

CSIRO ON THE MOVE

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This paper outlines some recent and planned developments in CSIRO which are all aimed, directly and indirectly, at 'creating wealth for Australia through science and technology'.

SETTING RESEARCH PRIORITIES

In its report 'Setting Directions for Australian Research' ASTEC concluded, from international case studies, that examples of successful priority setting have a number of structural similarities:

the exercise is overseen by a high level committee with **authority** to implement results;

a working group has executive responsibility with sufficient appropriate expertise to be accepted as **legitimate**;

detailed analysis is carried out by those with **technical credibility**; and

consensus generation ensures **commitment** to the results as well as encouraging input from all levels.

CSIRO has all these elements, and it has a **responsibility** to implement the results of its deliberations.

Since I joined CSIRO in March of this year, we have undertaken an assessment of national priorities for research, as a basis for determining the Organisation's own research priorities and resource allocation. CSIRO has a broad mandate, as indicated by its Ministerial Guidelines, which state that its "main task will be the conduct of strategic and applied research in support of national economic, social and environmental objectives". CSIRO conducts research in a wide variety of areas, as indicated by its organisational structure of the following six Institutes:

Animal Production and Processing;

Industrial Technologies;

Information Science and Engineering;

Minerals, Energy and Construction;

Natural Resources and Environment; and

Plant Production and Processing.

CSIRO must therefore undertake strategic decision-making at a very broad level, which is a complex task. To assist this process the Organisation has been developing a decision framework which can be applied at all levels from national priorities to programs and projects. A model based on multiple criteria is needed, which ultimately enables assessment of the economic, environmental

and other benefits to the nation of research that is conducted for particular purposes. There has been intensive consideration of:

- . the classification of the total possible national research effort into convenient and meaningful units or 'research purposes' ;
- . the criteria whereby the research purposes would be assessed; and
- . the methodology for assessing priorities.

CLASSIFICATION OF RESEARCH PURPOSES

A modified version of the national research classification, based on socioeconomic objectives, is being used. This is based on the comprehensive approach of the Australian Bureau of Statistics structure, which categorises all research into four 'divisions' or principal objectives (advancement of knowledge, economic development, national welfare and national security). Each division has more detailed classifications at the sub-division, group and class level. Sub-division level classifications to which science and technology are relevant are shown in Table 1. This is a comprehensive set of 'research purposes' but has been developed so that all are meaningful to CSIRO. Other options such as technology classifications were considered, but it was concluded that the current classification of research purposes is most appropriate at the broad national level.

KEY DATA

For each research purpose, key data such as the following have been assembled: gross value of production, exports, imports, value added, research expenditure in Australia and overseas, major performers of research, research intensity, key issues, opportunities and constraints. The data sets provide useful reference points for application of evaluation criteria.

EVALUATION CRITERIA

The CSIRO Board has recognised that, for a strategic research organisation, consideration of a range of criteria is essential when determining research priorities. Benefit-cost evaluations of many projects have been conducted, and criteria for evaluation of national and organisational research priorities are consistent with this approach. Explicit criteria for the assessments currently being made of research objectives are:

- . the *potential benefits* (economic, environmental and other social benefits); ie the maximum commercial or other returns possible from technological improvements resulting from research for the purpose in question;
- . Australia's ability to *capture* the benefits; ie the ability of Australia's organisations, private or public sector, to convert technical progress into commercial or other returns;
- . *R&D potential*; ie the scientific or technological potential of relevant research areas; and
- . *R&D capacity*; ie Australia's ability to conduct the R&D and realise its potential in a time' way.

The criteria are consistent with a conceptual framework for assessing the return on R&D which was developed by the US-based Industrial Research Institute during the period 1982-84.

TABLE 1

NATIONAL RESEARCH PRIORITIES SUB-DIVISION LEVEL RESEARCH PURPOSES USED BY CSIRO	
1.	Plant Production and Primary Products: Research to benefit field crops, horticulture and forestry, and the primary products of these industries
2.	Animal Production and Primary Products: Research to benefit livestock production, the fishing industry and their primary products (wool, meat, milk, fish, other)
3.	Rural-Based Manufacturing: Research to benefit processed food and beverage production, fibre processing and textiles, wood products and furniture, leather, other
4.	Minerals Industry: Research to benefit exploration, mining and extraction, refining and smelting and the production of basic metal and mineral products
5a.	Energy Resource Industry: Research to benefit the exploration for, mining and extraction of, and preparation and supply of energy resources (uranium, coal, oil, other)
5b.	Energy Supply: Research to benefit the transformation, distribution, conservation and efficient use of energy (electricity, gas, liquid, other)
6.	Manufacturing Industries: Research to benefit manufacture of mineral, fabricated metal and chemical products, machinery and equipment (transport, agriculture and mining appliances)
7.	Information and Communication Industries: Research to benefit production and provision of computer and communications equipment, software and services
8.	Transport: Research to benefit the provision of transport services (road, rail, sea and air) and intermodal materials handling
9.	Construction: Research to benefit planning and design, construction materials, methods, products and services (residential, industrial, civil, other)
10.	Commercial Services: Research to benefit water supply, wholesale and retail trade, finance, property, business, recreation (tourism) and other services
11.	Economic Development - Environmental Aspects: Research to minimise the pollution and other environmental degradation arising directly from activities associated with sub-divisions 1-10.
12.	Environment: Research to provide knowledge of climate, ecosystems, atmosphere, oceans, water resources etc., to assist conservation and sustainable use
13.	Health: Research to benefit public health, clinical health (organs, diseases and conditions), and health and support services
14.	Defence: Research to benefit the defence-related industries (electronics, weapons systems, surveillance, aeronautics, materials, other)
15.	Social Development (Community Services): Research to benefit social development and welfare services, public services, recreation and heritage (natural and cultural)
16.	Advancement of Knowledge

METHODOLOGY

CSIRO has adopted a scoring approach for evaluation. In a group situation, participants individually score each research purpose and criterion combination; after discussion and iteration, scores for each criterion are averaged across the group for that research purpose.

Group interaction is most important for the process to achieve its full potential. The Chief Executive and Institute Directors have undertaken scoring as a group, after considering supporting data and hearing presentations on each research purpose. Re-scoring has taken place following discussion of individual scores. CSIRO Board members have been actively involved.

Although scores are based on the most rigorous information available, they are representations of judgements and are significant in a relative rather than an absolute sense.

To facilitate comparisons, a single score for each research purpose may be obtained by combining the scores on the four criteria. Given the nature of the criteria, combination should be by multiplication, as defined in Figure 1. However, a listing of composite values masks valuable information, particularly in blending external factors with those which the research organisation can influence. A better method of combining individual criteria and considering the results is by display on an 'attractiveness-feasibility' screen, as shown in Figure 2. In this case:

- . *attractiveness* (determined by multiplying the score for potential benefits by that for ability to capture) measures the likely benefit of successful research and is determined by factors over which research organisations have little control; and
- . *feasibility* (determined by multiplying the score for R&D potential by that for R&D capacity) is a measure of the ability to achieve technical progress in Australia (per unit of R&D investment).

A research purpose which ranks highly on both attractiveness and feasibility clearly warrants investment of resources. The further towards the top right hand corner of the screen the research purpose lies, the more it is considered deserving of support. Selectivity in providing resources needs to increase as research purposes lie further toward the origin of the screen.

RESOURCE ALLOCATION DECISIONS

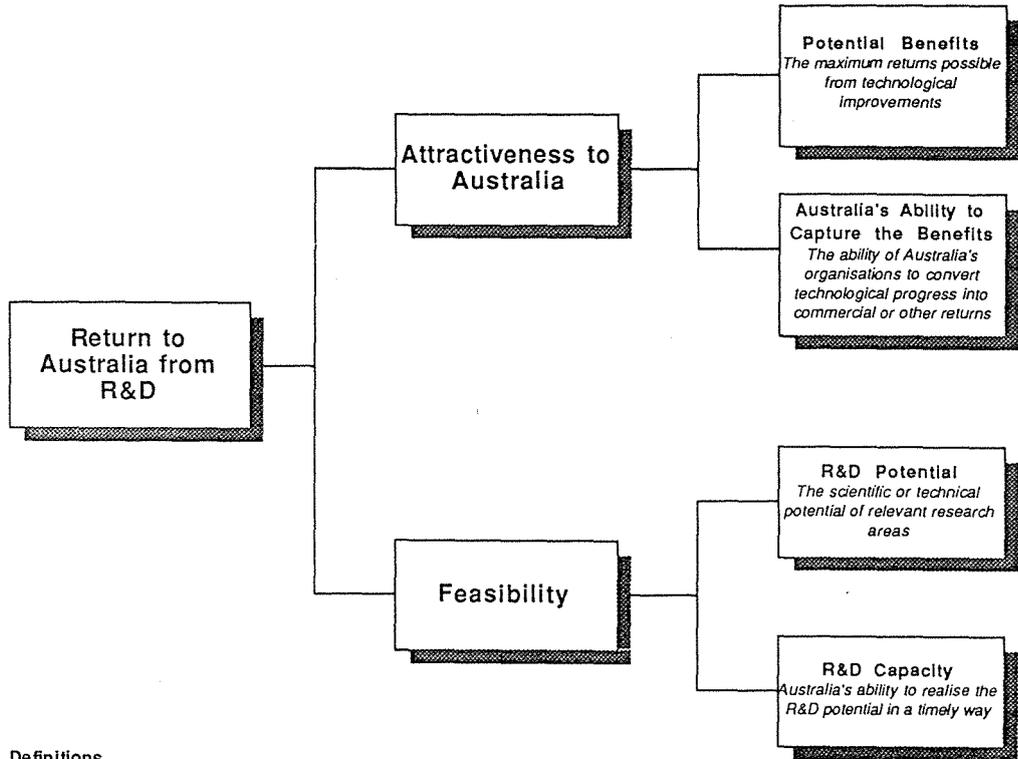
Based on the analysis above, CSIRO is considering resource allocation at two levels:

- . the level of research for each purpose which is appropriate at the national level; and, given conclusions in this regard,
- . the level of support CSIRO should provide for each purpose.

Decision-making in this regard demands good quality data on;

- . the existing levels of effort being undertaken by CSIRO and other organisations (both public and private); and
- . existing and possible levels of industry and other user support.

Figure 1. Priority Assessment Framework

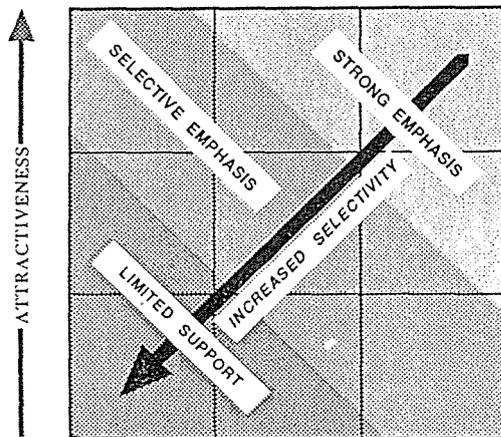


Definitions.

Attractiveness to Australia is the product of the Potential Benefits and Australia's Ability to Capture the Benefits. It measures the likely benefit of successful research and is determined by factors over which the research organisations have little direct control.

Feasibility is the product of R&D Potential and R&D Capacity. It is a measure of the ability to achieve technical progress in Australia (per unit of R&D investment).

Figure 2. Attractiveness-Feasibility Screen



Assumptions underlying less structured judgements are challenged by a comparison of current organisational, national and international levels of investment in research with the results of the scoring process. However, the responsibility to arrive at a **judgement** remains, though it is a judgement based more on data and knowledge sharing than before.

Importantly, CSIRO has found that exercises of the type outlined both require and encourage participants to step beyond their own sectional responsibilities, taking a corporate view. This enhances both the quality of group recommendations and decisions, and general commitment to them.

The outcome of these corporate deliberations will provide the framework to guide resource allocations at all levels in CSIRO. We are interested to contribute to, and take into account, the activities of other groups concerned with strategic directions for research. It is important that activities like this are comparable with those of other groups undertaking them, such as ASTEC. For this reason we strongly advocate the use of the ABS classification structure.

BUDGET ISSUES

As a strategic research organisation, CSIRO needs to have an established budget for a period of some years in order to plan its research priorities effectively and to implement its strategies. The Budget for the next triennium will be crucial for CSIRO'S management and performance over the next few years. The challenge for CSIRO is to demonstrate that it is a good investment for the appropriation provided by the Government, and for funds from industry and other users of research. A publication setting out information and examples of CSIRO's contribution to the nation has recently been prepared and will be available at NSTAG 90.

The August 1990 Budget showed a marginal increase in real terms for CSIRO's budget. However, the application of an efficiency dividend to the Organisation means that untied funds were reduced by \$3.8 million. The small real increase in total appropriation was a result of new funds for specific activities promised during the recent election. CSIRO will be negotiating its Budget for the next triennium later this year, based on the following principles:

- . maintenance of appropriation funding in real terms at not less than existing levels, but with an increase in the present capital base;
- . the right to argue specific cases for additional funding for major programs and capital items on a case by case basis;
- . retention of the 30% external funding target as the maximum but with some flexibility in the timing to allow the quality and relevance of the research output and general community benefit to be considered;
- . maintenance of the policy on retention of external earnings from all sources without any offsetting of appropriation; and
- . inclusion of overhead and infrastructure costs in funding from research councils and corporations.

BETTER CAREER OPPORTUNITIES FOR CSIRO

CSIRO and other parts of the research community are concerned about the problems that may arise in the future because young people in general are not finding careers in science attractive. Appropriate numbers of high calibre recruits may not be available when a substantial number of researchers retire over the next decade or so. CSIRO is addressing this problem, as well as a community equity issue, in its approach to award restructuring.

In tabling the 1985 ASTEC report on the future of CSIRO, the Prime Minister said that the scale of change in the 1980s was such that a re-directed role for CSIRO was fundamental to Australia's growth strategies. The adoption of this role has required a shift in the ethos of the Organisation from one which has been largely science oriented to one which is largely applications oriented.

CSIRO scientists have had a range of demands, beyond the conduct of research, placed on them over the past decade. Significant structural and policy changes have been undertaken to improve the effectiveness of the Organisation's research effort in terms of the national benefits that flow from that effort. The past four years have witnessed a restructuring of CSIRO along 'business system' lines to ensure that its organisational structure is aligned with industry sectors. A 30% external funding requirement is being achieved. Attention has been focused on:

- . better selection and management of research programs, including a framework of retrospective and prospective evaluations and a formal framework for broad research priorities as outlined above; and
- . improved staff performance review and development processes.

Research managers must balance the greater emphasis on application of research against a continuing need for the longer term strategic research on which future developments depend. They must also ensure that research addresses the protection of the environment and the sustainable use of resources - CSIRO must play the role of 'honest broker' on issues where economic development and protection of the environment may be in conflict. In this context the Organisation is increasingly being called upon to provide advice to government.

At the same time as scientists' responsibilities have broadened and deepened, their rewards have become unattractive compared with many other sectors of the community. Award restructuring has presented CSIRO with an opportunity to revise radically its salary structures, rewards, performance assessment processes and career development opportunities so as to address this problem. Consistent with the Government's structural efficiency principles, a broad agenda addressing these issues was developed with the unions.

The key objectives of CSIRO's award restructuring proposals are to:

- . provide better rewards and career structures in order to make science a more attractive and rewarding career;
- . establish in one award a nine-level salary structure covering all staff except the very top managers - the Chief Executive and Directors;
- . seek substantial salary increases for research scientists and research managers;

- introduce competence-based classification guidelines focusing on performance and achievements;
- enhance flexibility and efficiency through streamlining operational practices and conditions; and
- enhance training and development opportunities and introduce career planning for all staff.

Objective setting, performance assessment, reward determination and career training and development will be integrated in the implementation of changes.

The Industrial Relations Commission (IRC) has now endorsed a new nine-level salary structure proposed by CSIRO. Witness evidence on the proposed salary levels was presented to the IRC during August and early September 1990. Some fifty witness statements representing staff at most levels were handed up to the Commission. About thirty witnesses appeared before the Commission, including the Chief Executive, several Institute Directors and Chiefs. Unions involved in CSIRO cooperated in selecting witnesses and presenting CSIRO's case. The work value aspect of the case was completed with a summary presentation of CSIRO's case to the IRC on 4 and 5 September. A decision on salaries and translation arrangements was expected to be handed down in the second half of September. Implementation is expected to be phased in over the period to 1 July 1991. The positive outcome indicated in principle by the Industrial Relations Commissioner on 5 September is a landmark for community recognition of the contribution of scientists and technologists to the wellbeing of the nation.

COMMERCIALISATION AND THE ROLE OF SIROTECH

A significant part of CSIRO's research effort relates to environmental and other national benefit issues, rather than products with potential for commercialisation. However, commercialisation activities are a most important and growing aspect of CSIRO's responsibilities. We published our commercialisation policy last year and are giving further consideration to issues associated with it.

CSIRO sometimes has been perceived as driving research projects from a research perspective, rather than primarily in response to perceived market, community or social needs. The commercialisation of CSIRO research is often difficult. It is generally conceded that research commercialisation in companies that already have a line of related products, and accessible markets, is substantially more successful than in companies attempting to build a business based on an innovative research discovery.

Two-thirds of Australian manufacturing is now in the hands of multinationals who mostly perform their R&D overseas, and it is increasingly difficult to find Australian companies willing to undertake local technological development for markets which they control. It is against this potentially hostile environment that commercialisation strategies must be developed for CSIRO to succeed in the coming decade.

Under consideration is a transition for CSIRO's commercial arm, Sirotech, toward a new, more broadly based company, Australasian Technology Group. The immediate opportunity for Sirotech is to devote considerable attention to the nature of the business of specific Australian companies (and multinational companies operating in Australia), understanding their needs for technological innovation, and then developing specific plans for CSIRO research to be inserted into these selected

companies. This approach, being led by Dr Colin Adam, will both increase the intensity of research funding within CSIRO Divisions and encourage the development of a market-oriented R&D philosophy.

Commercialisation is a highly interactive and iterative process with the commercial partner, often extending over several years, and requiring more 'market-access' data than any Division will ever possess. Sirotech currently provides some market assessment data needed by Divisions to inform their research projects commercially. By routinely developing market intelligence about specific businesses and their current technological capabilities it would become possible for Sirotech to identify future opportunities with new customers. The financial backing needed for some innovative projects has already been obtained from BHP, Boeing and the Australian Wool Corporation by aligning specific Divisional research capabilities with specific long-range corporate objectives.

Over the next two years it is likely that many of the smaller contracts previously handled by Sirotech will be handled within Divisions, leaving Sirotech to negotiate larger "market-driven" opportunities involving CSIRO more widely.

With Sirotech having demonstrated capability in commercialisation of CSIRO research, consideration is now being given to formation of an Australian Technology Group (ATG), building on the experiences of groups like the British Technology Group, but involving particular aspects of financing which take into account the state of Australian capital markets following experience with the 150% taxation concession for R&D and the MIC scheme. A company with a broader charter and a sounder financial base than Sirotech could operate more as a technology evaluation, investment and marketing company than as an advisory technology transfer company.

The company could be chartered to select and commercialise specific technologies developed in public sector research in Australia. It could be empowered to invest in the further development of specific technologies in the source laboratory or elsewhere with appropriate partners.

Such an operation could be beneficial to Australian research establishments. CSIRO Divisions are already dramatically improving their commercial capabilities, and should continue to do so; it would therefore be important that ATG activities develop at a substantially higher managerial level. Rather than compete with CSIRO Divisions, or with the universities' 67 technology transfer companies, involved predominantly in consulting contracts and contract research, an ATG might concentrate on:

- (1) Assessment of the commercial potential of research, including market research, project definition and assessment.
- (2) Patent feasibility and intellectual property strategy assessment.
- (3) Feasibility and assessment of R&D ventures, including business planning.
- (4) International market access research and strategies for commercialisation.
- (5) Contract services and negotiations.
- (6) Financial services, licence agreements and capital formation.
- (7) Joint venture and ab initio start-up potential; company formation.

(8) Equity participation and management.

Further consideration will be given to the ATG concept in CSIRO.

CONCLUSION

These bold plans for CSIRO are a response to our 'shareholders', the Australian people - aimed at ensuring that the science and technology of the 'clever country' improve Australia's economic performance and, at the same time, its care of the environment.