IFLA WLIC 2013
SINGAPORE

Submitted on: May 4, 2013

Government Information, Publications and Information Dissemination Strategies for the Future: A Case Study of DRDO, India

Dr Rajeev Vij
Scientist F & Joint Director
Institute of Nuclear Medicine and Allied Sciences (INMAS),
DRDO, Government of India, Delhi, India
Email: vijinmas@gmail.com

Abstract

The Defence Research & Development Organisation (DRDO) works under the Ministry of Defence, Government of India. DRDO, through its network of 52 laboratories, is dedicated towards enhancing self-reliance in defence and also to provide spinoff benefits to society at large. This article describes some of the notable spinoffs from DRDO technologies which have reached the public in the areas of agriculture, agro-animal products, health and hygiene improvement (Malaria control), tele-education and telemedicine, pollution control, energy security, sanitation and waste management. The DRDO libraries in India have not been adequately researched to date. The primary aim of this article is to contribute to the knowledge of the general public about initiatives taken by DRDO in the area of information dissemination.

The Defence Scientific Information and Documentation Centre (DESIDOC) functions as the publication wing of the DRDO. It provides scientific and technical information via specialised publications, monographs, technical bulletins, online journals and popular science publications, primarily in English, although a few are in Hindi also. A full-fledged high quality in-house publishing facility has also been established, which includes designing, layout, typesetting, processing, and printing units for in-house production of DRDO publications. The DRDO has taken due note of the ICT revolution and has taken initiatives to put all its publications available on 24/7 open access (drdo.gov.in). It is presently moving towards creating digital archives for increased information access through open access dissemination for the public at large. The paper promotes the collection, bibliographic control, preservation and dissemination of information about spinoff benefits of defence technologies for the civilian population.

Keywords: Defence Research & Development Organisation (DRDO), spinoff benefits, agro-animal products, DESIDOC, digital archives, open access

1. Introduction

This article focuses on trends and patterns of information creation and dissemination, highlights how this information is reaching the public at large, and how it contributes to development and poverty eradication in India. The paper provides suggestions for improvement in information dissemination through increased awareness and mass distribution of DRDO electronic publication, thereby contributing to nation-building. Poverty in India is widespread, with the nation estimated to have a third of the world's poor[1]. India accounts for one-third of the world's poor, or people living on less than $1.25 (about Rs 65) per day, according to the World Bank, while 68.7% live on less than US$ 2 per day[2]. India ranks 65th out of 79 countries[3] on the *Global Hunger Index* according to a new report by the International Food Policy Research Institute. The top causes of poverty include overpopulation, low agricultural production, underutilization of resources, and unemployment.

Dr Kalam, former President of India, believes that India is a "developed" nation, stating "We are among the top five … in terms of GDP… Our poverty levels are falling; our achievements are being globally recognised today." He also bemoans our "negativism", stating "We are the second largest producer of wheat … [and rice] in the world …" But he doesn't reflect on the fact that India has the second biggest population in the world -- and the biggest collection of the hungry, the crippled, the diseased, and the deprived.[4] Under his able leadership as Director General of DRDO, Dr Kalam had initiated several beneficial activities and missions to address this issue.

2. Defence Research & Development Organisation

The Defence Research & Development Organisation (DRDO) works under the India Department of Defence Research and Development in the Ministry of Defence. DRDO is dedicated to enhancing self-reliance in defence systems and undertakes the design and development of world class weapons and equipment[5]. DRDO works in various areas of military technology, including aeronautics, armaments, combat vehicles, electronics, instrumentation engineering systems, missiles, materials, naval systems, advanced computing, simulation and life sciences. But DRDO also provides ample spinoff benefits to society thereby contributing towards nation-building.

The Indian Armed Forces are deployed in vast and diverse geographical areas and face different and difficult combat conditions. These situations demand research and development in the life sciences to meet the health requirements of the troops. The DRDO, besides doing research and development on weapon systems, has a group of life sciences laboratories. This group covers research in high altitude agriculture, food technology, human physiology, psychology, nuclear medicine, disease diagnostics and management[6]. Life Science Labs at DRDO are engaged in the development of appropriate technologies for unique food and health requirements for military personnel under unusual environments. Technologies developed by these laboratories have a wide range of civil applications[7].

3. Overview of Areas of DRDO Contributions for Societal Development

Education	Enhancing vocational skills Providing training for higher education and research Conducting training at grassroots level to villagers
Improve Health Systems	Hygiene; access to health-care systems Repellents- DEET & DEPA Malaria control Ophthalmic lasers Nutritional security Anti-leucoderma ointment Anti- eczema ointment Anti-toothache herbal solution (Dardhar) ELISA Kit for identification of food pathogens
Eradicating Extreme Poverty & Hunger	Increased agricultural productivity by developed agro-practices for 78 types of vegetables and 30 types of high altitude medicinal and aromatic plants Vegetable production in green houses Commercialized Seabuckthorn products Mushroom production technology Agrotech: fresh foods Hydroponics, aeroponics technologies Transgenic–Vegetables; resistance to cold Osmotin gene integration Processed foods Adapted germplasm for dairy cattle for wholesome milk Increased income generation Cultivation of medicinal and aromatic plants Upgradation of local breeds of cows for boosting milk production Upgradation of Zanskar ponies for transportation Germplasm Centre of German Angora Rabbit Pisciculture technology
Ensuring Environment Sustainability	Land and water management Green cover increases at Leh and Chandipore Establishment of a prototype National Germplasm Repository at Changla, Leh-Ladakh Use of earthworms for vermi-composting (Vermi compost from different organic wastes) Pollution control
Energy Security	Reduce dependence on oil; alternate energy from solar, wind, fuel cells, etc. Drip irrigation technology to conserve water Bio-diesel from Jatropha farming Solar based greenhouses Installation of a biogas plant at high altitude

Sanitation and Waste Management	Increase access to sanitation; waste management and treatment; bio-toilets for 1,000 gram panchayats Provision of portable water Water desalination plants Iron removal unit Water testing Infection imaging Bio-digester integrated into Railway coaches commissioned in Lakshadweep
Disaster Management	Disaster preparedness systems Multi-purpose foldable cot Relief operations for victims of flash floods in Leh Orissa cyclone relief operations A desalination plant at tsunami-hit Nagapattinam Relief operations during earthquake at Latur and Bhuj, super cyclone in Orissa and Andhra Pradesh Establishment of meteorological observatories Rugged and portable telemedicine systems Avalanche victim detectors (AVD) Sanjeevani (a life detecting device) Technology for the extension of shelf-life(s) of fresh fruits & vegetables Ready to eat foods: quick cooking foods Freeze dried foods and drinks, ration packs SATCOM terminals for communication during relief operations, water portability detection kits, post-traumatic stress disorder (PTSD) management

4. Contributions by the Defence Institute of High Altitude Research (DIHAR)

The Defence Institute of High Altitude Research (DIHAR), in Leh City, develops high altitude agro-animal technologies. Low cost agro-animal technologies developed by the institute have also found wide acceptance among local farmers. The laboratory, through its R&D efforts, has created a perceptible change in agriculture and animal husbandry which has resulted in a revolution in food production in Ladakh. For example, 30-40 years ago there was only handful of vegetables at Leh city: today you will find a huge quantity of large, fresh vegetables like cauliflower, onions, cucumbers, garlic, brinjal, and pumpkins available because of DRDO's contribution.[8] Adoption of these technologies has boosted fresh food availability and helped lift the socio-economic status of the people. By developing new research technologies in agriculture, horticulture, floriculture, animal husbandry, and poultry, DRDO enhances the local farming community's economy and farmers start to develop their own small-scale industries using high-value-low-volume products[9].

DIHAR has also introduced vegetables suited to the cold desert of Ladakh, and developed hybrid seeds which survive in these conditions. DRDO has also introduced trench technology. Today, farmers are able to produce 5000 metric tonnes of vegetables using DRDO technology and one can see the consequent economic development in remote areas.

Technology is transferred to local people through *VigyanKisan Melas*[10]. For meat requirements, DIHAR has introduced hybrid goats that quickly gain weight, and transferred the technology to local entrepreneurs along with the egg-hatching and chick-growing facilities[11].

DIHAR was recently honoured with the CSIR Award for S&T Innovations for Rural Development (CAIRD) in 2010 for the "Development of cold arid agro-animal technologies for rural development in Ladakh region (J&K)".

4.1. Training/Consulting Services available for the Civilian Population

- Training for poultry raring in Ladakh and suitable housing feed and breeds.
- Training for upgrades of local breeds of cows for boosting milk production.
- Training for conservation and upgrades of Zanskar ponies.
- Training, demonstration and consultation to local farmers on modern agro-animal techniques suitable for the region.
- Providing consultancy to Ladakh Autonomous Hill Development Council for formulating agriculture policies beneficial for the socio-economic development of Ladakh.
- Providing consultancy to Seabuckthorn cluster development (GOI) in Ladakh, chip grade potato production (PEPSICO) and Quality Marigold Seed Production (AVT, Cochin)
- Developing and providing a database on cold desert arid agro-animal technologies
- Training provided to the civilian populace and unemployed youth on mushroom production and vermi composting technologies. Many have started commercial production of mushrooms and vermi compost on their own.
- Use of vermi composting technology to deal with noxious waste material produced by households. The studies have been useful for socio-economic progress in the North Eastern Region[12].

4.2. Documentary films Produced by the DIHAR

- *DRDOs Efforts and Achievements in High Altitudes*
- *DIHAR Conquest*
- *Jai Jawan Jai Kisan Jai Vigyan* (in Hindi)
- *Medicinal Plants of Ladakh*
- *Vegetable Cultivation in Ladakh*
-

5. Recent Developments: the 'Aahar' Initiative

DRDO-developed Dal-Roti packs have become key instruments in meeting the challenge of providing India's population with cheap, hygienic, and nutritious food. Under the DRDO-FICCI Accelerated Technology Assessment and Commercialization (ATAC) Programme, DRDO, BASIX (a Social Enterprise Group) and the Federation of the Indian Chamber of Commerce and Industry (FICCI) are collaborating to develop and execute models for commercialization of DRDO technologies, with the intent of enhancing livelihoods. The partners will identify and commercialise technologies/products/processes developed by DRDO, focusing on the base of the pyramid as both producers and consumers, thereby improving and creating livelihoods for the disadvantaged.

BASIX will play the lead role in consolidating this project and conducting a commercialization pilot. The project will develop a model of creating small production units comprised predominantly of women, by organising and building of a range of skills and deploying simple technologies developed by Defence Food Research Laboratory (DFRL) which has also developed the Aahaar product - a hygienic, nutritious and convenient meal that tastes fresh, has a long shelf life, and is quickly served. This is a unique positioning in the market place for this category of foods. The technology has been referred to the National Advisory Council to be considered for various national programmes, particularly in the Mid-day Meal Scheme[13].

These products are suitable for use during long journeys, nutritional feeding, catering, and other civilian applications. The initiative will assist the poor, cushion them from long-term food inflation, and help in providing cheap, hygienic and nutritious food. BASIX is using DRDO research for enhancing food security for the public by bringing this product to market. In the first year of operation, as many as 26 DRDO labs across India participated and over 200 technologies are being assessed by Federation of Indian Chamber of Commerce and Industry. Through the ATAC initiative, DRDO has enabled the industry to leverage the knowledge and capabilities developed by its scientists and technologists.[14]

6. Products from the Society for Biomedical Technology

The Society for Biomedical Technology (SBMT) is an inter-ministerial initiative established to promote healthcare by providing indigenous solutions in the fields of medical equipment and devices. The Society for Biomedical Technology was established by DRDO in collaboration with the Department of Science and Technology (DST) under the Ministry of Social Justice and Empowerment and the Ministry of Health & Family Welfare. The activities of the Society are carried out by the DRDO laboratories and a few other well-known academic institutions and medical centres[15].

SBMT has developed a number of products including coronary catheters, Cytoscan, deep brain simulator, eye lasers, external cardiac pacemakers, floor reaction orthosis KalamRaju coronary stents, Project Tulsi, stress test systems, slit lamp microscopes, orbital implants, titanium bone and dental implants, laparoscopic surgery training simulators, cochlear implant, etc. for civilian applications.

7. Information Dissemination Strategy

The information dissemination strategies of the DRDO for societal benefit focus on:

- Increasing awareness about products and technologies
- Generating support and understanding for products and technologies
- Increasing civilian involvement
- Increasing commitment for DRDO products and technologies

This is being done through:

- Training and workshops
- An interactive website

- Email distribution of E-newsletters
- Making and releasing videos and films
- Organising and participating in national and regional exhibitions
- Establishing information dissemination help-lines
- Information dissemination through radio programmes
- Organisation of press conference and press releases
- Organising events: launches, speeches, open days, public events
- Discussion forums, blogs and podcasts
- Releasing advertisements on TV, radio, print, the web, and outdoor locations.
- Publications of books, brochures, fact sheets, leaflets, newsletters, posters, etc.
- Creation of knowledge repositories
- Creating digital archives for increased access to open access information.

Feedback is obtained through surveys, the readership of the newsletter, interviewing participants of training courses, and other means.

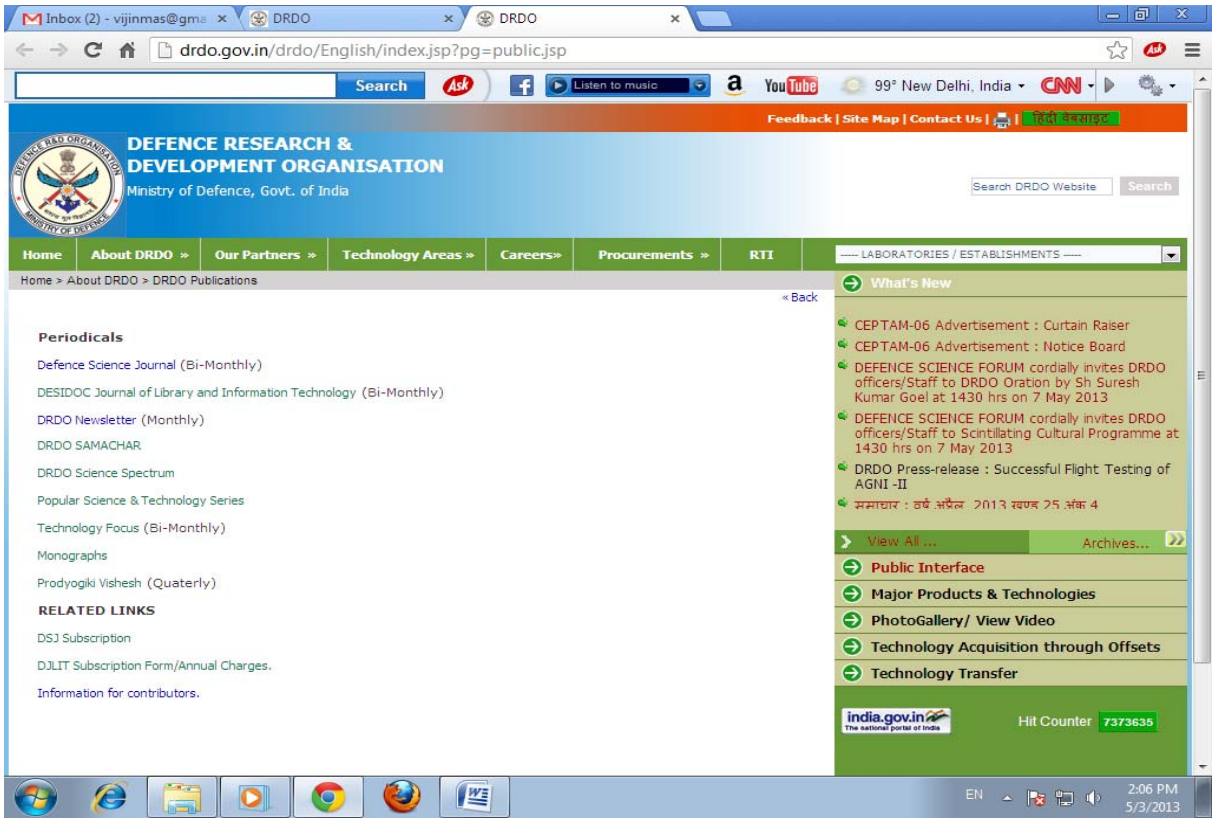
8. Publications by DRDO

The DRDO Publications homepage is given in Figure 1. The online publications posted by DESIDOC are:

8.1. *Defence Science Journal*

The *Defence Science Journal* is a peer-reviewed, open access, bi-monthly, DRDO research Journal and publishes original research directly related to defence. It covers various disciplines of science, technology and engineering. The major subject fields covered include: aeronautics, armaments, combat vehicles and engineering, biomedical sciences, computer sciences, electronics, material sciences, missiles, naval systems, etc[16].

Figure 1: DRDO Publications home page



8.2 *DESIDOC Journal of Library and Information Technology*

This peer-reviewed bi-monthly bulletin endeavors to bring recent developments in information technology to librarians, documentation and information professionals, students, and others.

8.3 DRDO Newsletter

Newsletters are among DRDO's most important communications tools. The *DRDO Newsletter* keeps the community informed of DRDO activities and accomplishments. Newsletters substantially improve the visibility of the organization and help strengthen relationships with customers or clients.

8.4 *DRDO Samachar (in Hindi)*

DRDO Samachar is a Hindi translation of *DRDO Newsletter* and aims to increase the visibility of the organization in Rajbhasha Hindi.

8.5 *DRDO Science Spectrum*

The *DRDO Science Spectrum* is an annual published by DESIDOC. The publication is a compilation of Science Day orations delivered by the DRDO scientists in their respective Labs/Estts.

8.6 *Popular Science & Technology Series*

Popularization of science is a major programme of DRDO Publications which publishes non-technical and affordable books for the public. DESIDOC has published 13 popular science books in English under different subject areas and two in Hindi. All the popular science books of DESIDOC have been well-received and several had to be reprinted 2-3 times.

I. Battle with Barnacles
II. Composite Materials
III. Computer & its Defence Application
IV. Electronic Warfare
V. Guided Missiles
VI. Kindling Creativity
VII. LASER & its Application
VIII. Night Vision Devices
IX. Radiation
X. Satellites
XI. Super Vision
XII. Toxicology & Human Life
XIII. The Living Desert
XIV. Sagar Mein Sangram (in Hindi)
XV. Computer AurRhakshaAnupryog (in Hindi)

8.7 *Technology Focus*

This publication, posted bimonthly by DESIDOC, highlights technologies, processes and products developed by DRDO. Each issue is devoted to a particular DRDO Lab/Estt or area of technology.

8.8 *Monographs*

DRDO started a Monographs/Special Publications Series in 1994 with an aim to promote the collection of specialised literature in areas of science and technology relevant to defence. DRDO invites proposals from scientists and provides grants to authors to help them alleviate expenditures towards contingent expenses, travel, and as an honorarium. Each title gives in-depth information on the subject, indicating current and future trends. The subjects selected for are generally ones for which there is demand at the regional, national and international levels[17].

8.9 *ProdyogikiVishesh (in Hindi)*

Figure 2: Screenshot of *ProdyogikiVishesh (in Hindi)*

This publication is posted quarterly to highlight the technologies, processes and products developed by the DRDO in Rajbhasha Hindi. A screenshot of *ProdyogikiVishesh* (in Hindi) is given as Figure 2.

Except for monographs, all the publications listed above are freely available, full text, on the DRDO website. They are regularly updated, open access, and searchable. A large number of special publications are also regularly posted by DESIDOC to meet occasional needs of the labs/estts and DRDO Headquarters. Printing is an important activity of DESIDO, with more than 100 publications produced each year. The Polygraph Division handles printing of regular and ad-hoc publications as well as booklets, pamphlets, brochures, posters, etc.

9. Other initiatives by DESIDOC: Database of Holdings of DRDO Libraries

The DRDO has 52 labs/estts across country which support the research activities of the parent lab. Their libraries are interconnected to each other and DESIDOC, which collects data on acquisitions made by all DRDO libraries in a relational database. In addition, the DRDO e-journal consortium facilitates sharing and improved access to information. Resources are shared among DRDO libraries that have common missions, goals, and users.

An Institutional Repository (IR) is a digital archive where a university/institution's intellectual work is made accessible and preserved for posterity. DESIDOC has created an Institutional Repository for archiving DRDO intellectual output. It is an online archiving tool that collects, preserves, indexes, & disseminates digital intellectual assets of research institutions (or organizations) and is accessible through a network. It is also used for long-

term preservation of digital documents. For this, DESIDOC uses DSpace open source software. The archives are available on both the DRDP Local Area Network and the Internet (beta version) for end users. This software supports the Open Archive's Initiatives Protocol for Metadata Harvesting (OAI-PMH) as a data provider, and has created enthusiasm for the self-archiving and IR movement, as the software is designed more for community-based usage. There are two levels of preservation: bit preservation and functional preservation. In the case of bit preservation files remain the same over time[18].

Presently DRDO IR contains four types of main communities: DRDO Headquarters, Image Gallery, Laboratories, and Women. It contains the collections of 3525 articles/papers related to biographies of DRDO eminent scientists, research papers and DRDO lab articles.

10. Directorate of Public Interface, DRDO HQ

The Directorate of Public Interface (DPI) has a mandate to plan and coordinate the activities of DRDO image-building. This includes planning the corporate identity, building work culture, and creating a value system for a globally respected and visible DRDO brand. DPI is the authorised channel for disseminating information about programmes, polices and activities of the DRDO and its labs, through print & electronic media including the Internet. Formed in 2008, it strives to enhance the bonding of DRDO with outside agencies like services, bureaucracies, the political leadership, industry, academia, S&T departments, students and the public[19].

11. Information Dissemination through TV Programmes

DPI is doing an excellent job in organizing, and telecasting the latest DRDO developments to the public. Recently telecasted episodes are listed below:

- Tejas—Inside Out: DRDO episode on Discovery Channel.
- Arjun MBT—Inside Out on Discovery Channel
- What Women Really Want? Dr ShashiBala Singh and Smt Tessy Thomas on CNBC-TV18.
- Walk the Talk. Dr VK Sarasvat, SA to RM, with Sekhar Gupta on NDTV 24x7
- DRDO Story on Super Soldiers on Sahara Samay TV.
- Agni-2 on India TV
- DRDO Story on Biodigester on LokSabha TV.

DPI is being directed to plan, organise, and telecast similar programmes on spinoff technologies more frequently, and offer a wider range of information products to the public.

12. Augmenting the DRDO Website

The official website of DRDO (drdo.gov.in) has recently been awarded with the prestigious Webratna Award 2012 by the Ministry of Communications and IT. The website is content rich, with contributions from 52 laboratories at different locations across country[20]. The website contains the latest visual effects and photo galleries with minimal download times. Desired information can typically be retrieved at a minimum of three clicks. The data is also available in Hindi.

DRDO can initiate a project to place information content on spinoff technologies in popular/nontechnical language on the DRDO website. This content should be highly illustrated and written in non-technical language for easy comprehension.

13. Future Dissemination Strategy

Effective dissemination means that the right people get the right information in a timely manner and in the right format. Effective dissemination engages the recipient in a process whether it is one of increased awareness, understanding, or commitment and action. The goal of dissemination is to encourage others to take action. The principles of communicating and disseminating results are:

- Focus on action.
- Study the audience background, needs, interests, concerns, and plans.
- Simplify the message: key points only.
- Report in many different ways: written products, personal briefings, meetings, seminars, workshops, and videos.
- Look for chances to report results. Be aggressive; don't be afraid to spread the word about your findings.

DRDO should follow an information distribution strategy in the future after assimilating the purposes listed above.

14. Conclusion

There is a strong link between science, literacy, economic development and sustainability. Scientific developments, if not communicated, are meaningless. A thorough outreach and communication plan is required to inform broader audiences, not only of what we are doing and accomplishing, but also why we are doing so, and how it is relevant to them. These communications should primarily be addressed to peers, stakeholders, and the public at large.

Even though the major beneficiaries of DRDO's contributions have been the defence forces, the spinoff benefits of DRDO have been of immense use to society. The food processing industries have commercialised many innovative technologies developed by DRDO. The hill agriculture technologies of DRDO have contributed to the economic development of people living in high altitude areas like Ladakh. The diagnostic kits developed for bio-defence will also be useful for the early diagnosis of diseases such as typhoid, malaria, plague, dengue and chikunguniya among the civil population living in rural areas. The water desalination

technology of DRDO has been able to provide potable water to a large population living in 40 villages of Rajasthan[21].

Hon'ble Prime Minister of India, Dr Manmohan Singh in his speech on the occasion of Technology Day Celebrations, stated that: *"The fruits of our technological progress must also reach to the common man. This is the only way in which we can make every citizen of India a productive participant in India's growth story. DRDO has a crucial role to play in leading by example."* He lauded the contributions of DRDO in nation-building and its yeomen services in the development of various products for civilians and societal applications. He also appreciated the services it renders to society[22].

Scientific knowledge should contribute towards economic prosperity and building a more inclusive society. Today, the bulk of India's population is gaining access to facilities for education and health care and living a life of greater hope and security. DRDO can make a meaningful contribution to these efforts by increasing public awareness about the achievements of DRDO in particular, and science in general, through interactive activities. Sincere efforts should also be made for measuring its performance, relevance and impact on society.

References

1. Indiana University Libraries, Bloomington. "Statistical Yearbooks at IUB (GIMSS)" http://www.libraries.iub.edu/index.php?pageId=3608. (Accessed March 23, 2013).
2. India accounts for one third of the world poor: World Bank, The Economic Times, 18 April 2013, 1.
3. Why India scores poorly in global hunger index. http://www.rediff.com/business/slide-show/slide-show-1-special-why-india-scores-poorly-in-global-hunger index/20121016.htm. (Accessed March 23, 2013).
4. Is Mr. A.P.J. Abdul Kalam an eminent scientist with an exceptional record and worthy vision? http://india.indymedia.org/content/2002/06/1650.shtml. (Accessed April 3, 2013).
5. Defence Research and Development Organisation (DRDO) http://www.drdo.gov.in/. (Accessed March 13, 2013).
6. Nourishing Persons Behind the Weapon. mod.nic.in/samachar/15july2001/html/ch6.htm. (Accessed Feb 13, 2013).
7. Engaged in the Science of Life. http://www.sainiksamachar.nic.in/englisharchives/2011/jun16-11/h7.htm. (Accessed Feb 3, 2013).
8. Nourishing Persons Behind the Weapon mod.nic.in/samachar/15july2001/html/ch6.htm
9. Engaged in the Science of Life - Sainik Samachar. www.sainiksamachar.nic.in/englisharchives/2011/jun16-11/h7.htm. (Accessed March 2, 2013).
10. DIHAR's 17th LadakhiKisanJawanVigyanMel. http://drdo.gov.in/drdo/pub/nl/2009/oct09.pdf. (Accessed March 2, 2013).

11. Defence Institute of High Altitude Research. http://drdo.gov.in/drdo/labs/DIHAR/English/index.jsp?pg=achieve.jsp. (Accessed Feb 3, 2013).
12. Spin-offs to the Civil Sector. http://drdo.gov.in/drdo/labs/DRL/ English/index.jsp?pg=Products.jsp. (Accessed April 5, 2013).
13. DRDO, BASIX, FICCI launch Aahar project to serve ready-to-eat roti, dal http://agriandfoodtidbits.wordpress.com/tag/readytoeat/. (Accessed March 23, 2013).
14. Enhancing food security through DRDO-developed Dal-Roti packs. http://www.ficci.com/pressrelease/877/Aahaar_-_PressReleaseFinal.pdf. (Accessed March 23, 2013).
15. Brief details of the projects undertaken by SBMT. http://www.sbmtindia.org/activities/. (Accessed March 1, 2013).
16. About The Journal. http://www.publications.drdo.gov.in/ojs/index.php/dsj/about. (Accessed March 3, 2013).
17. An Overview of DRDO Monographs. http://www.drdo.gov.in/drdo/English/index.jsp?pg=aboutusmonographs.jsp . (Accessed March 3, 2013).
18. Modi, Yogesh. "Building of DRDO Archives: The Initiatives of DESIDOC." DRDO Science Spectrum, March 2009, pp. 249-255.
19. Public Interface. http://drdo.gov.in/drdo/English/indexCorpDir_public.jsp?pg=AreasWork.jsp. (Accessed March 16, 2013).
20. DRDO Website Conferred Webratna 2012 Award. http://drdo.gov.in/drdo/pub/nl/2013/NL_January_2013_web.pdf. (Accessed March 15, 2013).
21. Tech Troop. sainiksamachar.nic.in/englisharchives/2008/feb01-08/h14.html. (Accessed March 22, 2013).
22. "PM addresses the DRDO Award Function." Press Information Bureau. pib.nic.in/release/release.asp?relid=38759. (Accessed March 23, 2013).