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POLICY AND PROGRAMME FOR IMPROVING EFFECTIVENESS OF THE APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

Report of F. Neville Woodward
Research Management Adviser

Kingdom of Thailand

9 October–30 November 1972

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POLICY AND PROGRAMME FOR IMPROVING EFFECTIVENESS

OF THE

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

MISSION THA - 001 - SWH (SF/ID)

INTRODUCTION

The Government of Thailand asked UNIDO for the services of an expert for two months to:

1. survey the organizational set-up and administrative practices of ASRCT, and TRI in particular, as well as their ties with industry, taking into account their current and future programmes;

2. recommend measures to be implemented (including modern managing methods and internal structure) to improve the effectiveness of research management within ASRCT resulting in more effective industrial application of research findings as well as rendering industrial extension services to industries;

3. advise on further action to be taken by UNIDO to assist in the attainment of the above purposes.

The writer, who was assigned this task, spent an eight-week period (6 October - 30 November 1972) in Thailand during which he examined in detail the organization and activities of the Corporation (ASRCT) and the Technological Research Institute (TRI) from their inception in 1964 to date. He also visited and held discussions with appropriate government officials, industrialists and university staff as well as with government and quasi-government organizations whose operations have or could have a bearing upon ASRCT and UNDP/UNIDO staff and experts.

On the basis of the information thus obtained, and recorded in summarized form in this report, the problems facing the ASRCT Management were identified and analysed and a policy and programme proposed which if implemented is believed will make the operations of the Corporation more effective and of greater and more immediate benefit to industry and the national economy than heretofore.

This task was made easier than it otherwise would have been by the setting up of an ad hoc "Planning and Organization Chart Committee" by the Governor, which had done a lot of preparatory work before the writer arrived and by the availability of the results of a study, by the ASRCT Science Policy Studies Unit (Sussex University), of the factors inhibiting technology transfer from the Corporation to industry.

PART I. CURRENT SITUATION

BACKGROUND

Following a request for expert advice from the Government of Thailand, the UN Technical Assistance Administration, provided the services of Mr. F.G. Nicholls for one year (June 1960 - June 1961) to survey such state aided research activities as existed and to recommend how these might be improved or expanded to assist industry. His report "A Programme for the Development of Scientific and Industrial Research in Thailand" envisaged an expansion and reorganization of the Department of Science, Ministry of Industry, but certain of his recommendations were not acceptable to the Government of the day. In a return mission Mr. Nicholls spent a further three months (July - September 1962) reexamining his proposals in the light of the Government's requirements and he amended his earlier recommendations to provide a more acceptable framework for the development of applied scientific research in the country. In his second mission report "The Development of Applied Scientific Research in Thailand: Stage One" dated September 1962, he recommended that:

> "the task of managing the nation's major applied scientific research effort be allocated to a new body to be known as the Applied Scientific Research Corporation of Thailand. This will be a statutory corporation with freedom to hire and fire staff on such terms and conditions as it may determine. It will be free to decide the priority and distribution of funds between its different activities after having received a bulk allocation of funds from the Government."

This recommendation and another to the effect that ASRCT should be made up of three separate research institutes (Agricultural, Technological, and Medical Sciences respectively) as well as administering a number of specialist centres and services were both accepted by the Government. It is worth bearing these facts in mind when considering the later development of ASRCT and how succeeding managements have allowed the written-in advantages of autonomy and independence to be eroded.

STATUS AND CONSTITUTION

ASRCT was brought into being in 1964 under the Applied Scientific Research Corporation of Thailand Act B.E. 2506. Its main objectives were defined as:-

> "to initiate, carry out, promote and support applied scientific research and investigation in connection with, or for the promotion of, any matter affecting national development, the natural resources, industries and administrative services of the Kingdom, including health and welfare of the Thai people, and to promote the application of the results of applied scientific research for the benefit of the nation."

Although ASRCT was set up as an autonomous body in the sense that it was not to be answerable to any one Minister or Ministry, provisions were written into the Act which gave the Minister (in charge of the Act) "power and authority of general supervision over the general activities of the Corporation". The Act also stipulated that "the Council of Ministers on the recommendation of the National Research Council (NRC) shall appoint not more than three governors, not more than four expert consultants and, if it deems it desirable, not more than two special governors" which collectively constitute the "Board".

In any event there have never been more than six Board members at any one time, but all who have so far been appointed on the recommendation of NRC have been civil servants or retired civil servants. In 1964 when the first Board was formed a 7-man "Special Advisory Committee" was also set up, and in subsequent Board meetings it was decided to appoint a further 15 qualified persons as "applied scientific advisers". There is no evidence that the Advisory Committee has ever met, or that the advisers have ever been consulted.

Whilst, during the first 5 years of its life, ASRCT operated as intended as an independent autonomous body with its own financial resources in the form of a US$ 5 million block grant from the Government of Thailand. Since 1 January 1970 it has become more and more like a government department both in thinking and method of operation with consequent loss of freedom of action, personal incentive, flexibility

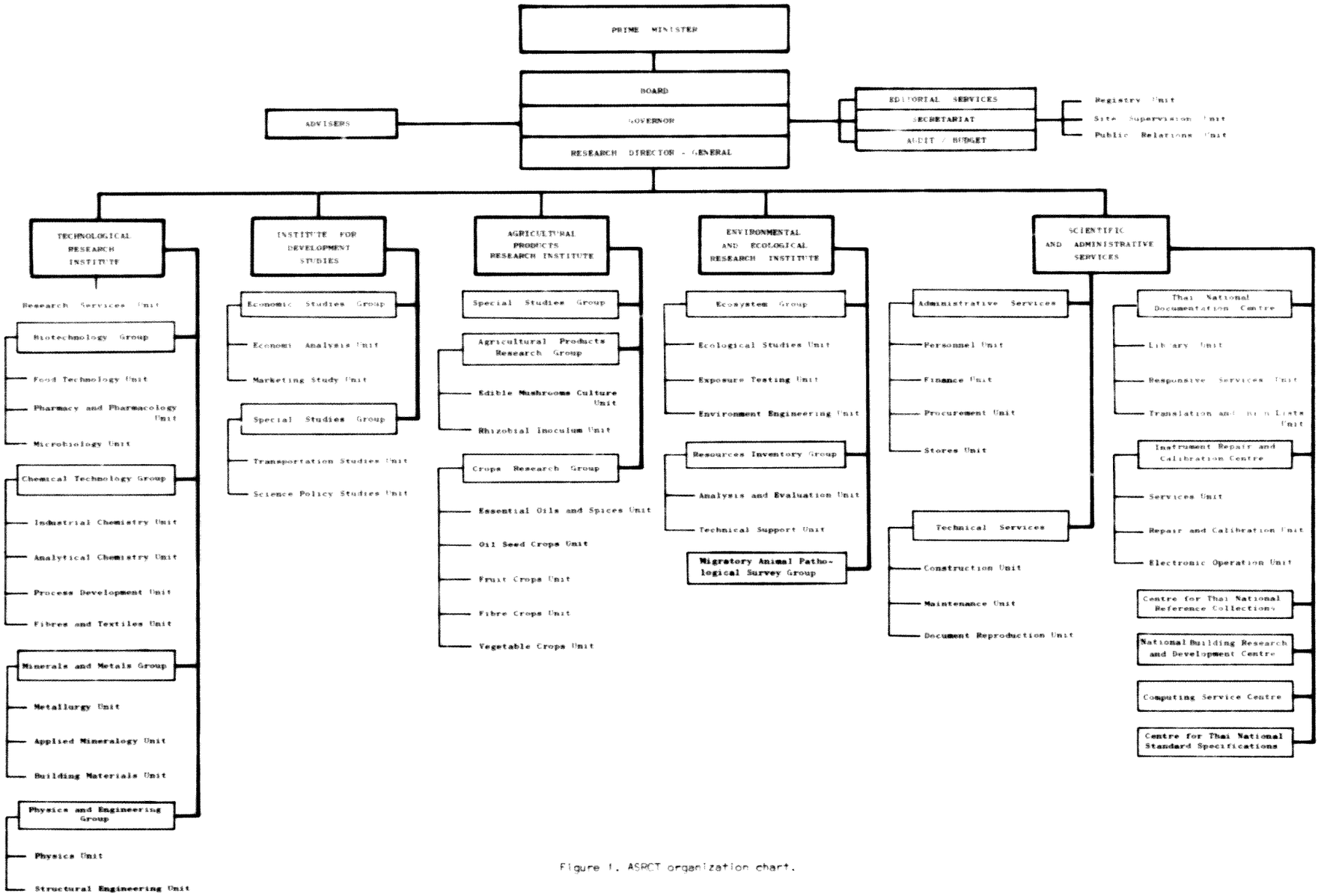

Figure 1. ASRCT organization chart.

and a good public image. To this can be attributed many of the management problems now facing the Corporation.

ORGANIZATION

Historical: The organization as originally proposed by Mr. Nicholls in 1962, i.e. division into Technological, Agricultural, and Medical Sciences Research Institutes, was never implemented because of opposition from the Ministries involved to the setting up of the two latter. During the period (1964-1969) when Mr. Nicholls was Special Governor with almost dictatorial powers the policy followed obviously was to widen the sphere of activity of the Corporation as far as possible, to include any sort of activity which could remotely be described as applied research—e.g. Migratory Animal Pathological Survey, Thai National Reference Collections: museum in embryo, etc. During this period the Technological Research Institute (TRI) was firmly established and with UNDP/UNIDO help and advice became a competent and reasonably effective research unit. In addition to this, three additional "research institutes" (RI) were set up within the framework of ASRCT, namely, the Institute for Development Studies, Agricultural Products R.I., and the Environmental and Ecological R.I. These appear to have been brought into being either as expediency measures or as a possible means of attracting financial support in the future. From the point of view of building up an overall workable management structure, their formation was unfortunate to say the least, as it gave even greater scope for some staff members to build up minor bureaucracies.

Present structure: The organizational structure at the time the ASRCT Board received a directive from the National Executive Council (NEC) in June 1972, to make the Corporation more effective and to reduce its expenditure with the minimum of delay, was that shown in Fig. 1: ASRCT organization chart.

As will be seen, ASRCT is currently divided into four research institutes (of which only one is sufficiently large to be viable); Administrative and Technical Services and six miscellaneous "centres", all answerable - directly or indirectly - to the Governor and through him to the Board.

Board: At the moment the Board is made up of a full-time Governor who acts as Chairman and chief executive, and four "expert consultants" who attend about ten halfday meetings a year. These latter, all distinguished men holding or having held positions of great importance in the Government's scientific, educational and planning organizations, are appointed in their personal capacities and consequently have done nothing to prevent conflict of interest between ASRCT and their own organizations. The private sector has no representative on the Board.

Contrary to normal practice elsewhere, the Board has not concerned itself with matters of overall policy and finance (it did not even see ASRCT's last submission to the Budget Bureau) but rather with such things as staff appointment, punishment and salaries, welfare and provident funds, approval of research proposals submitted by the constituent Institutes and ad hoc matters as they arise. Apparently staff members are never invited to attend a Board meeting; any proposals they wish to make are presented in absentia in written form.

This practice is probably a relic of the days when the Special Governor (1964-1969) and later the Research Director-General (1970-1972) had almost dictatorial powers and personally made such policy decisions as were made. During the first 5-year period ASRCT staff rules and an Administrative Manual were prepared and countless "directives" and "laboratory instructions" were sent to "all concerned" by the Special Governor. Job descriptions and directives for the ASRCT management were however conspicuous by their absence. Even before the NEC directive was received, the present Governor and certain senior staff members had realized that the Corporation was not being as effective vis-a-vis industry as it should be and that there was something wrong with the management structure.

Doubtless catalysed by the NEC directive, the Governor formed four ad hoc staff committees in June 1972 and another in September to advise him on possible steps to be taken to remedy the situation. These committees are named:

1. Advisory Committee (15 members): meets weekly to discuss current problems and situations; in effect it is a senior

staff meeting.

2. Budget Committee (5 members): set up primarily to get extra funds from the Budget Bureau to meet the ₱ 1.3 million deficit in 1971/72. It will work with Committee 3 on the internal allocation of the 1972/1973 budget and then be dissolved.

3. Policy and organizational chart Committee (The "Kasem Committee": 5 members): charged with the task of advising the Governor (before the end of October 1972) on such changes in the ASRCT statute, policy and organization as the Committee thought necessary to meet the requirements of the NEC directive.

4. Programme evaluation Committee (6 members)

and 5. Planning and monitoring Committee (5 members)

The two last Committees have never met, and if the recommendations made in this report are accepted they never will as the responsibilities proposed for them should properly be undertaken by non-executive professional staff groups attached to the Chief Executive's office and not by part time committees made up of staff members not having the required expertise.

Committee 3 (Kasem Committee): Prior to the arrival of the writer in Thailand this Committee had held many meetings on the basis of which it had drawn up a report outlining its proposals for improving the efficiency of ASRCT. This contained: (a) a proposed redefinition of policy, (b) rewriting the ASRCT Act B.E. 2506 to bring it more in line with modern thinking and Thailand's current needs, and (c) a proposed new organization chart.

Submission of this report to the Governor was withheld until the writer arrived and the Chairman of the Committee invited the UNIDO/TRI Project Manager (Mr. C.L. Wrenshall) and the writer to go through it in detail with the Committee. Four half-days were spent on this task and a number of alterations and additions were suggested and, after full discussion, accepted by the Committee whose report was then rewritten and submitted to the Governor on 10 November 1972. This, together with the present report, will be considered by the Board early

in December 1972.

INCOME SOURCES

Appendix I records sources of ASRCT funds from its inception to date and shows that apart from the annual government grant approved by, and passed through, the NRC (and of course UNDP/UNIDO support for TRI), most of the funding has come from American sources. This type of foreign aid began to fall off in 1970 and as there has been virtually no research undertaken for Thai firms under contract during the 8 years life of ASRCT/TRI, shortly, ASRCT's only source of income will be the grant from the Thai Government. This is in startling contrast to the original idea that ASRCT, at least partially, should aim to become self-supporting in a reasonable period of time.

Reasons that have been given for this are:-

(a) a sufficiency of grant aid, which was interpreted as meaning that there was little need to find income elsewhere.
(b) insufficient early liaison with industry to assess what is required.
(c) lack of effort to 'promote' ASRCT/TRI.
(d) competition with Thai Government agencies providing similar or related industrial services at no charge.
(e) the Thai investment climate where returns are quicker and often larger from tertiary than from primary or secondary industry.
(f) the Thai institutional framework which hitherto has promoted industry with less urgency than other countries such as Korea.

Apart from (e) and (f) the overriding reason is that, from the outset, ASRCT/TRI has operated as a research-oriented organization rather than as an industry-oriented business operation.

INTERNAL ALLOCATION OF FUNDS

Until now the Corporation's accounts have been broken down under eight headings, which although presumably meeting the Government auditors' requirements, has not provided the ASRCT management with the information necessary to run the Corporation on sound business lines.

For instance, it is not possible to find from the annual accounts how much was spent on the research programmes collectively or individually.

With the appointment of a new experienced budget officer, who unfortunately has just resigned, the system was being reorganized to provide information of a type more likely to help management.

An examination of the internal allocation of funds during the budget years 1970/1971, 1971/1972 is illuminating as it highlights in quantitative terms some of the problems that must be solved if ASRCT is to become more efficient.

Budget Plan 1970/71 and 1971/72

	1970/71		1971/72	
	$'000	Percentage	$'000	Percentage
Salaries and superannuation	12,500	61.0	14,850	67.5
Laboratory and workshop equipment/supplies	2,500	12.2	2,300	10.5
Office and building equipment/supplies	650	3.2	1,050	4.6
Books and periodicals	1,000	4.8	820	3.7
Site services	1,100	5.2	695	3.2
Maintenance expenses	600	3.0	350	1.6
Transportation and travelling expenses	500	2.5	600	2.7
Grants, i.e. outside earnings (nominal)	800	3.9	265	1.2
Operating expenses	600	3.0	110	0.5
Miscellaneous expenses	250	1.2	980	4.5
	20,500	100.0	21,990	100.0

It will be seen that salaries and related labour costs constitute an excessive and increasing proportion of the budget whilst funds available for equipment and support facilities for research and Development are much too small and are decreasing proportionately.

In the technology transfer study 1, it is correctly suggested that the salary content of the budget in an organization such as ASRCT should be no more than 50% of the whole (as against 61.0 and 67.5%

respectively in 1970/71 and 1971/72*) whilst funds for equipment and support facilities should be greater than 25% of the budget instead of 20% in 1970/71 dropping to 16.4% in 1971/72. This is additional evidence that ASRCT employs about 150 too many people and if the Corporation is to become efficient this fact must be faced and remedial action taken.

ACCOUNTING

Until recently the Corporation's accounting system and book keeping have been inefficient in many respects, particularly in that it has not provided management with the information required to make decisions. This is evidenced by the fact that during the financial year 1971/72, ASRCT ran out of funds and had to go "cap in hand" to the Budget Bureau to ask them to provide another $ 1.3 million to make up the deficit.

Although the mission's responsibilities do not include a detailed examination of the accounting system, it is quite clear that it should be reorganized so that management can be provided at least with the following information monthly:

(a) a balance sheet
(b) income and expenditure accounts for: (i) the month and (ii) the year to date compared with the plan both for central administration and the operating divisions
(c) new contracts signed during month with cumulative totals.

In addition, the chief executive, division heads and project leaders should be given a note covering the financial status of each individual research project under their control.

POLICY AND PLAN

No record can be found of the Board at any time having defined the Corporation's overall policy or drawn up a plan for the guidance of ASRCT management and staff.

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*and 67.7% budgetted for 1972/73.

This has resulted in an ad hoc research programme made up of disconnected projects considered by certain staff members to be worthwhile frequently on the basis of personal interest rather than a proven national or individual company need.

Far more serious, however, has been the effect of the lack of planning and the lack of internal communications upon staff morale.

It has encouraged the building up of many small bureaucracies within ASRCT and has allowed personal antagonisms, all too frequently very bitter ones, to cloud the management and adversely affect the actions of certain senior staff members. At a lower level it has led to frustration and frequently to disillusionment of young graduates who have returned from study abroad under the UN fellowship scheme. Practically all those contacted at this level complained that they did not know what the Corporation's policy was and furthermore when instructed to undertake work in the laboratory they were never told why or for what purpose it was being undertaken.

This, potentially, is a dangerous situation and if not remedied soon will inevitably result in the departure of these excellent and expensively trained young men to other jobs where their abilities and training will be given greater scope.

ASRCT ACTIVITIES PROGRAMME

The Corporation's working philosophy was based originally upon that of a large and well established foreign governmental research organization in a developed country (CSIRO Australia) and consequently was not attuned to the needs of Thailand.

The work of ASRCT's four component research institutes, based on this philosophy, has consisted almost entirely of research and development work in their own laboratories, workshops and offices. The Corporation has not operated extension or technical services, nor with one exception has it run training courses. It has been largely self motivated and guided, relatively uninfluenced by outside contacts.

The programme of ASRCT's constituent research institutes is a synthesis of 50 individual "programmes" which are broken down into 369

"projects" together with 65 "miscellaneous investigations" and 13 "confidential investigations".

In the absence of a national and a corporation plan, the individual "programmes" and "investigations" have mainly been initiated as previously indicated by individual staff members or at the suggestion of the UNIDO experts on the basis of a known need or more frequently personal interest.

The machinery for introducing a new "programme" into the system is cumbersome and time consuming.

The man with the idea either writes or asks the potential "project leader" to write a "programme outline"- which describes the objective and methodology of the proposed programme in outline, and indicates what type of staff will be required: no estimate of the cost is made. This, if he is a junior staff member, is discussed with his unit head, who passes it up to the group research director and then onto the institute director. If he agrees, it is then passed to the Governor and through him to the Board for approval. As the Board only meets monthly this causes delay and weeks can pass before permission to proceed filters back to the project leader. The whole operation appears to be designed to stultify personal initiative.

Execution of research programmes/projects: Before submitting a proposed programme for approval a technico-economic assessment is supposed to be made by the Economic Studies Group. Sometimes this has been done but quite frequently it has not. Once a "programme" has been approved by the Board or a "project" within such a programme approved by the institute director, until recently a "steering committee" was set up to plan and "steer" the research. This besides serving as a brake on the initiative of the project leader caused further delay in that it was always difficult to assemble the Committee as the Research Director-General had to take the chair. Steering committees have now fallen into disuse and the project leader directs the investigation usually carried out by himself with one or two assistants who may be trained in different scientific disciplines. At this level, in general, the work seems to be done competently and within a reasonable time.

The snag is that, if it is decided to scale up a process developed in the laboratory, it is passed to the Process Development Unit (PDU), in the Chemical Technology Group of TRI. Many projects have stuck there for years due to lack of equipment and trained personnel, or lack of interest of the people in the Unit. As in addition, the project leader is usually only interested in laboratory scale work, once his part of the project is completed he takes no further action except to complain that "it is held up in PDU". The writer could find little evidence of any rapport between those involved in laboratory research and those responsible for development.

This situation and the lack of trained chemical engineers and pilot-scale equipment are matters requiring urgent attention.

Overall programme: Examination of the latest quarterly computer printout of ASRCT overall programme reveals that:-

Of the 60 "programmes" listed only		29 are active
	and only	15 have been completed.
Of the 369 "projects" listed only		71 are active
		145 have not started
		28 have been suspended
		33 have been terminated
	and	92 completed.

Of the 69 "miscellaneous investigations" listed only 18 are active the rest having been terminated or completed.

It seems that at no stage is a programme or project evaluated and most of the "suspensions" and "terminations" are caused by lack of funds or the investigators have left the Corporation or assigned another task.

An analysis of the 15 completed programmes shows that only 7 were laboratory based i.e. 3 were concerned with indigenous plant or fish utilization, 3 with metallurgy and 1 with iodization of salt. There were 8 miscellaneous 'non-laboratory' projects including ecosystem, power and transportation system studies, as well as stabilized soil, sewage and sociological studies.

Similar analysis of the 29 "active" programmes reveals that 16 are biological/chemical, 4 minerals/metals, 1 building research studies, 1 science policy studies, and 7 miscellaneous (soil map, migratory birds, human resources, etc.).

Of the 16 biological/chemical studies, half are primarily concerned with agriculture/biology problems, 5 with utilization aspects of indigenous plants, and 3 with food production.

Without in any way belittling the quality of the work being undertaken on the 20 laboratory-based active programmes (which are nearly all concerned with developing new products and processes rather than with modifying, improving or adapting existing ones), it is suggested that the management should seriously consider whether or not an overall programme of this type is likely to achieve the Corporation's objectives.

Put another way: is this the best way of spending ฿20.5 million per annum to support nearly 400 staff working in buildings and with equipment in which many millions of baht have been invested?

Possible ways of using these resources and facilities to greater advantage will be suggested in Part II.

BUDGET, METHODOLOGY AND TIME SCHEDULE

In applying for financial aid from the Government, ASRCT is made to follow the stereotyped procedure used by all government ministries and departments in Thailand. This involves the submission to the Budget Bureau 10 months before the start of the next fiscal year of a 200 foolscap page document listing in detail every item, including individual chemicals, for which financial support is asked.

It is doubtful if any member of the Budget Bureau has ever heard of "sodium dithioglycolate" and it is less than likely that he or even an ASRCT chemist can anticipate the need for 2 grammes of this chemical up to 22 months ahead of its possible use, but nevertheless this is the type of information demanded.

The waste of ASRCT staff time in drawing this up is enormous and whilst it might be considered inevitable in a government department,

it is an exercise which a high-level autonomous organization such as ASRCT which is supposed to become self-supporting can ill afford. Suggestions as to how this difficulty may be overcome and how the Corporation can improve its 'budget and plan' methodology will be described in Part II.

STAFF, RECRUITMENT AND PERSONNEL POLICIES

Staff: At the time of writing, ASRCT has a total payroll of 381 made up of 16 research officers; 99 experimental officers, 41 service officers, 5 technical officers, 85 technicians, 49 ancilliary staff, and 85 assistants. Their distribution between the various institutes, centres and services is shown in Appendix III.

The "ASRCT Technology Transfer" study indicates that:-

(a) in general the quality of staff is too low;
(b) the ratio of research officers to experimental officers is about 1:6 whereas it should be nearer 1:2;
(c) the ratio of professional staff to support staff is about 1:2.5 whereas it should be nearer 1:1.5; and that
(d) if the present budget were properly apportioned between salaries/wages and direct support facilities and equipment, then a total staff no larger than 230/240 could be supported.

In general terms the writer agrees with these conditions.

Recruitment appears to be spasmodic and unsystematic as there is no Corporation staff plan. Since receiving the NEC directive there has been a freeze on further recruitment without Board sanction with a view to effecting some staff reduction by wastage.

The present grave situation in which there is far too large a payroll and far too many supporting staff, was accentuated in 1969 when after the Special Governor left, many retired senior civil servants were recruited. These gentlemen although doubtless competent to undertake their civil service responsibilities were mostly quite unqualified to undertake the task assigned to them in ASRCT.

Personnel policy: Although there was insufficient time to examine in detail the operations of the Personnel Unit the mechanisms

laid down for keeping staff records, administration of staff recruitment and appointment, salary reviews, etc. appears, on paper at least, to be satisfactory.

Two very important functions appear to be missing however; viz:-

(i) There are no regular and systematic reviews of staff members capabilities, technical, managerial and leadership, on the basis of which promotion or transfer can be made.

(ii) There is no mechanism for personnel training within the Corporation and no allowance in the budget for this.

Counterparts: In too many cases the UNIDO experts who have been of consistently high quality have not been properly used. In some cases there have been no adequate counterparts appointed, whilst in others appointed counterparts have shown little interest in or have failed properly to use the knowledge and experience of the expert.

SALARIES, INCENTIVES AND CAREER PROSPECTS

ASRCT salaries on paper are approximately twice those of the corresponding grades in the civil service. However as civil servants are exempt from tax and do not contribute to their pension fund, in actual fact ASRCT "take-home pay" is only about 20% higher than that of government employees. Full advantage of the ASRCT salary structure does not appear to have been taken, and salary as an incentive has been over emphasized.

Well tried incentives such as increased career opportunities, staff involvement in decision making, free time for own research, improved equipment and facilities, publication of work in the world technical press, etc. have not been used or apparently even considered.

TECHNICAL AND INFORMATION SERVICES

ASRCT does not operate an 'industry advisory service' in the conventional meaning of that term. There are isolated instances of ASRCT senior staff members providing technical advice on request from a company, but this has not been as the result of Corporation policy.

The Thai National Documentation Centre located at and administered

by the Corporation has an 'Information Services' Section which at the moment is limited to the provision on request of literature abstracts of publications in a number of areas of technology. It is not equipped to answer questions on production or processing or to provide advice.

REPORTING AND PUBLICATION POLICY

During the period 1965-70 243 ASRCT technical reports on the results of work carried out under research programmes/projects, miscellaneous investigations and studies and appraisal projects were prepared which were edited, printed and bound at and distributed by ASRCT. A bound volume of abstracts of these publications has been prepared which is excellent in every respect. An incomplete examination of these publications indicates that most of them are of high quality both in technical content and presentation.

It is disappointing that so few of these papers have been published in the world's scientific and technical press.

PUBLICITY, PUBLIC RELATIONS

The Corporation has not, nor has it ever had a public relations office or officer or a public relations policy.

Until recently the only publicity it got was fortuitous and ineffective. A rather amateurish brochure was produced in 1971, which is currently being upgraded.

In January 1972 the first issue of a one-page "ASRCT Research News" was produced describing about half a dozen ASRCT activities to stimulate public interest. This and succeeding monthly issues have been up to professional standard and have resulted in a number of enquiries.

PRESENT SITUATION, SUMMARY AND CONCLUSIONS

1. The quality of ASRCT/TRI's applied research output over its 8 years life has in the main been satisfactory and in some cases quite good.

2. Its developmental work has been less satisfactory largely due

to lack of equipment and suitable staff and frequently lack of cooperation between those responsible for "research" and those for "development".

3. With a few notable exceptions ASRCT/TRI's investigations have failed to help existing or catalyse the development of new industries.

Amongst the reasons for this are the following:-

(a) ASRCT/TRI management has been research rather than industry oriented. There has been no corporate policy or plan, no extension service or effective links with industry and its overall programme has been built up on an ad hoc basis. No evaluation of the component parts of this programme has been undertaken systematically.

(b) ASRCT/TRI has made little effort to find what industry required or to identify a potential industrial partner before initiating a research investigation. Rather it has worked on projects which the staff selected as being potentially valuable and tried to "sell" the end result not surprisingly with indifferent success.

(c) In the early days ASRCT/TRI although conscious of its independence and autonomy was run as an autocracy with all decisions taken by the chief executive. More recently although there has been some delegation of authority, the Corporation is being run like a government department with all the restraints and inhibitions attached thereto. Neither technique is conducive to the development of staff creativity or to the 'building of bridges' between the Corporation and the private sector.

(d) The present organization involving disciplinary institutes, groups, with units and centres overlaid by problem oriented programmes/projects/miscellaneous investigations is so complex that management and coordination is extremely difficult: in fact it has all but broken down.

Amongst the identifiable consequences of all the above are the following:-

(i) ASSET/TII has attempted to cover too wide a field and consequently it has not been able to put the necessary effort into high priority projects.

(ii) Its funds have been wrongly allocated. As it has built up too large a staff, too much is spent on salaries and too little on technical activity.

(iii) Internal communication has been poor and there is neither a personnel policy nor an incentive scheme. Because of this and the lack of delegation and policy definition, many staff are disgruntled and their enthusiasm suppressed. There are a surprising number of personal animosities between senior staff members.

(iv) There are far too many internal meetings and committees (with consequent waste of time and accumulation of papers) and negligible effort to train staff and stimulate their enthusiasm and initiative.

(v) ASSET/TII's public image is poor (just another government department) or nonexistent. It has neither machinery nor policy for publicity or public relations.

PART II. RECOMMENDED ACTIONS

In making the following suggestions, which are based upon the experience of independent and government supported industrial research institutes operating in many parts of the developed and developing worlds, allowance has been made for conditions peculiar to Thailand.

The recommendations which follow are listed under the same headings as used in Part I for ease of reference. Before these are even considered it must be realized that the changes necessary to effect the required results are so radical that they can only be effective if the ASRCT Board (reconstituted as suggested) and top management are prepared to alter their thinking and actions in four fundamental respects:-

(a) They must operate ASRCT as a business and not as a research organization.

(b) As all they have to offer are brains and skills, the organization and management must be so altered that the professional staff members, particularly the young ones, are given every opportunity to take responsibility, develop initiative, creativity and management skills.

(c) Means must be found for reducing the number of staff significantly, introducing one or two new key personnel with industrial experience and initiating staff training courses.

(d) A decision once taken must be followed through to implementation. Unless the Board is prepared to do this, the following recommendations cannot possibly be effective.

STATUS AND CONSTITUTION

The constitution as laid down by the Act of B.E. 2506 is obviously due for revision and the Kasem Committee has recommended certain changes particularly with regard to the Corporation's objectives, Board composition and functions, appointment and responsibilities of a chief executive, and complete separation of ASRCT and NRC.

As the Committee has redrafted the Act for the consideration of the Board and through it the NEC in consultation with the TRI Project

Manager and the writer and has accepted their suggestions, there is no need to elaborate further at this stage particularly as the principal changes proposed will be described in detail later. It is our recommendation that a new Act along the lines suggested should be promulgated.

Provided the ASRCT Board is prepared to run ASRCT as a business whose function is to assist and stimulate industry along the lines recommended later in this report (and not as a research oriented government department as at present), then in the writer's opinion the Corporation should continue to be, and to operate as, an independent autonomous organization within the terms of the new Act.

ORGANIZATION

The present organization as shown in chart form in Fig. 1 is now generally agreed to be unworkable. It is recommended that ASRCT management structure should be so simplified that the Corporation can operate as a single entity with clearly defined objectives and responsibilities in a manner that can be understood alike by the staff and potential users of ASRCT's skills.

To this end the principal changes recommended are as follows:-

1. Two ASRCT centres and one group should be wound up or transferred elsewhere, thereby narrowing the Corporation's areas of activity;

2. The Board should be reconstituted and its functions and responsibilities redefined;

3. The current conflicting responsibilities of the Governor should be divided between a Chairman of the Board and a chief executive with the title 'Managing Director' or 'Director'. For the purposes of this report the latter will be referred to as 'Director';

and 4. ASRCT should set up and operate an Industry Advisory Service.

Implicit in these recommendations is the need for a change in outlook at all management levels so that ASRCT can, with the minimum of

delay, become a business organization geared to the needs of industry, rather than one which tries to sell its ideas - developed at great expense—to industry. Furthermore internal communications must be vastly improved with delegation of responsibility and decision making, and the number of committees and meetings - with consequent accumulation of paper - very considerably reduced.

The details of the proposed changes are as follows:-

1. Reduction in scope of ASRCT: The following centres and group should be wound up or transferred elsewhere:-

(a) Centre for Thai National Reference Collections.

(b) Centre for Thai National Standard Specifications. It has been suggested that this Centre and the Office of Commodity Standards should be merged under the umbrella of the Thai Industrial Standards Institute.

(c) Migratory Animal Pathological Survey Group.

It is understood that the possibility of the National Building Research and Development Centre being combined with the Division of Training, Ministry of Public Works to form a separate agency outside ASRCT is being considered by the NEC.

2. Board composition: The Board should be reconstituted as follows:-

It should be made up of nine members, three of whom retire annually in rotation. They should represent:

Government (3) for instance:	a representative of the Prime Minister's Office. Secretary-General(s) of: National Economic Development Committee, Board of Investment
Private sector (4) representing:	Industry Banking Engineering University
ASRCT staff member (1):	Chief executive

Chairman: Who should be a man of stature and wide experience not necessarily a scientist.

Board responsibility: The governing Board is the body which is ultimately responsible for the Corporation's activities. It should be a policy defining non-executive body and concerned with long-term objectives and overall finance, rather than with detailed operations of the Corporation and its staff which are the responsibility of the Director.

One of the Board's first duties should be clearly to define what the Corporation's function is to be and the objectives once defined must be communicated within the laboratories - through the Director - in order that they can be understood at all levels.

The Board should also be responsible for approving and defending the budget, defining policy on conditions of employment, etc., and should appoint the Chief executive/Director.

It should not be responsible for, or concern itself with, individual research programmes, the terms of agreement between ASRCT and individual potential sponsors or clients, detailed financial matters or personnel problems below the level of Director.

3. Chairman: It is customary for the Chairman of a research organization such as ASRCT to serve, as do the Board members, on a part-time basis. However, under the conditions now prevailing in Thailand in general and within the Corporation in particular, there is a strong case for the Chairman of the Board to serve on a full-time basis probably for a number of years ahead.

It is suggested that the Chairman's duties in addition to those laid down by statute should include high-level public relations and liaison as well as to obtain support for the Corporation as defined in Appendix IV.

Chief executive/Director is the man responsible for implementing the policies laid down by the Board and ensuring that these functions are fulfilled. In a business organization he would be designated "Managing Director" (Europe) or "President" (USA/Canada). His respon-

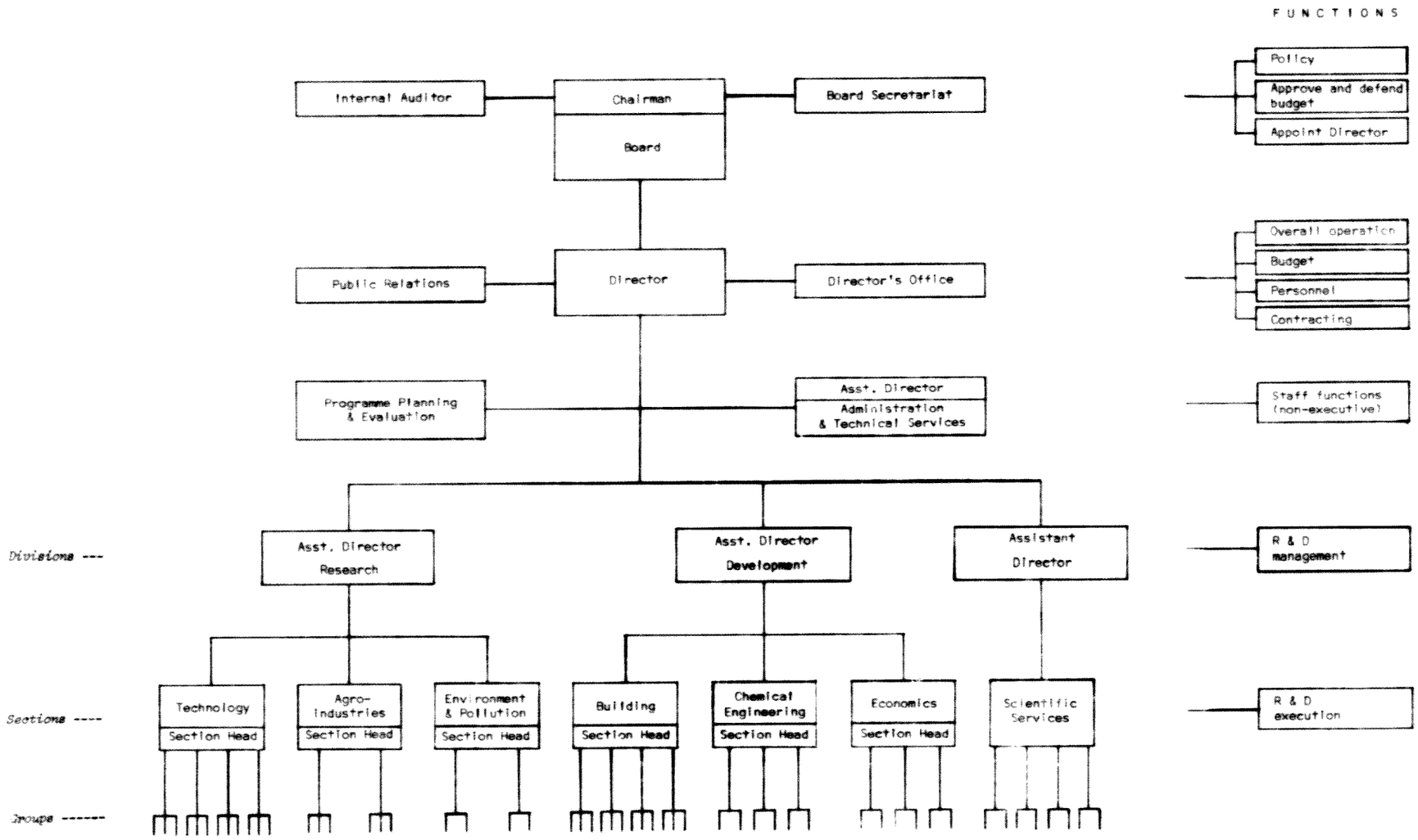


Figure 2. ASRCT proposed management structure.

sibilities are more clearly defined in Appendix V and in a UNIDO report.[2]

4. Proposed reorganization: The streamlined organization proposed is shown in skeletal form in Fig. 2 (Detailed organization charts are not suitable for research institutes as they suggest a rigid structure and tend to make staff think and work in watertight compartments.).

In brief this consists of the Director, who receives policy guidance from, and is answerable to, the Board and is served by a Director's Office, a Public Relations Office, and a Programme Planning and Evaluation Group; the latter having a non-executive staff function. Directly reporting to the Director would be 4 functional divisions each headed by an Assistant Director responsible for Research, Development, Scientific Services, and Administration and Technical Services respectively.

This means that the Director has seven people directly answerable to him (4 Assistant Directors and the Heads of two small offices and the Planning/Evaluation Group) in addition to which he has to report to the Chairman and develop many extramural contacts. Any increase in the number of line responsibilities would be unworkable. The organization structure advocated by the Kasem Committee in which the Heads of six research departments, two non-research departments and three offices are all answerable directly to the Governor would only perpetuate the weaknesses of the present system and consequently must be avoided at all costs.

The responsibilities of the two staff groups and the three operating Divisions should be clearly defined and understood by management at all levels. These definitions and allocation of responsibility must be made by the new management, but the following suggestions based on experience elsewhere can be used as a guide.

Staff groups

Public Relations Office answerable to the Director but with a direct link with the Chairman is responsible for publicizing the Corporation and what it has to offer. Methods for fulfilling this function will be outlined later.

Programme Planning and Evaluation Group should be directly responsible to the Director and should have the following responsibilities:-

(i) Examine, edit and collate the draft budget prepared by the operating divisions to provide the Corporation's budget for the Director.

(ii) Advise the Director on project selection based on technico-economic assessment made by or in cooperation with the Economic Analysis Group of the Economics Section.

(iii) Undertake evaluation of running research programmes/projects at regular intervals to enable the Director to decide whether the programme should continue, be altered or terminated. Evaluation techniques are described in a recent UNIDO publication.[3]

(iv) Undertake surveys in association where possible with the appropriate industrial organizations to identify problems requiring solution to improve the national economy.

The man in charge of this group should be technically qualified preferably with industrial experience. He should also have an economic or similar qualification. His supporting staff should be small in number but technically qualified and preferably have some knowledge of industrial economics.

Functional Divisions

The Administration and Technical Services Division headed by an Assistant Director should undertake the responsibilities covered by the existing Administrative and Technical Services Group, but the techniques used by the Accounting and Personnel Units should be modernized.

The new Business Office (with modified responsibilities) should be moved into the Administration Section.

It should send letters of agreement to potential clients having first checked that (a) they are properly worded, (b) the costings therein are correct, and (c) that there is no ethical conflict. This office, in association with the appropriate Division head, should decide which staff member should be the project leader of a new research project.

The Business Office should no longer be responsible for project costing, which should be done by the project leader or for processing in-coming enquiries which should be handled by the proposed new Industrial Advisory Service (see below).

Research Division should be made up at the outset of two existing institutes (i.e. the present TRI and APRI) concerned with technological and agro-industries research respectively, with provision for a third section to be concerned as and when the need arises with environmental pollution problems. This is not meant to replace the erstwhile Ecosystem Group although it should take over and activate that group's Environmental Engineering Unit. It is suggested that the TRI Process Development Unit be given new guidelines and be transferred to the

Development Division, which also should be made up of three new sections based on an existing centre (NPRDC) and two existing units (Process Development and Economic Analysis) suitably modified. The Building Section should be the new name for the National Building Research and Development Centre which should be structured and operated as at present until such time as a decision is made on to its future. The proposed Chemical Engineering Section should be headed by an engineer with practical industrial experience and should take over the responsibilities of staff and equipment of the Process Development Unit (PDU) which incidentally has been without a head for 5 years. It should, however, endeavour to carry out its task in a different way from that adopted by PDU. Until now when a laboratory investigation has been completed and written up it has been considered by a working committee (chaired by the Governor) and if decided to go further, a technico-economic assessment is made and if this looks promising, the project was passed to the PDU for scaling up.

This methodology has failed to work for a number of reasons, e.g. (a) there has been neither equipment (nor money to purchase it) nor trained staff, (b) there has been a queue of projects, (c) indecision of and amount of time taken to convene working groups, (d) research staff often don't talk to development staff, and (e) the Chemical Technology Group Director, like other group directors, has no authority to make decisions or even spend $20.

This "bottle neck" which has held up some projects for years could be overcome to a large extent if the following procedures were adopted:-

1. On completion of a laboratory investigation, if the section and Division Heads decide (no committee required) that the results could serve as the basis for an industrial process, the Development Division after providing the necessary technico-economic data will endeavour to identify a company who could be interested in developing the idea. Very often companies are found who prefer to do the pilot-scale work themselves either alone or advised by the research institute staff.

2. If this approach fails, the possibility of undertaking pilot-scale work at the works of an interested company should be explored. The aim should be to get the company to provide the plant on which the Corporation's Chemical Engineering Section staff would work side by side with the firm's staff. If the firm wants to keep the results to themselves, then they must pay for the service; if they are prepared to release the results after a lapse of 6 months or a year, then the service should be free.

3. If both of these approaches fail and only then and as a last resort should a pilot-scale plant be erected within the Corporation. Once this has achieved its purpose, the plant should either be sold to the company which has been persuaded by the results obtained to go into production or else dismantled and the component parts put into store.

Economics Section should take over the staff and responsibilities of the existing Economic Analysis Unit which provides technico-economic data on the basis of which management can decide whether or not a proposed research investigation is worth undertaking, or whether a project when completed is worth developing. The Unit should work closely with the Chemical Engineering Section and with the Programme Planning and Evaluation Group.

The existing Marketing Study Unit, within the Institute for Development Studies, should transfer responsibility for producing "ASRCT

Research News" to the Public Relations Office and concentrate all its efforts on the provision of an industrial advisory, consulting and trouble shooting service. It should be renamed

Industrial Advisory Service whose function would be:

(a) To direct any request for assistance to the correct person or department in the Corporation and ensure that the service provided is paid for at economic rates;

(b) Operate a Technical Information Service until such time as the Documentation Centre is able to do this; and

(c) Appoint two industrial liaison officers (ILO) who should be technically qualified (chemistry or engineering), have industrial experience, and be versatile.

Their duties would be as follows:-

(i) They should pay regular planned visits to companies concerned with manufacturing and processing to acquaint them with the facilities available at ASRCT and how these may be used most effectively.

(ii) They should advise industry about the work going on not only in the Corporation but also in the universities and elsewhere in Thailand and abroad.

(iii) When on routine visits to a company, or when requested to call by a company the ILO should ascertain and discuss the company's technical problems. Many of these the ILO will be able to suggest an answer for immediately, whilst others might have to be taken back to the Corporation for the Technical Information Service to find an answer in its records or by discussion with the appropriate Corporation expert. Provided no investigational work is required, the service up to this stage should be free. If on the other hand investigational work is required, then an estimate of cost of this would have to be prepared by the appropriate technical staff member who would ultimately be responsible for under-

taking the work.

The ASTD staff member designated to undertake specific advisory work of this nature must make use of the facilities and knowledge available elsewhere in the Corporation and should keep in direct touch with the client. Any report produced at the end of the exercise should be sent to the client by the IAO to maintain his direct contact.

Scientific Services Division should consist of Thai National Documentation Centre (whose Technical Information Service should be expanded and improved and a modern data retrieval system put into operation), the Instrument Repair and Calibration Centre, and so long as they remain within the Corporation the two centres and the group earlier recommended for transfer or run down.

General

The proposed streamlined organization can only be really effective if the following major changes are introduced:-

1. Management at all levels - division, section, group, units— must clearly understand what the Corporation's overall policy and plan is and where their individual responsibilities are.

2. Responsibility, with corresponding authority, should be delegated wherever possible.
   For instance the assistant directors should be given full responsibility for all internal operations of the Corporation, executing policies for which the Director has final responsibility. This leaves to the Director the functions of policy formulation, planning, supervision of staff activities, relations with the Board, top level external relations with clients and potential clients, and public relations.
   Similarly, the section heads must have responsibility (without having to get permission from a higher authority) to work out, with group leaders, the research staff and techniques to be used to carry out the constituent research programmes of the overall plan.

3. The present practice whereby permission from higher authority -

frequently up to Board level - must be obtained before almost anything can be done must cease. On no account must the Board become involved in detailed operations and once an overall corporate programme is agreed responsibility for executing it must be passed to section, group, and unit heads. Funds for each project must be allocated and, within these limits, authority to spend them must be given to section and group heads.

4. The present habit of telling young graduates what to do without telling them why and thereby stultifying their interest must stop.

5. The present system of holding dozens of meetings and setting up committees for every conceivable purpose with inevitable accumulation of paper is wasteful, time consuming, and stultifies initiative. It should be replaced by personal contacts followed by individual decisions at the appropriate management level.

A notice on each manager's desk which reads:

> Delegate - Communicate - Stimulate - Time is money
> Always follow through

would serve as a timely reminder of the key factors in good management.

INCOME SOURCES

In Part I, under this heading and in Appendix II it was shown that apart from UNDP/UNIDO, practically all AS\CT's income since its inception in 1964 has come in the form of Thai government grants (฿ 100 million) or grants for specific purposes mainly from American government agencies (฿ 24.5 million) whereas only a negligible amount (฿ 1.9 million) was earned. In this latter category, no record can be found of any work having been done under contract with any industrial firm operating in Thailand or abroad.

Contract research: This constitutes potentially a significant source of new funding with none of the restrictions and time consuming

practices inevitably associated with government grants. Furthermore as the Corporation's Act lays down that one of its income sources should be "Fees charged by the Corporation for investigation or for scientific tests or measurements or for other services" by doing this sort of work it would not only be fulfilling one of its obligations but also providing a service which industry really needs. Reasons why this has not been done in the past are listed on page 8, but if the recommendations in this report are implemented, all the objections except (e) and (f) (Thai investment climate and institutional framework) are removed. Even (e) and (f) are not insurmountable as evidenced by the recent flow of enquiries following the issue of "ASTOT Research News".

The techniques used by independent laboratories throughout the world to get business was the subject of a seminar conducted by the writer at the Corporation on 8 November 1972 and is described in the record of that meeting.[4] These have been employed satisfactorily by KIST and by SIRIM and there is no reason why these should not be equally successful in Thailand.

The relevant extract from the record of the seminar is:-

"How to get business: Senior (and junior) staff—i.e. the chief executive, assistant directors (R & D) and section heads where appropriate—keep in constant contact with their opposite numbers in industry and government, discussing topics of common interest - not the 'hard sell'. It is rare to get a 'sale' at the first visit, but a return call made about 6 months later may be more successful.

"When a 'lead' arises, the assistant director or section head and the contract officer assigns a staff member to follow up. The selected staff member writes a proposal which is seen by the division heads concerned and they allocate staff time and hence budget. From this a cost assessment is drawn up, cleared with the business manager for costing, accuracy and possible ethical conflict, and sent in duplicate to the 'prospect' hopefully within 5 days of the 'lead' arising. If acceptable, the client and institute jointly sign the document which is now an agreement. The

staff-member assigned now becomes the team leader.

"Form of Agreement: Experience shows that a simple document, based on a standard pro forma originally checked out by a lawyer, is best.

"The Agreement comprises a brief letter covering:-

(a) Background
(b) Scope (about 4 lines)
(c) Method of approach (dangles a bait but gives no secrets away)
(d) Time and cost, i.e. states number of months and maximum cost. Travel and special equipment is charged extra.
(e) Names of (i) team leader (ii) contact man.

Don't itemize costs and don't bargain over costs."

A typical proposal outline, which if signed becomes a letter of agreement will be found at Appendix VI.

In some cases, multiclient agreements can be drawn up, e.g. with several members of an industry, but these are more complex and usually require a lawyer's services for each agreement to safeguard competitor-clients interests.

Estimate of cost: An ASRCT directive (22 September 1972) instructs that costs should be charged on the basis of the formula:-

(Staff time + material costs) x 2.5 less a discount.

The amount of the discount is to be assessed by yet another ASRCT committee and varies from 0 - 100% dependent upon whether

(a) the research and development is of value to the economy or to a company;
(b) size of programme;
(c) relationship between work for client and ASRCT projects;
(d) ability of firm to pay.

It will be found that the "discount" factor will lead to trouble and eventually prove to be unworkable. It is recommended that it be dropped.

Timing: If a potential client's interest is to be maintained and a business-like impression to be given the interval between an enquiry and the Corporation's proposal should not be more than a few days.

The present procedure involving 21 steps including clearance with 5 individuals over a period of 5 weeks is bound to lose more clients than it attracts.

Procedure after agreement is signed: For most industrial projects undertaken under contract, the work is undertaken by a multidiscipline project team. A task force is got together by the project leader (the individuals invited clearing their availability with their immediate chief) and the amount of time required from each and when being worked out in advance so that everybody knows.

Suppose a client wants a new breakfast food developed, then the following task force might be assembled and a time schedule drawn up as follows:-

Function	Estimate of man-days for each Month						
	Jan.	Feb.	Mar.	Apr.	May	June	Total
Product development (team leader)	8	8	8	10	12	12	58
Experimental Kitchen	6	12	15	18	18	12	81
Flavour panel	2	2	4	4	4	8	24
Market research	3	3	4	4	5	5	24
Chemistry – physical	3	3	4	4	5	5	24
Chemistry – carbohydrate	1	1	1	2	2	2	9
Chemistry – protein	2	4	4	2	1	1	14
Nutrition	1	-	-	1	1	1	4
Process engineering	1	1	2	2	3	3	12
Packaging development	2	2	3	3	4	4	18

The team meets once to agree on the programme and define individual duties and unless it is a very large programme does not meet again until the end of the project. Thus large, lengthy project meetings, with loss of man-hours, are avoided. Instead, the project leader who has sole responsibility coordinates sectoral activity, and edits the synthesis of formal reports which he submits to the client periodically and takes follow-up action.

The advantages of the system are:-

(i) its speed and effective development of skills;
(ii) it expedites technology transfer;
(iii) it reduces any tendency for "empire-building" amongst staff;
(iv) it develops management skill at all levels.

A reasonable target would be to endeavour to obtain 25% of the Corporation's income from contract research within the next five years.

Additional income sources: The possibility of winning support from appropriate international foundations should be explored.

A technique for enlisting the direct interest and financial support, usually a tax deductable business expense of industrial organizations and executives which has been successful in many parts of the world, is the establishment of an organization of "Industrial Associates of the XYZ Research Corporation". Approval for such a plan must be given by the Board and on no account must the organization be directly concerned with the Corporation's policies or have access to confidential information. The members are accorded some benefits such as an occasional seminar or special summary reports on a topical subject as well as the privilege of a reasonable amount of information services. Membership is usually limited and a graduated subscription fee structure employed. More important than the income, however, is the direct interest of leading industrialists in the welfare of the Corporation.

It must be clearly understood however that membership is not an alternative to having work carried out by the Corporation under contract.

INTERNAL ALLOCATION OF FUNDS

It is recommended that every effort be made to reduce the proportion of the total funds available allocated to salaries and wages from the current 57.7% to about 50% and increase expenditure on equipment and support facilities from the current 18.4% to something in excess of 25%.

This can only be achieved by (a) reduction in staff numbers, (b) increase in income without staff increases, and/or (c) reduction in

overhead costs. (a) will be considered under 'staff problems' later and one means of achieving (b) has been described and it should be possible to achieve economies under (c).

ACCOUNTING

On page 10 it is suggested that the accounting system be improved so that specific financial information can be provided to top management each month to assist in the decision making process. A copy of a monthly report of this type by the secretary/treasurer of an established British independent contract research organization has been left with the ASRCT management.

On page 10 it was further suggested that the financial status of each individual research project should also be given to appropriate personnel monthly.

For this to be done it is necessary to give a number to each project (the business office does this) as well as for 'overhead' activities, etc. and for all members of staff (including the Director) to be provided weekly with a time card on which is recorded each evening the time spent on individual projects or overhead activities against a project or administrative member.

On the basis of these time sheets every project leader should receive a note each month on the status of his project budget thus enabling him to control the activity on projects for which he is responsible.

POLICY AND [illegible]

The reconstituted Board should take an early opportunity of defining the Corporation's policy and publicizing this internally and externally. As a basis for discussion it could be something like the following:-

Policy: The Applied Scientific Research Corporation of Thailand (ASRCT) is an independent non-profit research, development and consulting organization specifically set up in 1964 to help industrial development in Thailand. It is equipped and staffed to help individual companies on a confidential basis:

(i) to improve existing and develop new products and processes;
(ii) in the solution of company manufacturing and marketing problems and to provide advice on:
(iii) the development and use of local raw materials;
(iv) the application of the results of technological research wherever conducted on a national basis or to meet individual company requirements.

Plan: A corporate plan should be drawn up annually, at the same time as the budget is programmed: together they become the "Budget and Plan" for the year.

The plan should be drawn up and designed to make effective use of the Corporation's resources to serve the country's industrial requirements and should be based on three information sources:

(i) The Government's Third National Economic and Social Development Plan 1972-76, which is not very helpful as besides stressing the need for development of agro-industries, the only guidance it gives to ASRCT is to recapitulate the work programme currently in hand;
(ii) The findings of the proposed ASRCT industry survey as described below;
(iii) Such ideas of the Corporation's research and development staff as are reasonably assured of industrial support.

Once the plan has been drafted by the Programme Planning and Evaluation Group on the basis of information provided by the research and development divisions, the Director will discuss it with senior research and development personnel and if necessary amend it before submission to the Board for approval. Once approved it should be made known to the Corporation's research and development management at all levels.

ASRCT PROGRAMME

The overall Corporation's working programme, is a synthesis of the individual programmes and projects as is the case at present, i.e. it is an expansion and itemisation of the corporate plan.

Current programme: As the current overall programme—officially made up of 30 programmes and 369 projects plus sundry "miscellaneous investigations" and "confidential investigations" (see pp. 13, 14)—is cluttered up with "not started", "terminated" and "suspended" investigations, it is recommended that these latter be removed from the overall plan. The research and development division heads in consultation with the appropriate section heads should then examine the large number of programmes/projects listed as "not started" and decide whether or not they should be activated: if not they should be removed.

After this the Programme Planning and Evaluation Group in association with appropriate research and development personnel should evaluate the current 28 programmes and 71 projects described as "active" and advise the Director which in its opinion should be retained and which should be terminated. National need and industrial feasibility should be the main criteria in this evaluation process. The "miscellaneous" and "confidential" investigations should be similarly evaluated and those that survive should be converted into programmes or projects and these categories discontinued.

At the end of this lengthy but very important exercise, the Corporation will have a very much reduced but a realistic programme representative of the Corporation's current skills and interest. This sifting process will inevitably release many research staff who would then be available to carry out any new investigations that are shown to be necessary by the proposed "industry survey".

Proposed industry survey: Many national industrial research institutes undertake a survey of all secondary industries in the country to find the type of technical service that is required and from which it will receive support before commencing operations. ASRCT did not do this.

It is recommended that ASRCT undertakes such a survey limited to industries in its own areas of interest, e.g. chemical industry based on biological materials, essential oils, fermentation industries, metals and minerals industries. This should be done by a small team led if possible by a foreign expert according to a pre-arranged plan.

Before this is done however ASRCT top management should have discussions with:

(i) Government planning and development agencies
(ii) Leading figures in industry
(iii) Industrial associations and Chamber of Commerce
(iv) Financial institutions concerned with industrial development to get a "feel" for industry's needs on the national scale which should make the survey more useful and less time consuming.

The information revealed by the top level interviews and the survey should provide a sound basis for future corporate plans.

BUDGET: COMPILATION AND PRESENTATION

On pp.14, 15 the difficulties experienced by ASRCT in drawing up and presenting its annual request for financial support following the archaic system laid down by the government were outlined. It is suggested that the Governor, in company with his counterparts in the scientific government services (Ministries of Industry, Agriculture, and Public Health), should present a reasoned case to the Budget Bureau explaining that running a large and complex research operation is quite unlike running a conventional government department.

There is a precedent for this in many countries where only a brief outline plan supporting specific requests for financial support from the national treasury is required. Acceptance of this technique is based on the knowledge that scientists are as responsible as anyone else, in research it is impossible to anticipate events in detail, certainly not 18-22 months ahead, that they flourish on flexibility and in any event they have to account for their stewardship of public funds at the year end.

It also helps enormously if, when presenting the request for financial support to the Budget Bureau, it is accompanied by a brief, easily understood report on the last year's activities.

Of course if the Corporation is successful in attracting contractual support from industry, then it will be in the happy position of not

being entirely dependent upon the government for its livelihood. In any case the procedure to be adopted in compiling the annual budget is the same, i.e. the Director, about 3 months before the fiscal year ends, asks the division and section heads to draw up a divisional budget and research programme with priorities for the following year. These individual proposed programmes and financial requirements are examined, edited and collated by the Programme Planning and Evaluation Group prior to submission to the Director. The latter, after reviewing the entire programme with the division/section heads as a group and satisfying himself that the proposed programme, priorities and budget are realistic and in keeping with the objectives of the Corporation, will submit these to the Board for its consideration and ultimate approval.

Obviously not all good ideas are generated at the time of budget preparation, so Directors must be given some flexibility. To this end it is desirable to establish some "free" funds, often 5-10% of the budget, which can be spent at the discretion of the Director.

If the budget request is cut back by the funding authority, the process goes into reverse and the Director, together with the division/section heads, reapportions the internal allocation of funds.

STAFF

On page 5 it was pointed out that with a payroll approaching 400, ASTIT has about 150 more staff than the funds at present available can properly support and furthermore the numbers of "support" staff are far too high. Unless the total number employed, particularly support staff, is reduced on present funding, the Corporation cannot possibly operate efficiently. In other words this problem although difficult must be dealt with as a matter of urgency.

As the Governor, in keeping with Thai tradition, is not prepared to dismiss staff, then some method must be found to transfer the surplus to suitable employment elsewhere. The Taiwan Union Industrial Research Institute when faced with this problem in 1969 reduced its staff of over 600 to less than 300 in two years by transfer to nationalized industries which were in need of personnel with technical experience.

Recruitment should be selective and systematized and kept to an absolute minimum until the staff crisis has been solved. Normally anticipated staff requirements are included in the budget and plan.

PERSONNEL POLICIES

An excellent UNIDO report provides guidance on personnel problems and policies.[6] The two points referred to earlier (p. 16) namely regular assessment of staff members' capabilities and provision in the budget for and setting up of training facilities are both adequately covered in this publication. There is an obvious need for upgrading the ASRCT Personnel Unit to bring it in line with modern thinking.

INCENTIVES

Staff incentives of the type mentioned on p. 16 as well as others appropriate to Thailand should be studied by the personnel officer who should then advise the Director on their possible implementation.

PUBLICITY, PUBLIC RELATIONS

ASRCT should either recruit a public relations officer (PRO) or engage the services of a professional organization in this field: it is not a job for amateurs.

Public relations involves a comprehensive programme to acquaint the public and possible sponsors with the Corporation's existence, its skills and facilities, and as opportunity arises of its successes.

Well tried techniques are:-

(i) Production and dissemination (using a carefully thought out mailing list) of a "glossy" descriptive brochure, attractive leaflets describing separately the various functions of the Corporation and of course the ASRCT Research News.

(ii) Articles in the technical and lay press, use of radio and TV (KIST aims to get at least on mention per day in the national press).

(iii) Talks by staff members at meeting and conferences.

(iv) Exhibits at the entrance halls of the Corporation's buildings.

(v) Open days, when the Corporation's laboratories and workshops are open to inspection by industrialists, government officials and other interested individuals who attend by invitation.

One technique successfully used in Norway might be found useful in Thailand. On one day each year about 400 people are invited to attend the national applied research headquarters, when the heads of 20 research institutes are each allowed 3 minutes briefly to described - with visual aids - the activities of their institute over the last year. It is considered to be so important that the King takes the chair and cabinet ministers attend. This is followed by questions, an exhibition and dinner and sandwiches, the whole operation being completed in two hours.

To many people AIST has an unfortunate image because they think it is a government department. Also its name is considered by many to be too long and giving the wrong impression.

With regard to the former, AIST should be completely divorced from NRC and its grant from the government should come direct and not through that body. The physical removal of NRC from the Bang Khen campus, although difficult, would do much to improve the Corporation's image.

If AIST is to be renamed, its new name should be shorter and have initials that are easily remembered and said, cf. KIST and AIT.

The Kasem Committee favours "National Applied Research Corporation (NARC)", another name worth considering is "Research Corporation of Thailand (RCT)".

SUMMARIZED RECOMMENDATIONS

All the recommendations made in Part II are aimed at converting ASRCT from a research oriented organization into an industry oriented business operation. This involves a fundamental change in thinking and operating philosophy on the part of the Board and the Corporation's top management.

To this end the following specific recommendations are made:-

Recommendation 1 (p. 20)

The Corporation's constitution as laid down in the Act of B.E. 2506 should be rewritten. Provided the Board is prepared to run ASRCT as a business operation, it should continue to be an independent autonomous body.

Recommendation 2 (pp. 21-27, 33)

ASRCT's management structure should be so simplified that the Corporation can operate as a single entity with clearly defined objectives and responsibilities (see Fig 2, opposite p. 24).

The principal changes recommended are:-

(i) Two existing centres and one group should be wound up or transferred elsewhere, thereby narrowing the Corporation's areas of activity.

(ii) The Board should be reconstituted and its responsibilities redefined.

(iii) The current conflicting responsibilities of the Governor should be divided between a Chairman of the Board and a chief executive.

(iv) The chief executive (responsible for all aspects of the running of the Corporation) should be aided by three new non-executive staff groups, namely: a Programme Planning and Evaluation Group, a Director's Office, and a Public Relations Office.

(v) The current operating research institutes and centres should disappear as separate entities and be absorbed into the proposed new streamlined structure as sections within three

new functional divisions.

(vi) The proposed four operating and support divisions (Research; Development; Scientific Services; and Administration and Technical Services) should be headed by assistant directors with clearly defined and delegated responsibilities.

(vii) Wherever possible, industry-oriented projects should be carried out by multidiscipline project teams drawn from the appropriate divisions, sections, etc., each team to be under the full control of a project leader.

Recommendation 3 (p. 27)

The current "bottle neck" in development work at the pilot plant stage should be overcome by means of new accelerated "scaling up" procedures including use of existing plant belonging to interested companies.

Recommendation 4 (p. 28)

ASIOT should set up and operate an industrial advisory, consulting and trouble shooting extension service - to be named the Industrial Advisory Service, built on the existing Marketing Study Unit.

Recommendation 5 (p. 30)

ASIOT should aim to win 2% of its income by 1977 from contract research. It will involve closer and continuing contacts with industry.

Recommendation 6 (pp. 35-37)

(i) The Board should define annually a corporate policy and plan with a 5-year projection.

(ii) The existing ASIOT overall programme, after individual project evaluation, should be greatly reduced in size and scope. New projects should be introduced into the programme on the basis of information obtained from the proposed industry survey. Communications with industry must be greatly improved and potential industrial partners identified before initiating new research.

Summarized Recommendations

Recommendation 7 (pp. 35, 38)

The budgetting procedure should be modernized and streamlined and the internal allocation of funds drastically reoriented. The accounting system should be reorganized to provide management with meaningful financial and cost data.

Recommendation 8 (pp. 39, 40)

(i) So long as the annual budget remains at about £ 20 million, a way must be found for reducing the total staff to about 240.

(ii) Personnel policies and staff incentives must be reviewed and updated and training schemes initiated.

Recommendation 9 (pp. 29, 30, 35, 36, 41)

Every effort must be made to "liberalize" the Corporation's activities and give them a sense of urgency and practicality by such means as:-

(i) Clear definition of the Corporation's policy and plan and where individual responsibilities lie.

(ii) Delegation of responsibility with corresponding authority at all levels.

(iii) Eradicate the present system whereby permission has to be obtained from higher authority before anything can be done. Encourage personal initiative.

(iv) Reduce the number of meetings and committees by 90% and the amount of paper used and replace by personal decision after informal consultation.

(v) Emphasize internally and externally that ASECT is not a government department. To help achieve this, completely divorce ASECT from HMC and consider renaming the Corporation to give it a more modern and independent image.

POSSIBLE FURTHER ACTION BY UNIDO

s the suggested recommendations require a fundamental change in outlook and method of operation, it is obvious that the ASECT management will require further guidance and backing, at least in the early stages, if they are to be effectively implemented.

Two possible ways of doing this are:-

(i) Establish a "sister" relationship with an independent contract research organization in a developed country to provide guidance, training and back-up services. Such a relationship existed for three years between the Korean Institute for Sciences and Technology (KIST) and the Battelle Memorial Institute.

(ii) Provide the services for a period of up to 9 months of a man experienced in this type of work as adviser to the ASECT Director. Of the two alternatives the first is to be preferred but probably will have to depend upon bilateral aid from a country having the required type of research organization, e.g. Canada, Norway, United Kingdom or the United States of America.

Informal "soundings" by the Project Manager and the writer suggest that this may be possible.

The assistance of a UNIDO expert may be required for 2-3 months to plan with the Project Manager the proposed limited industry survey (i.e. 37). The actual visits could be undertaken by a 3-man team consisting of the expert and two appropriate ASECT staff members.

Any further UNIDO assistances of this nature should be conditional upon the acceptance and implementation by ASECT of the recommendations in this report.

ACKNOWLEDGEMENTS

The writer is indebted to the many people who have helped in the execution of this mission. In particular he is most grateful to the Governor (Dr. Tab Silanidhi) and Board of ASRCT, the Acting Governor (Dr. Boon Indrambarya), the Director (Dr. Kasem Balajiva) and staff of TRI and the Corporation's other institutes and centres, to the UNIDO/TRI Project Manager (Dr. C.L. Wrenshall) and his colleagues, to the UNDP Resident Representative (Mr. Thomas F. Power Jr.) and his staff, and last but by no means least to his counterpart Group Captain Korn Satrabhaya.

Bangkok
24 November 1972

F.N. Woodward

REFERENCES AND RECOMMENDED READING

1. ASRCT Science Policy Studies Unit: "Success in the Transfer of Technology from ASRCT." July 1972.

2. F.N. Woodward: "Organization of Industrial Research Institutes and their Relationship with Clients." UNIDO Publication ID/WG2/R.11 dated March 1967.

3. Industrial Research Institutes: I. Project Selection and Evaluation, II. Financial Administration. UN Publication E 70. II. B. 21-(1970).

4. ASRCT Record of Meeting (71.11.08): "Independent Consultancy and Contract Research - How it has developed and how it operates." (F.N. Woodward).

5. L.W. Bass and F.N. Woodward: "The Management of Multi-discipline Project Teams." Chemistry and Industry, 1967, pp. 1890-1896.

6. E.S. Hiscocks: "Personnel Policy in Industrial Research Organizations." UNIDO Publication ID/WG2/R.8 dated 20 March 1967.

APPENDIX I

ORGANIZATIONS VISITED AND INDIVIDUALS WITH WHOM DISCUSSIONS WERE HELD

9 October - 24 November 1972

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

Board members:-

Dr. Tab Nilanidhi	Governor
M.C. Chakrabandhu Pensiri Chakrabandhu	Rector Kasetsart University
Mr. Benoo Suvansith	Secretary-General, National Economic Development Board
Dr. Praprut Na Nagara	Director-General, Department of Science, Ministry of Industry
General Netr Chemayodhin	President, Family Planning Association

Staff members:-

Technological Research Institute (TRI)

Dr. Kasem Balajiva	Research Director
Dr. Suan Vardhanabhuti	Director, Biotechnology Group
Dr. Bancha [illegible]makdi	Director, Chemical Technology Group
Mr. Nitasana Kichitakul	Research Services Unit

Agricultural Products Research Institute (APRI)

Dr. Narong Chomchalow	Acting Research Director

Environmental and Ecological Research Institute (EERI)

Dr. Boon Indrambarya	Research Director
Dr. Sermpol Kotasak	Environmental Engineering Unit
Dr. H.E. McClure	Migratory Animal Pathological Survey

Institute for Development Studies

Group Captain Sorn Satrabhaya	Acting Research Director
Mr. Martin Bell	Science Policy Studies Unit
Mr. Phaichayon Jathavikul	Marketing Study Unit

Scientific and Administrative Services	(Department/Centre Heads)
Mr. Ananta Chintakananda	Administrative Services
AVM. Pramote Cheuynak	Technical Services
Mrs. Chalermwan Choosup	Thai National Documentation Centre
Capt. Prabhai Yeonil	Instrument Repair and Calibration Centre
Dr. Prasert Lohavanijaya	Centre for Thai National Reference Collections
Mr. Vadanyu Nathalang	National Building Research and Development Centre
Mrs. Suparn Chamsawasdi	Computing Service Centre
Col. Suthi Sangsomwong	Centre for Thai National Standard Specifications
Mrs. Aree Kengpol	Budget Officer

UNIDO Experts

Dr. C.L. Wrenshall	Project Manager
Mr. N.L. Wake	Commercial Development
Dr. G.A. Kirkendale	Structural Clay Products
Dr. C. Chu	Chemical Engineering
Mr. R.L. Ferguson	Industrial Economist
Dr. E.P. Munger	Metallurgist
Mr. G. Gaczynski	Rubber Products Technology
Mr. J. Overgaard	Building Materials

INTERNATIONAL, GOVERNMENTAL AND NON-GOVERNMENT ORGANIZATIONS

United Nations Development Programme (UNDP)

Mr. Thomas F. Power, Jr.	Regional Representative
Mr. Nils Tamm-Ericson	Industrial Development Field Adviser

National Research Committee

Dr. Pradisth Choosakul	Secretary-General
Dr. I.H. Billick	UNESCO Science Policy Adviser

Asian Institute of Technology

Professor F.H.D. Williams	Transportation Engineering

Board of Investment

Mr. Somporn Sudsayakhupta	Secretary-General

Industrial Finance Corporation of Thailand

Mr. Tos Phantumsen	Manager, Operations Department

Department of Industrial Promotion, Ministry of Industry

Industries Service Unit

Mr. Vandi Hutasingh	Deputy Director
Mr. J.D. Lloyd	UNIDO Marketing Expert

Textile Industries Division

Mr. F. Massa	Textile Technologist (UNIDO)

British Embassy

Mr. [illegible] Hurrel	Head, Development Department
Mr. J. Peat	Economist
Mr. J. Greaves	Commercial Counsellor

Canadian Embassy

Mr. Lance Bailey	

U.S. Embassy

Mr. Roy M. Hill	Director, USOM/Thailand
Mr. Frederick F. Simmons	Deputy Director, USOM/Thailand
Mr. Donald C. Marsden	Chief, Private Enterprise Division
Mr. H.P. Johnson	Principal Officer, Economic & Development & Investment Office, USOM/Thailand.
Mr. David I. Steinberg	Regional Economic Development (RED)

APPENDIX II

ASRCT INCOME SOURCES

(₵'000)

	Government grant	Foreign aid	ASRCT earnings
1964	4,000	122	-
1965	5,000	-	30
1966	7,929	320	103
1967	13,480	3,291	108
1968	11,044	4,198	160
1969	12,000	5,193	275
1970	12,000	4,811	525
1971	15,600	3,798	368
1972	20,380	2,676	360
	101,433	24,409	1,929
% of total income	79.4	19.1	1.5

APPENDIX III

ASRCT STAFF NUMBERS AND DISTRIBUTION

NOVEMBER 1972

Unit	R.O.	E.O.	S.O.	T.O.	Techn.	Ancil.	Asst.	Total
Board Secretariat	1	-	2	-	-	2	-	5
Editorial Services	-	-	2	-	-	2	-	4
Audit/Budget	-	-	1	-	-	-	-	1
Administrative Services	-	-	12	-	1	22	35	70
Technical Services	-	-	4	-	43	-	13	60
Thai National Documentation Centre	-	-	13	-	-	5	-	18
Centre for Thai National Reference Collections	-	6	-	-	3	1	1	11
Centre for Thai National Standard Specifications	-	3	2	-	-	1	-	6
Instrument Repair and Calibration Centre		5	-	1	17	1	-	24
National Building Research and Development Centre	1	8	-	-	-	1	-	10
Computing Services Centre	-	1	-	-	-	1	-	2
Technological Research Institute	8	42	1	3	10	4	18	86
Agricultural Products Research Institute	2	14	1	-	1	1	6	25
Environmental and Ecological Research Institute	4	8	3	-	11	6	12	44
Economic Studies Group	-	12	-	1	-	2	-	15
Total	16	99	41	5	86	49	85	381

APPENDIX IV

WORKING CHAIRMAN: JOB DESCRIPTION

The Chairman's responsibilities in addition to those laid down by statute could include the following:

1. Public relations:

It is most important that the Research Corporation build up a public image as a top rank independent industrial consulting organization. In addition to the use of normal public relations techniques (brochures, radio, TV and the press; seminars, open days, etc.) it will be necessary to make and maintain high level contacts with industrialists, government departments and other research organizations in Thailand and abroad. Because of the Chairman's position he could make a significant impact with such bodies. Another important responsibility of the Chairman would be to speak at high level meetings and conferences at international and national level not only on the activities of ASRCT but also on the part played by Thailand in the application of technology. Not the least of his important duties would be to receive and entertain high level visitors to the Corporation.

2. Liaison and co-operation:

It is also essential that the Corporation be conducted in such a way as to avoid overlapping or duplicating the activities of other research organizations. Top level discussions and continuing liaison with these bodies are therefore essential and would be best conducted by the Chairman.

3. Support for the Corporation:

In addition to funding from the Thai Government and hopefully, increasing financial support from industry in the form of contracts, there are many other possible sources of finance available to an independent national research organization like ASRCT.

A number of potential sources of technical and financial support have been identified in earlier contacts and these need to be followed up energetically. In almost every developed country in the world there are large foundations with funds available to support research in some

shape or form. Typical of these are the Foundations bearing the names of Ford and Rockefeller in the USA: Nuffield, Wolfson in the UK and Volkswagen in Germany. The Chairman because of his position and high standing is in a unique position to stimulate the interest of these organizations in ASRCT in particular and Thailand science and technology in general. One of his responsibilities at the outset could be to build up contacts with and stimulate the interest of the diplomatic representatives of these countries with the ultimate view of obtaining bilateral aid. In this connection UN agencies other than UNDP/UNIDO could be contacted.

APPENDIX V

CHIEF EXECUTIVE/DIRECTOR : JOB DESCRIPTION

Chief executive, the man responsible for implementing the policies laid down by the Board and ensuring that these functions are fulfilled is the Director. He should be a scientist/technologist of wide experience and proven managerial ability, a man capable of making decisions and ensuring that they are implemented and of sufficient stature to enable him to meet on equal term with senior industrial government and university officials.

Institute policies, technical objectives, organization and future plans are the responsibility of the Director, subject to Board approval of his recommendation. In preparing these policies and plans he will usually seek the advice of his senior colleagues.

Project formulation and direction are responsibilities normally delegated to senior members of the technical staff and their activities are given general supervision and approval by the Director, Assistant Directors and Section Heads.

Personnel policies are established by the Director with the guidelines laid down by the Board. Procedures are formulated by the Administrative Officer and these are executed at the respective organizational levels according to responsibilities delegated by the Director.

Financial policies (internal) are established by the Director, subject to approval by the Board. Procedures to carry out these responsibilities are developed by the Administrative officers.

Public relations policies are set by the Director where advisable in association with the chairman and implementation is carried out by the Public Relations Office or Officer.

External contacts at the executive level are usually developed by the Director and Assistant Directors and they may ask for the assistance of the Chairman and Board members. Contacts at the operating level should be delegated to appropriate project leaders.

Staff training: The choice of programmes and selection of staff for training will be the responsibility of the Director advised by appropriate Assistant Directors. These programmes should formally be approved by the Board before implementation.

APPENDIX VI

INVERESK RESEARCH INTERNATIONAL

Proposal Preparation

Proposals should take the following form.

Dear .....

Prospect Number
Title

'Following the discussion with your colleagues during my visit to .... on ..... we now have pleasure in submitting the following research programme for work to be carried out at Inveresk Research International.'

BACKGROUND

State the clients problem as expressed to you to enable him to check that it has been correctly conveyed.

Outline the expertise which IRI has and which is relevant.

OBJECTIVE

APPROACH

Outline the research programme, but be cautious about listing potentially patentable ideas. Be more specific about the techniques to be used. If you specify one detailed line of approach, state that it may be modified if proved to be unsuccessful during preliminary studies.

COST AND DURATION

Estimate contributions from all personnel likely to be involved, including outside consultants and fill in costing form in conjunction with Division Head. Submit this for confirmation to the Organization Secretary.

If necessary arrange for the work to be phased and suggest review periods for each phase. Give duration and then state:

'For the work outlined above, we propose that you authorise a maximum expenditure of ..... for professional services and expenditure. Travel and out-of-pocket expenses will be charged additionally at cost.

Out invoice will be rendered monthly and is payable on receipt.'

REPORTING

'Formal reports will be submitted at (three-monthly) intervals and in addition informal presentation of important findings will be made as necessary by telephone and through brief letter reports. In addition, a final report will be submitted on completion of the work. Relevant members of the IRI staff will also be available for discussions concerning the progress of the work.'

GENERAL PROVISIONS

Include as many as necessary of the following:

'Our work for clients is conducted on a confidential basis, and we will treat information developed hereunder in accordance with our established professional standards.'

'Reports resulting from this assignment become your property; however, our authorisation in writing is required if our reports are reproduced in whole or in part for use outside your organisation. It is understood that the name of Inveresk Research International is not to be used for advertising or promotional purposes without prior written permission.'

'We will use our best endeavours to carry out the work specified but we cannot be held responsible for failure to carry out any of the commitments due to a cause or causes beyond our control.'

'Our agreement may be terminated on thirty days written notice by either party.'

'All inventions made during the course of the work will be reported to you and will be your property. You will have the right at your own expense to seek protection on such patents in any and all countries throughout the world. At your request, however, and on your

behalf, we will file and prosecute applications on such inventions. In the event of your not wishing to apply for a patent in all or any country in the world Faverdale Research International may, subject to having obtained your prior permission, prosecute applications for a patent at its own expense and for its own benefit.'

'The charges shown in this proposal do not include V.A.T.'

ACCEPTANCE

'For the purpose of staff scheduling, this proposal is made subject to acceptance within thirty days. If you require an extension of this time, will you please inform us in writing prior to .....

If this proposal meets with your approval, please sign and return the enclosed copy as authorisation for us to proceed with the work.

We look forward with great interest to working with you on this project and will devote our best efforts to accomplishing the work outlined above.'

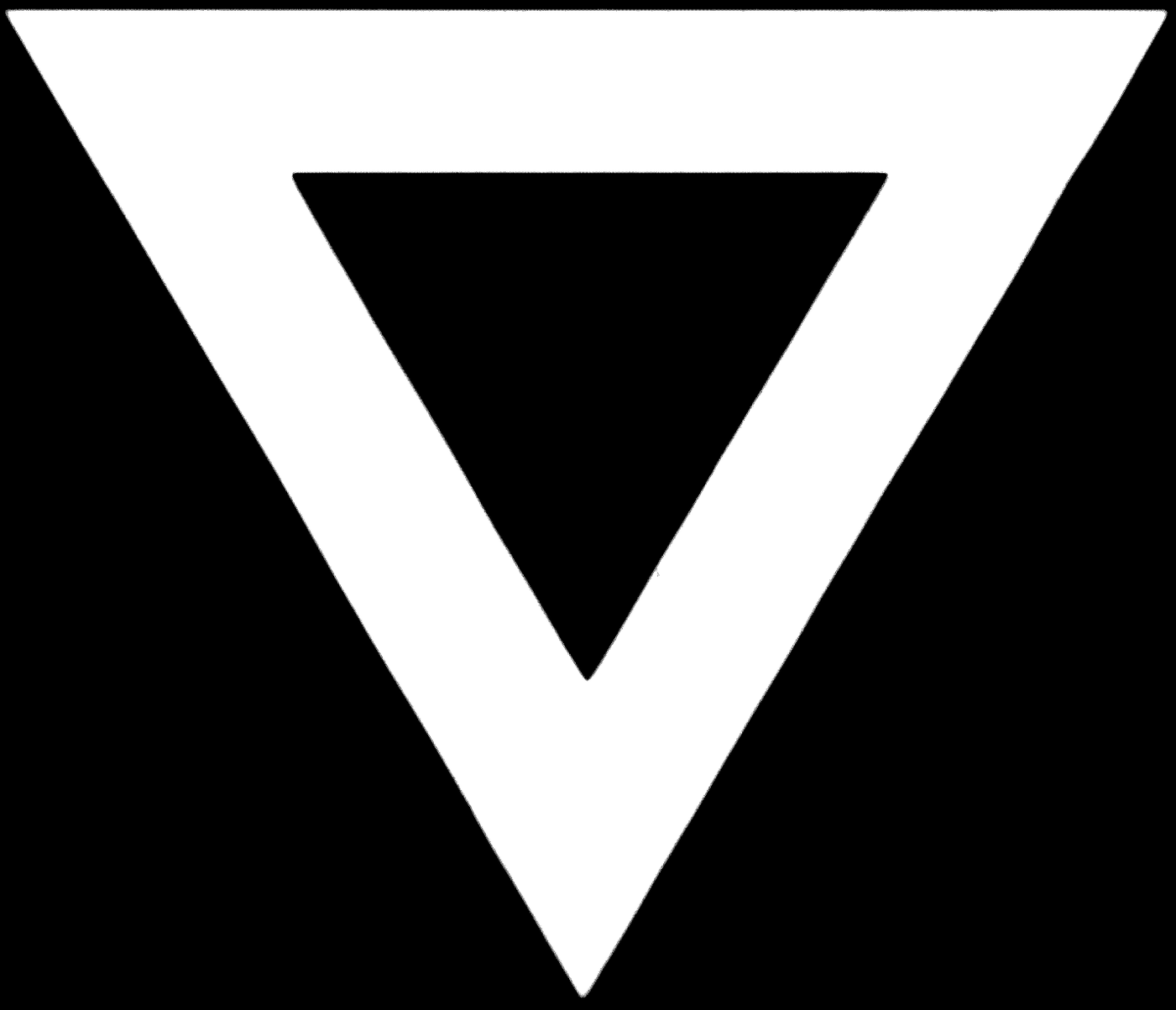
Yours sincerely,

Project Leader

Approved for FRI

Accepted for client

C-551



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