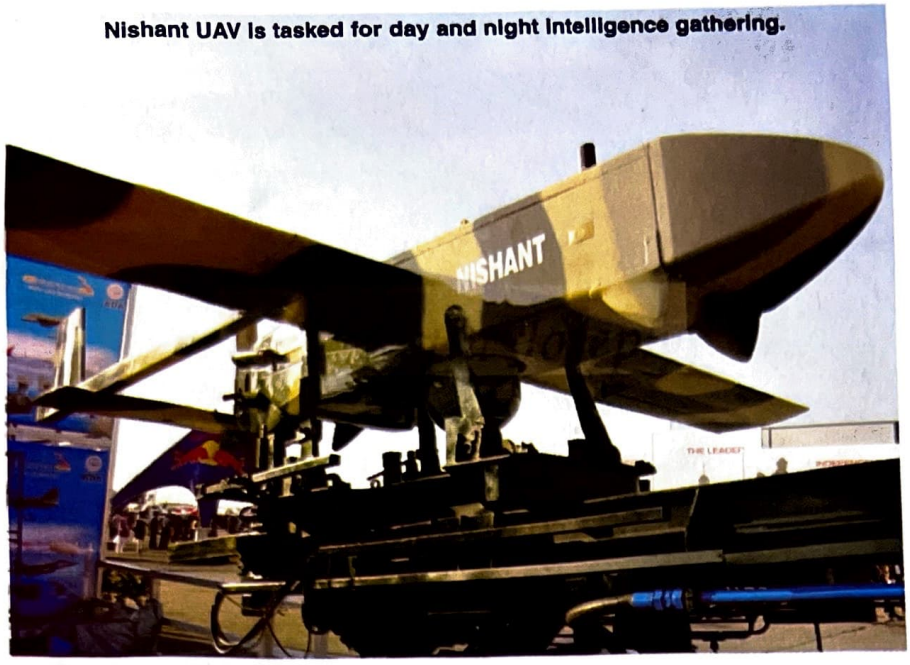
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China has gone into UAV development and production in a big way, primarily from the commercial angle. However, they are using drones realising that they have the potential to fill a lot of different niches in the

Drones help in reducing mishaps and casualties

A good way to understand crash rates is to view the number of Class A mishaps ($1M+ cost, fatal or permanent total disability, or destruction of aircraft) against cumulative flight hours. Finally, we add in the U-2, a manned ISR airframe with similar total flight hours, and the F-16, another manned aircraft with a large number of flight hours. Data for other manned platforms exist, but most do not have equivalent number of flight hours.

Note that manned and unmanned aircraft are all trending downward similarly, showing the results of experience and continuous improvements. The Q-1 (Predator) lags behind other airframes, both manned and unmanned. This is not surprising given the Q-1 is the first mass used large unmanned airframe. Additionally, the Q-1 may be used in situations and environments that may be more dangerous than manned aircraft, leading to more mishaps. The more modern Q-4 and Q-9 are on par with manned airframes, showing that unmanned airframes can have accident rates similar to or better than manned airframes without the risk to crewmen.



Nishant UAV is tasked for day and night intelligence gathering.



PLA's military framework, including counter-terror operations.

Iran has used drones extensively in Syria and Iraq, supplying these governments with reconnaissance data and identifying targets for manned air-strikes. Altogether, Iran probably has more operational experience with drones than any country – other than Israel or the United States. Iran has exported its drones to proxies, such as Hezbollah, where they mostly play the same ISR role, though they have also experimented with suicidal drones.

Classification of UAVs

Currently, there is no widely-accepted classification of UAVs due to wide range of capabilities, size and operating characteristics of different systems. However, there are four broad areas under which UAVs can be classified: altitude, range and endurance, weight and applications.

High-altitude operation UAVs can climb above 60,000 feet; medium-altitude operations go up within a range of 18,000 - 60,000 feet; low-altitude operations are up to 18,000 ft; while very-low-altitude operation UAVs are able to fly below 1,000 ft.

Endurance is either in terms of range or duration in flight. When a UAV can operate in a range of more than 500 km or can stay in the air for more than 20 hours, it is considered to have good endurance.

Drone strikes in Pakistan

All 2014 actions	
Total strikes:	25
Total reported killed:	14-183
Civilians reported killed:	0-2
Children reported killed:	0-2
Total reported injured:	44-67
All actions 2004 – 2014	
Total Obama strikes:	357
Total US strikes since 2004:	408
Total reported killed:	2,410-3,902
Civilians reported killed:	416-959
Children reported killed:	168-204
Total reported injured:	1,133-1,706

Based on weight, there are three categories. Class III weigh over 600 kg, class II weigh between 600-150 kg, while those below 150 kg are termed as class I UAVs, which are further sub-divided into Micro (less than 2 kg), Mini (2-20 kg) and Small (more than 20 kg).

Based on application, these could be used for combat missions, reconnaissance, as a target and decoy, for research and development and for civil and commercial use.

The United States has its own classification that consists of three tiers. Tier I consists of low-altitude, long-endurance (Gnat 750). Tier II consists of Medium Altitude Long Endurance (MALE – Predator and Reaper). Tier III consists of High Altitude Long Endurance (HALE – Global Hawk and Pioneer).

Armed UAVs

Technically termed as an unmanned combat aerial vehicle (UCAV), or simply a combat drone, it is armed with weapons. These UAVs are much simpler and cheaper than aircraft since equipment necessary for a human pilot, such as cockpit, ejection seat, flight controls and environmental controls for pressure and oxygen are not needed, thus resulting in a lower weight and size.

An armed UAV, however, differs from a cruise missile in that it is recovered after its mission while a cruise missile impacts its target and gets destroyed itself. The USA was the first country to export a UCAV – the MQ-9 Reaper – to the UK in 2007, who used it in Afghanistan. China became another exporter of armed UAVs to Nigeria, which deployed these against Boko Haram, a terrorist



Rustom II is yet to put on test.



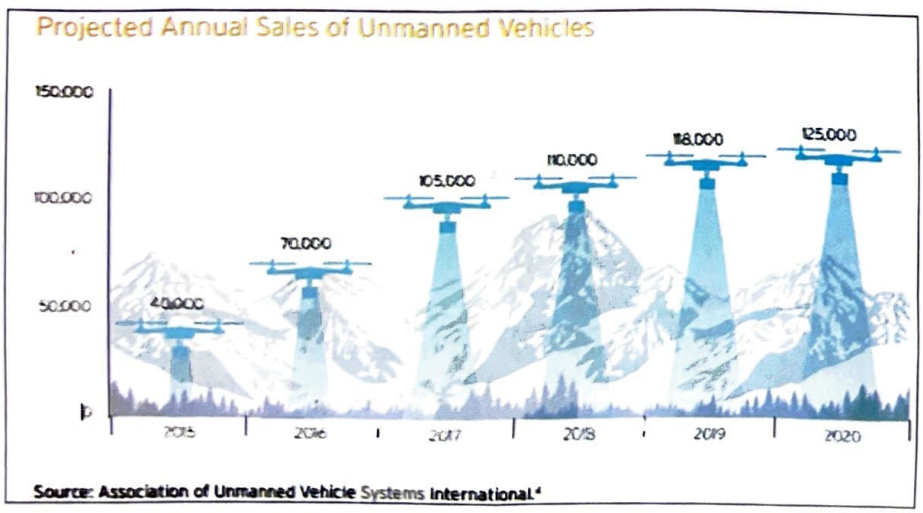
DRDO has tested Lakshya-II as a target drone.

outfit. Attacks from armed UAVs have been criticised world over for accidentally killing civilians while hunting suspected terrorists.

Conventional roles of UAVs: UAVs are ideally suited to perform missions that cannot be economically or feasible carried out by manned aircraft. It is most effective, when attack aircraft attrition rates are anticipated to be unacceptably high. In such a scenario, use of UAVs eliminates loss of expensive aircraft and reduces the number of causalities of non-replacable pilots.

Varied uses of UAV are

- Accurate armed attacks on enemy's vital targets with the help of special targeting cameras, using guns and missiles.
- Post-strike damage-assessment using cameras.
- Reconnaissance of an area of the enemy to locate or ascertain strategic features. It uses cameras and mikes.
- Remote-sensing of a difficult terrain, using electromagnetic spectrum sensors, gamma ray sensors, biological and chemical sensors.
- Commercial aerial surveillance applications for livestock monitoring, wild-fire mapping, pipeline security and road patrol.
- Aerial photography for sports.
- Domestic policing particularly in connection with drugs and terrorism.
- Providing disaster relief through delivery of medicines, vaccines and even food and water.
- Search and rescue, particularly in inhospitable areas and in adverse weather conditions.
- Targets for training of pilots.



Future uses of UAVs

There are endless possibilities. Few of the emerging and future applications can be as follows

- Wildlife conservation, one such programme being AREND (Aircraft for Rhino and Environmental Defence) with the objective of combating poaching in Africa's national parks.
- In agriculture, for removal of weeds and to protect local plant life from areas, which are either inaccessible or demand excessive time to monitor the flora region.
- Autonomous monitoring of bridges for cracks and defects, that could lead to their collapse.
- To supply wi-fi to disaster-struck areas; systems being tried for a range up to 110 km.
- Solar-powered drones to provide internet access to the world's

under-served regions.

- Delivery of essential documents, such as driving-licences and identity-cards.

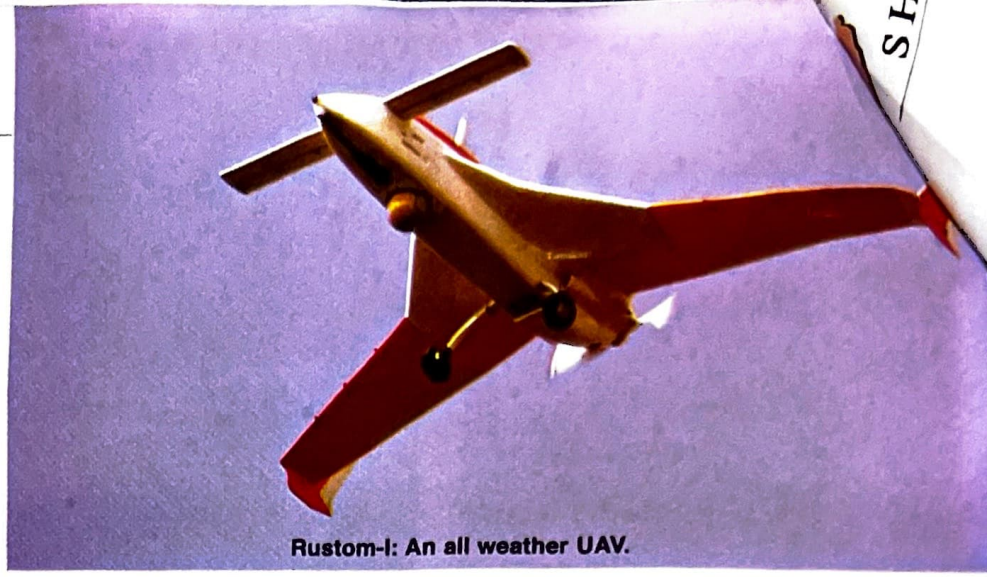
UAVs in India

India's National Disaster Relief Force (NDRF) used drones to help Nepal map the scale of devastation caused by the earthquake in April-May. The drones were earlier used effectively during Bhuj earthquake and then during the unprecedented floods and landslides in Uttarakhand, in 2013. These drones belong to the Defence Forces.

The use of drones by civilians is not permitted as yet in India, where UAVs are mainly confined to surveillance and reconnaissance. Drones used on India's long India-Pakistan border are simpler than the ones used on the Chinese border in Ladakh, where they require longer endurance and high-altitude capability.

India's first delivery was from Israel in 1998 and, since then, almost all UAVs, as per SIPRI, have been from Israel. Of the 178 purchased, 108 are Searcher and 68 are Heron. As per a report, during the last two decades, India has been number one UAV-importing nation followed by the UK and France.

The Indian Armed Forces have been operating UAVs for over a decade. These were acquired by the Army from Israel – the first one being Searcher Mark I, followed by Mark II and, finally, the Heron. The Searcher II has been used in mountainous regions, plains as well as in deserts. Indian UAV pilots have optimised the UAVs successfully under India's varied and tough-weather conditions.



Rustom-I: An all weather UAV.

UAVs have provided excellent inputs about any intrusion on the Line of Control (LoC) as also on issues, which assist in operational planning. Though there have been problems about the quality of pictures obtained while using Synthetic Aperture Radar (SAR), significant improvements are happening in this field to get clear images of the object.

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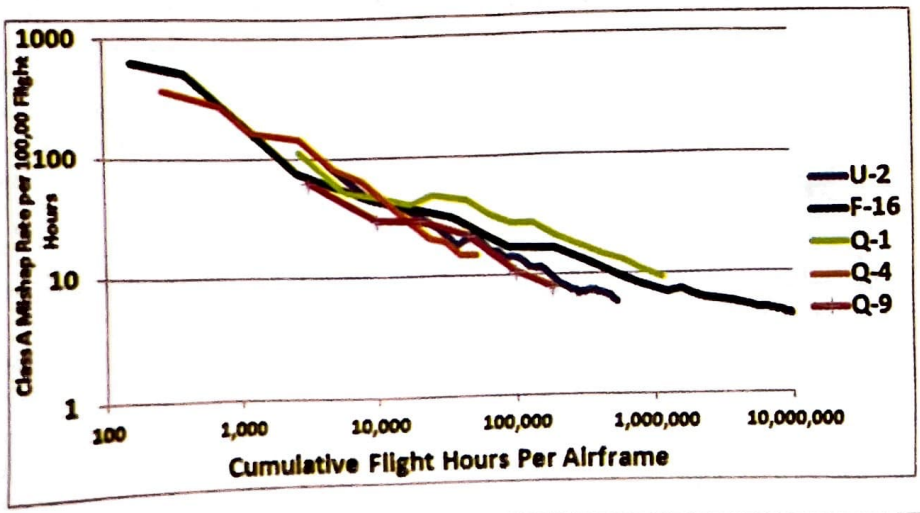
The Indian Air Force soon followed the Army and acquired conventional UAVs. The IAF has lately acquired Harop, again from Israel, which was first displayed during the Aero India show in 2009. It does not carry any ammunition but is designed to loiter over the battlefield and attack targets by self-destructing into them like a missile and is termed as a 'loitering missile'.

The Indian Navy was the last one to induct UAVs in its inventory and has a squadron of Searcher Mark II and Heron, which suits its long-range shore requirements.

Indigenous UAV programme

Nishant is a reconnaissance UAV, primarily tasked for day-and-night intelligence-gathering over enemy territory. It is also used for training, surveillance, target-designation, artillery fire-correction and damage-assessment. It is catapult-launched from an all-terrain, hydro-pneumatic launcher and is recovered with the help of on-board parachute system and an underbelly airbag.

Lakshya is a remotely-piloted, high-speed target drone system, which provides realistic, towed, aerial sub-targets for live-fire training. The drone can be ground/ship launched and is recovered by a 2-stage parachute. It has a crushable nose-cone, which absorbs the impact of landing, minimising damage. About 30 have been inducted into the Defence Services since 2000. A variant Lakshya-1 is used to perform dis-





NETRA: This surveillance UAV has featured in a hit Hindi movie.

creet aerial reconnaissance of battlefield and target acquisition.

Rustom is all-weather, medium-altitude, long-endurance combat UAV being developed by for the three Services. It will operate at medium to long ranges and gather near real-time high-quality imagery radio signals. It will perform a range of military missions as well and will replace/supplement the Heron UAVs in service with the Indian Armed Forces. Rustom 1 was successfully flown in 2009 while Rustom H's flight is planned some time in 2015.

Netra is a light-weight, autonomous UAV for surveillance and reconnaissance operations and has been jointly developed by Research and Development Establishment and a private firm Forge Technologies. It can take-off and lands vertically like a helicopter. The UAV was featured in the hit movie *3 idiots*. It is currently used by Indian Armed and paramilitary forces. The National Disaster Response Force used the Netra drone during the 2013 Uttarakhand floods to identify survivors and assess damage.

Future programmes

India is going a big way on UAVs. Panchi, the wheeled version of the Nishant UAV, was successfully flight-tested in December 2014, and is capable of operating from semi-prepared runway, thereby reducing the turn-around time between missions.

The AURA (Autonomous Unmanned Research Aircraft) is planned to be a combat UAV, capable of flying at 30,000 ft. and releasing missiles, bombs and precision-guided munitions. The programme is in its project definition stage and is classified. The design work is being carried out by Aeronautical Development Agency (ADA). The drone would be a stealthy, flying-wing concept aircraft, with internal weapons and a turbofan engine. It is planned to be introduced around 2019 - 2020 and the likely user is going to be the Indian Air Force.

It is reported that, in the near future, the UAVs would be permitted for civil use by the civilian organisations as well. Once it happens, the areas for use would be as wide as anyone's imagination! ■

India's UAV inventory, both imported and indigenous drones

UAV	Max weight (Kg)	Payload (Kg)	Altitude (Feet)	Range (Km)	Endurance (Hours)	Speed (Kmph)
Searcher II	500	68	20,000	-	18	200
Heron	1,150	250	32,000	350	52	207
Nishant	380	45	11,800	160	4.5	185
Lakshya	705	Towed target	16,400	150	-	0.7 Mach
Rustom 1	720	95	26,000	-	12	225
Rustom H	1,800	350	35,000	250	24	225
Netra	1.5	Camera	300	2.5	-	30

WAY IN, WAY OUT

Best system!

In the year 1962, I was called by the Director of the "Kokshokhmmash" plant, Slavyansk in USSR, to explain why Indian trainees in USSR are propagating against their Communist System.

As the group leader of Indian trainees from HEC, Ranchi, I was told that some Russian children in the school had challenged their teachers when they were told that in Communism system everything is provided cheapest in the world. They told their teachers that their Indian friends have informed that the cost of a woollen suit in India is 25 to 30 roubles, a full woollen sweater for 6 to 8 roubles and a leather shoe about 5 to 6 roubles in India, which works out to be 4 to 5 times cheaper than in India.

I told the director that Indian trainees have become very friendly with Russian people, specially children to learn Russian language. Casually when they wanted to know the cost of living in India they were told the actual price, without any knowledge that the some will go against Communism in USSR. The director then very politely told me to tackle this problem carefully so that he does not get further warning from the Communist Party. Somehow we managed the whole affair carefully so that our action does not went against the Communist ideology.

— *S. P. Jain*

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