

EDUCATION, SCIENCE AND TRAINING

SENATE LEGISLATION COMMITTEE – QUESTIONS ON NOTICE 2003-2004 ADDITIONAL ESTIMATES HEARING

Outcome: CSIRO
Output Group: - CSIRO

DEST Question No. E956_04

Senator Carr provided in writing.

Question:

How many CSIRO Divisions are involved in such work?

What work are they engaged in?

Please provide a detailed, division by division answer.

Answer:

CSIRO has provided the following response.

Security-related research

This answer has been framed in the context of being as comprehensive as possible. We have detailed research which is mapped under the Safeguarding Australia National Research Priority, as well as technologies developed for other purposes that have potential applications to security related areas.

Security has always been an important part of CSIRO's research, but it is important to note that this research is focused in the civilian domain. CSIRO's research contributes to the protection of Australia's people, livestock, plants, food, water and infrastructure from harm.

Security-related research and development within CSIRO covers a wide range of disciplines, ranging from protection against invasive pests and diseases to detection technologies that have the potential for counter-terrorism or conventional defence applications. In 2001-02, CSIRO's estimated expenditure in the general area of security research was approximately \$81 million, with over 80% of that (\$65 million) going to protection from pests, weeds and diseases. Expenditure for the current financial year is estimated to be of a similar level, again predominantly in biosciences.

Of the five key areas of research identified in the Safeguarding Australia National Research Priority, CSIRO contributes significant national leadership to just one – our knowledge of invasive pests and diseases.

Of the 21 divisions and business units within the organisation, 18 are engaged in research that has been identified as having potential security application, as detailed below:

Atmospheric Research (CAR)

Aerosol Research.

Investigations of the chemical and physical properties of atmospheric aerosol over northern Australia, and studies of the impact of tropical haze on radiative transfer. The aerosol work is not classified *per se* but could be used to better model the performance of surveillance systems under conditions involving tropical haze.

Ocean Modelling System (also CMR).

This project produces daily, three-dimensional maps of currents, temperature and salinity in the oceans around Australia, with resolution of eddy-currents in a region within 2000 km of the coast, and resolution of local coastal currents (1 km scale) in a relocatable 500 km by 500 km box. A comprehensive understanding of the marine environment is essential for accurate climate modelling, but can also be utilised to assist the safe and optimum deployment of the Australian Defence Force in the maritime environment.

Hyperspectral Analysis (also CMIS).

Developing applications of hyperspectral image analysis, using aircraft and satellite platforms, and a variety of instruments for detection. Current focus is on landscape change, plant damage detection, toxic bloom detection in water, and some chemical signal detection. However, hyperspectral analysis could be used at event sites for remote damage assessment and possible chemical characterisation. Instruments could be developed on portable platforms for local analysis and integration into emergency response operations.

Australia Telescope National Facility (ATNF)

Nil.

Energy Technology (CET)

Nil.

Entomology

Diagnostics.

- Reference material for insect vectors and invasive species of invertebrates, with an extensive data base.
- Key IP in extracting clean DNA from “dirty” environmental samples and molecular markers for specific soil borne diseases.
- Biosensors and other molecular diagnostic technologies for detection of organisms.

Detoxification & Bioremediation.

- Proprietary enzymes for detoxifying hazardous chemicals.

Smart Biocides.

- Fast-acting and no-residue fumigants for devitalisation and decontamination.

Risk Assessment.

- Protocols and advice on risk assessment, and management of invasive species.

Facilities:

- Perth and Canberra High Security Physical Containment Facilities – PC4 and PC3 – high security facilities for research into plant pests and pathogens.

Exploration and Mining (CEM)

Magnetic Anomaly Detection (also CIP).

Superconductor-based detection systems, developed for the minerals exploration industry, have potential application in providing increased detection range, bearing and depth for submarines and sea mines.

Machine Vision, Robotics and Parallel Computation (also ICT).

The light-weight, low-power sensor systems that have been developed for the exploration and mining industries are ideal for surveillance activities and in applications such as pilotless aircraft for Coast Watch.

Secure Radio Communication in Noisy Environments (also ICT).

Development and application of radio communications and signal processing for the mining industry that could be applied to defence applications.

Guidance and Navigation of Large Vehicles (also ICT).

Unmanned vehicles for operating in unstructured and evolving terrains. Applications have been developed for mining vehicles that could be applied to unmanned defence vehicles.

Seismic Monitoring.

Real-time acoustic and seismic monitoring with algorithms for event detection, signal discrimination and interpretation and fusion technology for seismic source characterisation. This technology, developed for mine environments, has potential applications in remote border surveillance and control with the possible ability to detect, classify and locate a range of sources, including ground vehicles and explosions.

Food Science Australia (FSA)

Integrated Food Safety.

FSA's Integrated Food Safety theme is the focus for any work around food contamination (chemical, physical or microbiological) and chain security, whether adventitious or malicious. FSA is also the co-partner in the National Food Industry Strategy (NFIS) Australian Centre of Excellence for Food Safety, and the Director of FSA sits on the Food Chain Assurance Advisory Group to the Critical Infrastructure Advisory Council which is currently developing a National Food Security Strategy. Within this, FSA is advising on the monitoring, surveillance and scientific response in the event of a food security crisis.

Within the Integrated Food Safety theme the issue of food security falls into two FSA science platforms: active packaging which is being oriented into potential tamper evidence systems (for example, laminates that separate or films that change colour on tampering) and the detection and mitigation strategies for food contamination, mainly microbiological, but also chemical.

Facilities:

- FSA has physical containment (PC2 and PC3) laboratory facilities enabling safe work with both pathogens and toxic substances and also have analytical facilities capable of being mobilised for screening and surveillance programmes if necessary.

Forestry and Forest Products (CFFP)

Security Papers.

The fraudulent tampering of security documents produced on laser printers is becoming an ever-increasing problem worldwide and one for which a cost-effective solution is being actively sought. The project aims to find improved ways of producing a stronger bond between toner and paper, developing a new paper grade that allows dissemination of classified or sensitive information in a more secure manner.

Border Security for Plant Imports.

The project uses molecular biology techniques and is supported by fungal collections in both Perth, WA and Clayton, VIC.

Health Sciences and Nutrition (HSN)

Protein-Based Biosensors (also Molecular Science).

CSIRO's Parkville laboratory, through its involvement in the CRC for Diagnostics, produces novel diagnostic reagents against possible biowarfare targets.

Biological Dosimetry of Radiation Exposure and Countermeasures.

The Genome Stability Project is internationally renowned for the development of sensitive techniques for measuring exposure to ionising radiation and other genotoxins using genome damage as the biological marker of exposure. These methods are now used world-wide for biological monitoring of radiation accidents. The techniques developed by the Genome Stability Project can be used to (a) assess accurately the extent of radiation exposure in a large group of people, (b) rapidly identify those with life-threatening doses of genome damage for bone-marrow transplant therapy and (c) design appropriate dietary countermeasures that minimise the genotoxic effects of exposure to radiation.

ICT Centre (ICT)

Machine Vision, Robotics and Parallel Computation (also CEM).

The light-weight, low-power sensor systems that have been developed for the exploration and mining industries are ideal for surveillance activities and in applications such as pilotless aircraft for Coast Watch.

Secure Radio Communication in Noisy Environments (also CEM).

Development and application of radio communications and signal processing for the mining industry that could be applied to defence applications.

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Data Integration.

The IMP software enables complex queries on multiple databases that are owned by different organisations. Key elements of the design are aimed at collating data across organisational boundaries.

Acoustic Mine Imaging.

A high-resolution, real-time underwater imaging system developed for use by the Australian Navy, which can be incorporated into an unmanned vehicle for the detection and destruction of sea mines.

Video Surveillance, including Face Recognition (also CMIT).

CSIRO has capabilities in video surveillance, with particular focus on the automatic analysis of the video stream to capture faces and match them to a database of images (face recognition) and in developing parallel hardware and software computing to support very fast processing.

mm-Wave Passive Imaging.

An imaging system that can penetrate cloud, fogs and clothing for surveillance purposes is at early design and prototype stage.

Industrial Physics (CIP)

Sub-Surface Radar.

SiroPulse was developed for civil engineering and mining applications, but units have also been used for the detection of hidden microphones.

Magnetic Anomaly Detection (also CEM).

Superconductor-based detection systems, developed for the minerals exploration industry, have potential application in providing increased detection range, bearing and depth for submarines and sea mines.

Nanotechnology.

A search of public domain literature to determine what constitutes “state of the art” in the nanotechnology domain.

High Power Ultrasound.

Investigating the use of ultrasound to remove marine growths from maritime vessels and to sterilise bilge and cooling water.

Acoustics & Ultrasonics.

“Bandicoot” has been developed for the airframe industry and uses ultrasound to detect structural flaws in composite materials. It is also intended to develop the unit for scanning packages and boxes for anomalies in construction or unexpected discontinuities.

Microtechnology and Surface Engineering (also Molecular Science and CMIT).

Optical variable devices (OVD) and microtext and images for document security, forensic tracers, machine readable covert identification systems, personalised cards for drivers’ licences, credit cards and identity cards and product protection, including currency authenticating systems.

Land and Water (CLW)

Biological Sciences.

- Microbial ecotoxicology - using microbes to detect the toxic effect of chemicals in its environment.
- Molecular diagnostic tools to assess the functional status of microbial populations in soils, sediments and aquatic environments.

Detoxification & Bioremediation.

- Treatment methods for the production of biologically stable drinking water.
- Methods for removing uranium from water.

Remote Sensing and Monitoring.

- Development of high resolution, real-time image analysis of satellite data applied to environmental monitoring applications. Sentinel Hotspots (bushfire mapping) is a recent initiative likely to be extended to other emergency applications.
- Remote real-time monitoring of key infrastructure through continued development of ‘smart’ monitoring networks.

Landmine Detection (also CMIS).

CLW apply soil science expertise and analysis to detect surface and shallowly buried targets such as landmines, unexploded ordinance, weapons and graves.

Facilities:

- Isotope Analysis Service providing stable isotope analyses for hydrological, environmental, biological and medical purposes. CLW also has a comprehensive carbon dating capability, CFC laboratory and analytical facilities for ^{222}Rn (radon) and ^{226}Ra (radium).

Livestock Industries (CLI)

Livestock Industries is developing diagnostic tools for, and in some cases, studying in depth, a number of exotic livestock pathogens. These include pathogens of aquaculture species (prawns and fish), well known pathogens such as Foot and Mouth Disease virus, West Nile virus, BSE, avian influenza, as well as newer or emerging agents such as the Nipah and Hendra viruses. There is also work on developing diagnostic tools for SARS.

CLI also has a contract with the University of Calgary (Alberta) to help develop a vaccine against "gladders", an ancient and well known bacterial respiratory disease of horses. The bacterium can infect humans, is easily isolated and could potentially be cultivated as a biological warfare agent.

Facilities:

- CLI maintains the Australian Animal Health Laboratory (AAHL) in Geelong, VIC, which is the only high security facility in Australia for holding animal and human pathogens.

Manufacturing and Infrastructure Technology (CMIT)

Security in Food Packaging (with FSA).

CMIT provides its patented "holographic" excelgram/vectorgram technology to packaging materials to FSA's tamper-evident active packaging research, as well as radio frequency tagging of packaging, allowing efficient tracking of batches of food.

Video Surveillance, including Face Recognition (also ICT).

CSIRO has capabilities in video surveillance, with particular focus on the automatic analysis of the video stream to capture faces and match them to a database of images (face recognition) and in developing parallel hardware and software computing to support very fast processing.

Microtechnology and Surface Engineering (also CIP and Molecular Science).

Optical variable devices (OVD) and microtext and images for document security, forensic tracers, machine readable covert identification systems, personalised cards for drivers' licences, credit cards and identity cards and product protection, including currency authenticating systems.

Protective Materials Technologies.

Materials that can withstand extreme loads for use in construction. These extreme loads may be caused by a combination of hydrocarbon fires, explosive blasts, and both low and high velocity impacts.

Detection and Recovery from Water and Air-borne Pathogens.

Technology to determine the risk factors through the whole water cycle, from water collection, water treatment, transport, waste treatment and then disposal. It includes both physical and biological issues including the potential health effects and the possible environmental effects from contamination, and developing options for distributed monitoring and controlled management of alerts.

Infrastructure Performance and Sustainability.

Autonomous monitoring of whole of infrastructure performance using a large number of widely distributed sensors in an array format. Systems developed to network all the information and provide dynamic evaluation.

Transport Security.

Studies of the security that can be achieved in transport systems given the constraints imposed by cost and service provision needs. CMIT is building Geographic Information System (GIS) based tools for real-time traveller information (including real time reading numberplates with highway speed and monitoring movements of vehicles on roads), allowing rapid response to incidents.

Bulk Freight and Baggage Screening (also Minerals).

The overall objective of the project is to develop and field test new techniques for the non-intrusive inspection of air cargo. International airport baggage conveyor systems are being monitored to prevent dangerous goods and humans from entering secure airport areas via conveyor systems at one major airport.

Marine Research (CMR)

Risk Assessment and Management of Marine Pests.

This project assesses the threat posed by known and potential introduced species in the marine environment, examines the potential for using integrated pest management techniques to control known pest species and aims to minimise the risks of new introductions by developing better ballast water and hull fouling management protocols and treatment methods.

Ocean Modelling System (also CAR).

This project produces daily, three-dimensional maps of currents, temperature and salinity in the oceans around Australia, with resolution of eddy-currents in a region within 2000 km of the coast, and resolution of local coastal currents (1 km scale) in a relocatable 500 km by 500 km box. A comprehensive understanding of the marine environment is essential for accurate climate modelling, but can also be utilised to assist the safe and optimum deployment of the Australian Defence Force in the maritime environment.

Mathematical and Information Sciences (CMIS)

Hyperspectral Analysis (also CAR).

Developing applications of hyperspectral image analysis, using aircraft and satellite platforms, and a variety of instruments for detection. Current focus is on landscape change, plant damage detection, toxic bloom detection in water, and some chemical signal detection. However, hyperspectral analysis could be used at event sites for remote damage assessment and possible chemical characterisation. Instruments could be developed on portable platforms for local analysis and integration into emergency response operations.

Data Analysis.

- Specialised statistical algorithms for analysis of DNA and protein data from bioassay microarrays.
- Image analysis, with particular emphasis on automated extraction and analysis of quantitative information from digital images.
- Automated detection of features and events within audio and video data.

Computational Fluid Dynamics.

Modelling of high speed fragmentation, blasting and effects of explosions.

Modelling of Thermal Infra Red Techniques for Landmine Detection (also CAR).

A mathematical model based examination of the environmental and other factors that influence the strength of the surface soil temperature disturbance above buried objects such as landmines. This work has application for the thermal IR detection of landmines. Other methods of landmine detection, such as metal detection and ground penetrating radar have also been modelled.

Modelling of Aircraft Movement.

Applied mathematical modelling of flight dynamics, flight kinematics and communications relating to aircraft proximity, in particular, the mathematics of User Preferred Trajectories (UPT) as discussed in the Australian Air Traffic Management Strategic Plan 2003 and as applies to airborne navigation guidance and control algorithms. This capability could be directed towards system solutions that reduce the number of unknown aircraft, the presence of which, adversely affects airspace safety, security and survivability.

Environmental and Economic Risk Assessment.

Collaboration with organisations such as AQIS, Biosecurity Australia, and other government agencies, to determine potential impact of threats to Australia's agricultural industry, environment, and infrastructure such as power supply authorities.

Multivariate Public Health Surveillance.

Multivariate models can be used to forecast specific health incidences from nurse/doctor notes at emergency departments, student absenteeism at schools, and from laboratory test results. These will help health services to rapidly identify and respond to major public health problems, whether benign or malignant in origin, by indicating what is driving the increases, where, when and at which health service is the best place to contain the problem.

Minerals

Bulk Freight and Baggage Screening (also CMIT).

The overall objective of the project is to develop and field test new techniques for the non-intrusive inspection of air cargo. International airport baggage conveyor systems are being monitored to prevent dangerous goods and humans from entering secure airport areas via conveyor systems at one major airport.

Demining and in-Field Screening: Gamma Camera.

The gamma camera is capable of forming three-dimensional (3D) images of objects that can only be viewed from one side. The images formed are based on the density distribution of the target. Originally designed for the detection and localisation of buried landmines, work to date has shown that the camera will be capable of forming 3D images with 20-30 mm resolution up to 200-300 mm into the ground.

Molecular Science

Biosensors (also HSN).

Development of new materials for the detection of toxins (toxin-sensing gels). This work is complementary to the research done in HSN.

Microtechnology and Surface Engineering (also CIP and CMIT).

Optical variable devices (OVD) and microtext and images for document security, forensic tracers, machine readable covert identification systems, personalised cards for drivers' licences, credit cards and identity cards and product protection, including currency authenticating systems.

Advanced Composite Materials.

Structural chemistry and composite fabrication technologies have a wide range of possible applications, including military hardware.

Literature/patent survey of international capabilities in nanotube research and technologies.

Petroleum Resources (CPR)

Nil.

Plant Industry

Plant Industry develops methodologies and germplasm for protection against serious pests and diseases of cereals, pastures, cotton, grain legumes, fruit and vegetables.

Work on the evolution of plant diseases in natural ecosystems is providing information on the persistence of plant diseases and their impact.

The Australian National Herbarium provides a major facility to assist in the early identification of invasive plants.

Sustainable Ecosystems (CSE)

Wildlife, Pests and Diseases.

Vertebrate pests and introduced diseases threaten Australia's native plants and animals, damage agricultural production and can affect human health. This research aims to understand the way populations and communities of native wildlife and pest animals persist and interact with each other and the environment, with the intent of devising methods to conserve wildlife and manage and control populations of pest species using ecological and biotechnological solutions.

Textile and Fibre Technology (CTFT)

Smart Textiles:

- Membranes that are breathable but impervious to large molecules in one direction.
- Textiles which react and neutralize specific chemicals.
- Flexible electronics – garments with interwoven sensors could have application in monitoring the health and wellbeing of armed personnel.