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Final Report

COMMERCIALIZATION OF R & D AT TISTR

UNIDO Project Nº SI/THA/93/803

August 1994

CONTENTS

CONCLUSIONS

In order that in the future authorities and enterprises may clearly perceive the impact caused by the work of TISTR in the increase of competitiveness in Thai production, as well as in the increase of income coming from the private sector, a progressive change of focus from "product out" to "market in" is of vital importance.

This means favoring R&D projects and technological services requested by companies, as well as pre-competitive in-house projects that would help to prepare TISTR for future sales and in which active entrepreneur participation is also necessary.

In order to achieve this, a set of suggestions is submitted in this report having as main objectives to place TISTR closer to production needs and to constantly improve its internal management.

Two suggestions should be specially emphasized that aim towards the improvement of TISTR image and the enthusiasm and commitment of TISTR best resource, i.e. its personnel.

We are referring to give first priority to the implementation of a program for improving TISTR image considering that its reality is by far better than the general opinion people have of it.

And equally or more important is the implementation of a program oriented towards a progressive improvement of salaries and non-monetary incentives.

Consultants that have experienced a similar process are conscious that this is not easy but it is certainly feasible.

ABBREVIATIONS

UNIDO	:	United Nations Industrial Development Organization.
TISTR	:	Thailand Institute of Scientific and Technological Research.
NCGEB	:	National Center for Genetic Engineering and Biotechnology.
NSTDA	:	National Science and Technology Development Agency.
NECTEC	:	National Electronic and Computer Technology Center.
NMMTC	:	National Metal and Materials Technology Center.
MOSTE	:	Ministry of Science, Technology and Environment.
EGAT	:	Electricity Generating Authority of Thailand.
PFO	:	Preserved Food Organization.
TOT	:	Telephone Organization of Thailand.
CAT	:	Communication Authority of Thailand.
MOI	:	Ministry of Industry.
DIP	:	Department of Industrial Promotion (Ministry of Industry).
MDI	:	Metalworking and Machinery Industries Development Institute (Ministry of Industry).
TTC	:	Technology Transfer Center (MOSTE).
DOSS	:	Department of Science Services (MOSTE).
ISD	:	Industrial Services Division (MOI).
TMDPC	:	Thailand Management Development and Productivity Center.
TPA	:	Technological Promotion Association.

INTRODUCTION

This final report which has been prepared by Mrs. Maria Angélica Moreno A. Marketing Director of INTEC-CHILE and Mr. Mariano Berazaluce D. Deputy Marketing Director of INTEC-CHILE, as UNIDO experts on Commercialization of Research and Development, under the supervision of Mr. Sergio Musa L. Director of INTEC-CHILE, all of them under UNIDO subcontract in collaboration with Mr. Nils Ramm Ericson, UNIDO Consultant and Project Coordinator.

This report could not be prepared without the valuable orientation and support of Mrs. Malee Suwana and M. Peter Ellwood, of UNIDO Vienna, before, during and after the mission. INTEC-CHILE team would like to express their special thanks to them.

Those who prepared this report would like also to express their thanks to TISTR Acting Governor Mr. Chalermchai Honark, to Mr. Anek Tamratanaporn for his valuable advice, opinions and information, and to all the members of TISTR staff that enthusiastically contributed to make this draft possible.

I. TISTR

I.1 HISTORY

The Thailand Institute of Scientific and Technological Research (TISTR) is a non-profit making state enterprise under the Ministry of Science, Technology and Environment (MOSTE). TISTR was originally set up by the Applied Scientific Research Corporation of Thailand Act B.E. 2506 (1963) which was repealed and replaced by the Thailand Institute of Scientific and Technological Research Act B.E. 2522 (1979) following the establishment of MOSTE in the same year.

I.2 OBJECTIVES

TISTR has the following objectives:

* To initiate and conduct research and to provide scientific and technological services to state agencies and private enterprises for economic and social development of the country;

* To conduct scientific and technological research in order to promote the utilization of natural resources appropriate to the economic conditions, environment, health and welfare of the people;

* To improve productivity in accordance with the Government policies by propagating the results of scientific and technological research to benefit the country in agriculture, industry and commerce;

* To train scientific and technological researchers;

* To provide for the testing and measuring services and other scientific and technological services.

I.3 TISTR'S MAIN POLICIES

* To expedite the policies of the Ministry of Science, Technology and Environment dedicated to promoting the country's scientific and technological efficiency with the aim of self-reliance.

* This will be done by giving encouragement,incentive, assistance and support for the use of the results of research and development to tackle economic and social problems on all fronts.

* To mobilize the country's human resource to work for the development of scientific and technological research in order to effect practical operational results. This includes measures for screening, controlling and distributing technology systematically, and also for encouraging local inventions and high technology productions in future.

* To operate as a "center of excellence" responsible for the provision of scientific and technological services, such as in testing and standards, supply of relevant information and consultation to the government and private sectors, both locally and regionally.

* To work in close cooperation with the private sector engaged in various enterprises and with research and development units in order to build up an atmosphere in which science and technology are seen as the means by which the national problems may be solved.

I.4 ORGANIZATION

TISTR has approximately 700 people, organized as it shows in the attached chart.

I.4.1 EXECUTIVES (Managers)

The Chief Executive Officer is the Governor, a member of the TISTR Board. There are two Deputy Directors. All the Heads of the 3 offices, the head of the Service group and the heads of the group of the Departments relate directly to the Governor.

I.4.2 R AND D AT TISTR.

The Research and Development group of TISTR has 15 Departments:

- Food Industry Department.
- Pharmaceuticals and Natural Products Department.
- Chemical Industry Department.
- Biotechnology Department.
- Building Technology Department.
- Electronic Industry Department.
- Engineering Industry Department.
- Metal and Materials Technology Department.
- Agro-Technology Department.

- Energy Technology Department.
- Environmental and Resources Management Department.
- Ecological Research Department.
- Thai Packaging Centre.
- Automotive Centre.
- Special Programme Centre.

The last one mentioned above is responsible for the operation of integrated projects under a combined R and D effort among specialists from different Departments and Centers of TISTR.

I.4.3 THE SERVICE GROUP

It has five Centers

- Testing and Standards Centre.
- Thai National Documentation Centre.
- Engineering Consultancy Service Centre.
- Industrial Cooperation and Promotion Centre.
- Research Service Centre.

I.4.4 SUPPORT GROUP

There are 3 offices that help the Governor and give support to the Centers and to the Departments.

- Office of the Governor
- Office of Policy and Planning and
- Office of Administration.

I.5 TISTR'S R AND D and other technological services output.

I.5.1 PRODUCTS

- Reverse Osmosis Brackish-water Desalinator.
- Air-cleaner for Office, House, Car and Factory.
- Briquetting Machine.
- Extruder.
- Waxer.
- Micro-computerized Private Automatic Branch Exchange (MCPBX).
- Electronic Ballast
- Computer Model TISTR 1016: Laotian Language Software.

- Special Steel and Alloy Products.
- Roller.
- Tantalum Powder.
- Prefabricated Bathrooms.
- Biofertilizer.
- Garlic Natural Capsule.
- Antiinflammatory Plygesal Cream.
- Senna Tea Bag for Laxative.

I.5.2 PROCESSES

- Process Improvement for High-grade Kaolin.
- Technology Improvement of Gems Quality.
- Soil Cement Technology.
- Utilization of Cassava.

  * Ethyl Alcohol 99.5% for Energy.
  * Dextrose Anhydrous.
  * Animal Feed.

- Research and Development on Rubber Sheets for Rubber Reservoir Lining.
- Production Process Improvement for Transparent Noodle Factory.
- Removal of Aflatoxin in Peanut Oil.
- Process Improvement in Rubber Band Factory.

I.5.3 SERVICES

- Services for Industry and Export Promotion:
  * Metrology and Testing.
  * Packaging.
  * Post Harvest Technology.

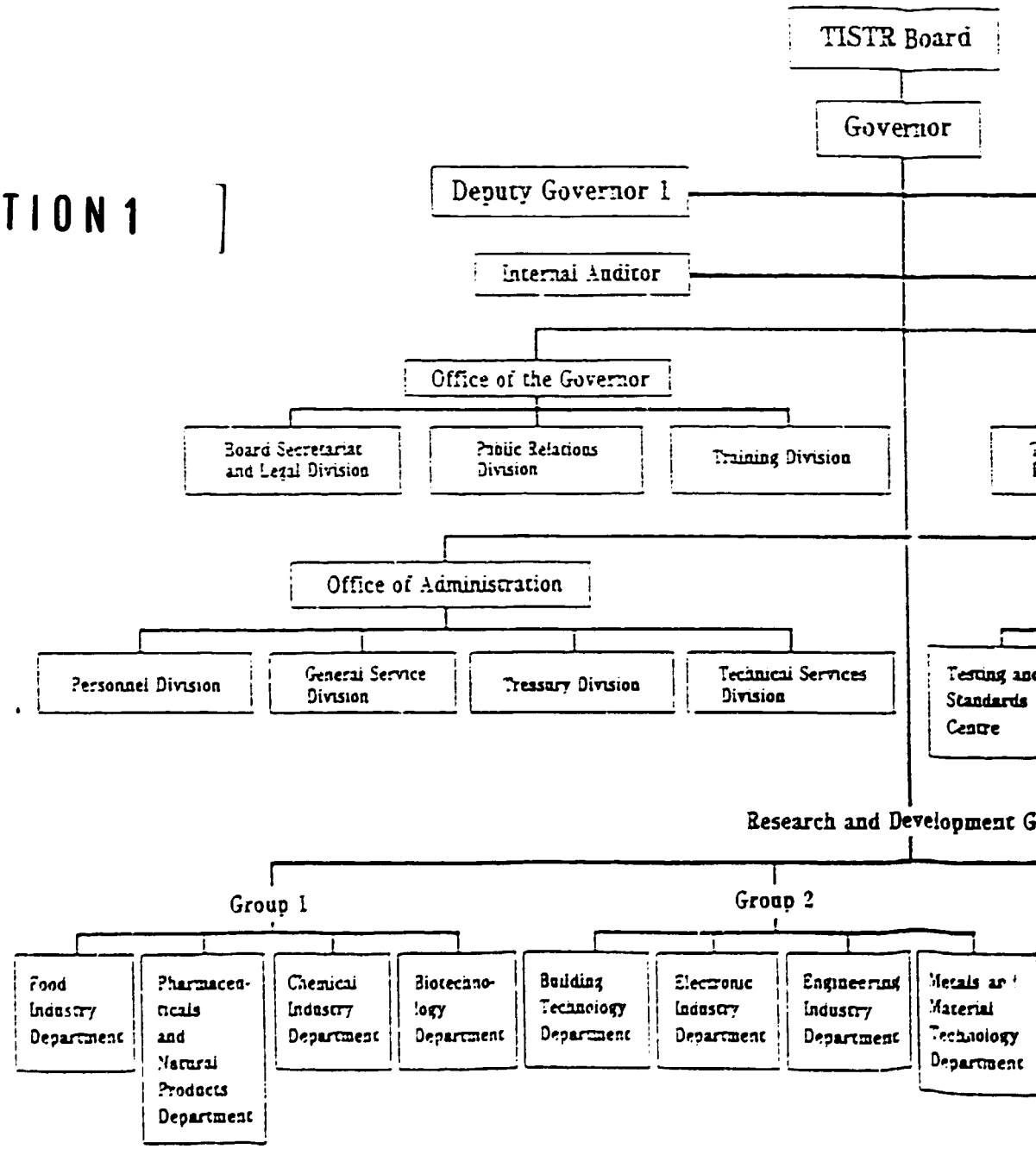
- Engineering Consultancy Services such as Huai Saphan Hin Hydroelectric Dam.
- Master Plan for Provincial Development at Surat Thani, Surin.
- Master Plan for Tourism Development at Ko Samui, and Hua-Hin.
- Energy Conservation for Industrial Plant such as Fish Meal Factory.
- Dusit Zoo Museum.
- King Rama VI Museum.

This chapter has been extracted from the TISTR'S Brochure, published in 1993.

ORGANIZATION

THAILAND INSTITUTE OF SCIENTIFIC AND

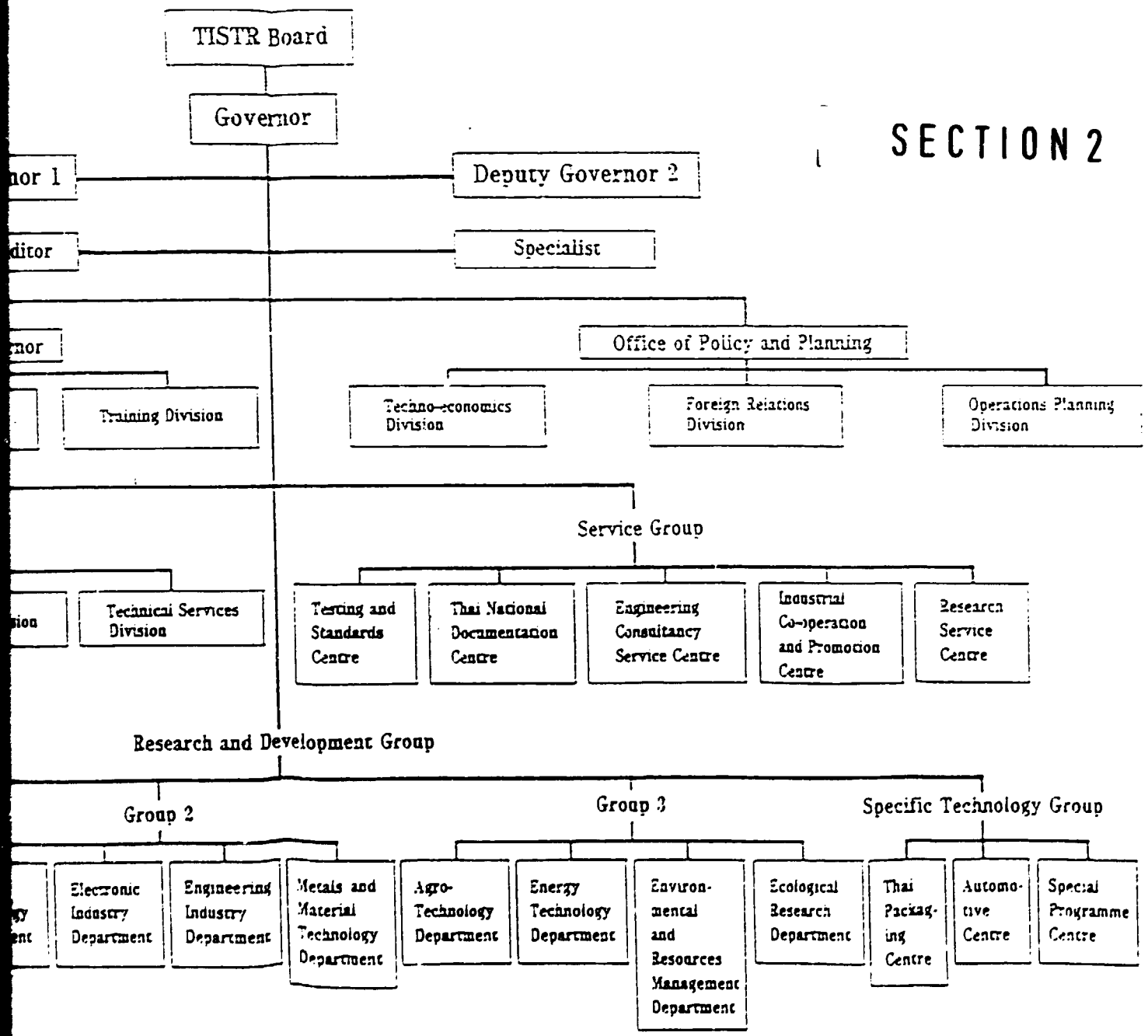
SECTION 1



ORGANIZATION CHART

E OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH

SECTION 2



II. TISTR'S CUSTOMERS, CURRENT AND POTENTIAL

II.1 CURRENT TISTR'S CUSTOMERS

Current TISTR demand is very heterogeneous there are small, medium and large enterprises, both private and public, in Bangkok area and in the regions.

Analizing the needs observed, during the visits, the following list of services could be mentioned. Most of them are current services of TISTR for them already:

Laboratory analysis, technical information, prototype designs, products development and process engineering.

In the case of one large private company with its own laboratories, they are planning to buy R and D projects to TISTR, under their design, in those specialities they do not have.

Also as an example, it is necessary to mention a big public enterprise that mantains its interest in TISTR R and D in house projects developed at laboratory scale, even when they have their own R and D group.

The two examples mentioned above show great expectations in those segments.

Furthermore, when analyzing the answer of small companies, they are not thinking in taking any risk and after a great effort of TISTR for designing a new product and carrying the market studies, they would like to have a big subsidy from TISTR, when purchasing the technology for entering in production.

It is easy to understand their position, but if the case is representative of many other small companies, future market in this segment will be not successful even with great effort on the part of TISTR.

Finally, information provided by medium size companies show potential good possibilities for TISTR in all the services mentioned at the beginning, if TISTR improves its operative following the suggestions mentioned in this chapter (II.3).

Specially for this segment but not exclusively, a State Fund to promote the development of future demand of R and D projects will be very useful.(III.4)

II.2 CRITERIA TO SELECT MARKET SEGMENTS

II 2.1 EXPORTS EVOLUTION.

One way to analyze this subject, so that opportunities can be found, is to study the evolution of the country's economy during 1988–1992 particularly in export evolution (6).

Exporters are very sensitive to technological changes, so among other enterprises they are the best clients for suppliers or R an D, engineering and other technological services. They are competing hardly in the world market and their customers are perfectionists that demand high quality products.

There are two principal criteria for predicting demand for technological services for present and future exports. Sectors with:

a) A big increase in exports during 1988–1992
b) A substantial volume of exports maintained since 1988.

Both sectors need, and will need, reduced costs (even if salaries rise),to improve product quality, higher productivity and adequate time for delivery. For these purposes, technological services must be provided, with the exception of those too big companies that are capable of having their own in–house services.

Initial opportunities are to be found in the following industries:

Textile products, Machinery and mechanical appliances, Precious stones and jewellery, Electrical apparatus for making and breaking electrical circuits, Footwear, Electrical appliances, Furniture and parts, Plastic products, Canned crustaceans, Sugar, Rubber products, Ceramic products, Clocks, watches and parts, Transformers, generators and motors, Insulated electric wire cable, Vehicle parts and accessories, Optical appliance and instruments, Chemical products, Toys, games, Sport requisites, Rice, Rubber, Tapioca products, Frozen fowl, Tobacco leaves, Shrimp, fresh and frozen, and Fish, fresh and frozen.

A more complete selection is shown in a table of Annex 4 extracted from the Thailand Country Report.

All of them are current and potential customers of technological services. Nevertheless, for R and D projects there are better options in private primary sectors and in Public enterprises when R and D projects are related to typical processes and products of one sector.

automation, defined as area problems, better options are located in medium size companies rather than in small and large ones.

II.2.2 TISTR SALES

To be more selective an additional criteria could be applied, related to the evolution of sales, during the last five years in each Department of TISTR. Similar criteria to those described in point II.2.1 should be followed.

a) A big increase in self financing.
b) A substantial amount of sales to the above listed clients maintained during the last years.

Consultants are not including as a part of self financing: International Cooperation Funds, and State direct monetary contributions.

The following are examples of TISTR Departments for which it is possible to predict a growing of their sales: Metal and Material, Environmental and Resources Management Department, Metrology and Packaging Centre.

If those Departments achieve good technical and economic results and easy and frequent relations with clients, the positioning obtained ensures greater successes.

II.3 CUSTOMERS OPINIONS REGARDING TISTR

The opinions expressed by the clients were very variable in nature, mainly treating matters directly concerning TISTR and other more general aspects touching on the scientific-technological system of the country. We include here a summary of the opinions of the clients. The opinions about TISTR were favourable, neutral, or unfavourable, and relate mainly to Management, Marketing, Promotion, and Technical capability and performance.

in many cases the opinions given referred to more than one aspect; also they appeared with different frequencies during the interviews. Some opinions were rather similar, but others were contradictory.

From here onwards, we shall treat as strengths of the Institute those opinions that are clearly favourable, and as weaknesses, those that are negative. For intermediate opinions, the analysis will be centered on considering those aspects to be improved so that such situations become strengths.

MANAGEMENT

In the opinion of some clients, their experience with regard to TISTR could be expressed

as fairly useful and pleasant, given that, for example, the contracting procedures were simple and expeditious. Nevertheless, others considered that it was necessary to improve, in general, procedures for working with the Institute, and likewise to make more intensive the release and spreading of information on their different modes of operation.

The provision of services implies, in the opinion of the clients, the need for greater administrative agility and efficiency for managing projects and responding to contractual situations. This is especially applicable to projects that involve significant amounts of work in the field, whether supervising technical procedures supplied by the Institute or controlling industrial activities.

Another important aspect perceived in different ways by the clients is that relating to bureaucracy; some consider that it is typical of public administration, while others see TISTR as working better than other governmental organizations, and that it also has mechanisms for going over problems. On this particular aspect, administrative difficulties in overcoming unexpected problems encountered while carrying out projects in the field were mentioned.

The clients also saw some decision-making processes as cumbersome, with little delegation to middle-level managers. It was mentioned that too many decisions are referred to the Governor; for example, getting authorization to leave the Institute to visit a client.

Situations such as these, which probably make their impression on the clients on the occasion of their frequent contacts while projects are being carried out or at the time of requesting further advice, appear to these consultants to be of relatively simple and appropriate solution. An important factor in the shaping of a good image for the Institute is the greater agility seen by the clients, that is, the promptness with which their requirements are attended to. The view that "at TISTR they act like us, with the swiftness of a private business" is adopted naturally, without remark. This contributes to erasing the preconception of a slow, ponderous institution so often classed, rightly or wrongly, as part of the Public Administration. This greater institutional agility, in an increasingly competitive environment, constitutes a certain advantage for better utilizing the opportunities that the market offers.

Another important aspect that concerns businessmen is the lack of mechanisms that motivate the researchers of TISTR to seek out projects outside the Institute aimed at solving the real problems of businesses and organizations. At least among the businessmen interviewed, a willingness to pay for the services of the Institute was detected. In fact, they declared that all the R & D carried out internally should be saleable commercially. Doubtless, such sales would be benefited if the selection beforehand of the subjects to be developed is made with the participation of the industrial sectors, and/or, even better, if such projects are contracted by the latter.

To some extent, this criteria for facing up to real situations may exist much more in the activities of TISTR than in other organizations supplying technology in Thailand. This would explain the thinking of some of those interviewed regarding the fact that, among the institutions for supplying technology, TISTR seems to be one of the most pragmatic.

MARKETING

The consultants took the opportunity to study different examples of relationships between the Institute and their clients. As we have already stated, these relationships were seen as easy and comfortable.

One mechanism which makes it possible to demonstrate good experience in testing new products in the market is that of the "marketing trials". As an example we can cite the biofertilizer test that is being carried out in the country, with a view to reducing the use of chemical fertilizers. This is a pilot project being realized right now between a dependant organism of the Ministry of Agriculture, a private company, and the Institute, the new fertilizer is being handed over to the country workers, produced by the company according to the formulas, processes, and control of TISTR. It is interesting to mention here that this Ministry did not hire TISTR to complete a technological development – instead they, knowing that this was already done, directly entrusted to them the task of biofertilizer production. At the same time the Institute had to resolve the problem of industrial-scale production by hiring the manufacturer. Without ignoring the rich practical experience in technical matters that is of course involved in production, that which interests us here is the close collaboration created both with the client and with the supplier, which, at the same time, allows the Institute to improve its perception of the real needs of its target market.

Regarding the provision of services and development of external projects, that is, projects requested and financed by clients, positive results have been achieved, creating good relations with the producing sectors of industry.

An example which illustrates the above point is the project developed for a plant for pulp production using bagasse. This concerned maintaining the bagasse – a subproduct of the production of sugar which is created during a period of only three months in each season in good conditions of humidity after harvest so that it could be gathered, stored, and subsequently processed during the remaining part of the year.

In the interview with the client, who declared himself to be very satisfied with the work carried out by TISTR, a series of elements making up an appropriate course of action was pointed out. The Institute should not only maintain but also continuously improve this procedure. The Institute provided and successfully transferred the technology to a large company that, at the same time, was willing to invest in the R & D. The company had

known the Institute, knew personally the management of the relevant department, knew about the high level of training of its professional staff, and knew that it had good equipment even better than that of its possible competitors. Moreover, permanent contact was being maintained, which allowed them to keep informed of the current activities of TISTR. The work was carried out in close collaboration, which made possible a good transfer of knowledge fro... TISTR to the client's professional staff.

It is important to point ut here that this client has its own R & D facilities, used for covering the needs of its particular field of production, and that it is willing to go outside to contract out those matters that are not part of its specialisation. This business criteria, in the opinion of the consultants, opens up a potential market in all the other large companies of the country which TISTR should continuously investigate, determining their requirements and offering their services.

Examples similar to the above were presented to the consultants in, among others, the development of pharmaceutical products.

Also there are good examples of collaboration and successful commercialization of technology between TISTR and businesses. Starting from in-house projects, cases were mentioned of licensing, joint ventures and R & D contracts with private and public productive sectors.

One of the businessmen interviewed, during his search for environmental technologies, received a ministerial recommendation that he contact TISTR. The conversations bore fruit in developing at least two joint projects:

- Joint-venture for purifying brackish water by reverse osmosis.
  Thirty purifying units were produced, with TISTR providing the technology and the client the manufacturing and the marketing. These units were for resolving situations of scarce drinking water in the northeast of the country.

- Fabrication of an electrostatic air cleaner. This equipment, produced on the basis of a prototype developed and guaranteed by TISTR, is for removing particles and smells in offices, conference rooms, schools, hospitals, etc. In the catalogues and leaflets it is mentioned that the technology comes from the Institute. The company paid royalties to TISTR for each unit sold over three years.

There was an opportunity to learn about two more cases: that of an anti-inflammatory pharmaceutical product now present in the Thai market, and that of a catalytic converter for use in automobiles whose prototype development and license agreement is being negotiated.

The factor common to all these cases is that these are all about internal projects, which

means that the Institute should make an initial effort to develop the technology to the level needed in order for commercialization to be possible. This means previously assigning the Institutes' own resources to financing these activities, accompanied by a natural uncertainty over both the technical results and the turning of the possibilities for subsequent sales of the technology into reality.

This 'modus operandi' of first investing and then recovering the investment through licenses is how some of the interviewees think the Institute should act. Moreover, they consider that TISTR should invest in projects with a view to the long term, in those which are good for the country. Nevertheless, the consultants consider that, apart from the greater financial effort that this imposes on the institution, this makes more difficult the decision on which lines of research are to be pursued, given the wideness of the definition of goals as that which is good for the country, and given the fact that the potential receivers of the technological developments are not involved from the beginning of the work to be carried out.

Another aspect, in the opinion of some of the interviewees, is that Marketing may be insufficiently developed in Thailand. It is not possible for the consultants, nor is it relevant here, to start a more substantial discussion of this view. Nevertheless, in the light of the opinions gathered, an analysis of TISTR's particular situation should be attempted, given that every effort made to increase knowledge of the market, to find and take on projects whose ideas come from the outside context or from ideas created by the Institute's researchers, would be put to good use and of undoubted usefulness.

Without ignoring the successful cases shown above, the interviewees mainly believed that there is a lack of enough work for bringing TISTR closer to industry and business, that is, there is not enough monitoring of the clients needs in such a way that would make it clear what their needs are and make it possible to define projects in accordance with their interests instead of with that which the researchers think necessary. They believe that it is fundamental to build a bridge between enterprises and the Institute.

In the case of some specific in-house projects, less-favourable opinions were expressed in the sense that, at TISTR, there was ignorance of the market they wanted to reach and also of the utilization of the products developed. They considered that there was a lack of preliminary market analysis and commercial feasibility before starting the projects. In conclusion, and as a recommendation, they believe that TISTR should ask its clients more intensively about their interests and also about their opinions on the ideas and on the work done for them.

PROMOTION

In general, TISTR seems to be well known by its clients operating in the fields to which the activities of TISTR relate. The majority of those interviewed showed that they have a lot of knowledge about who is who at TISTR, likewise a lot of knowledge about the in-

house projects, which they obtained by means of leaflets, regular contacts, newspaper ads and newsletters.

Expressed thus, these opinions constitute a strength for the Institute. Nevertheless, there were some clients who declared that it was necessary to improve the spread of technological information, advertising, and promotion about TISTR and its work. In this area, they indicated that there was a lack of enough technical output from TISTR that would make it well known among businesses.

Some of those interviewed also declared that there was a lack of a more extensive spreading of information about procedures for working with TISTR. In particular, they recommended that the clients' acccess to technological information be improved, especially when they visit TISTR.

On the matter of leaflets and information sheets, they viewed it appropriate to improve its quality and increase its quantity.

The above defines, in the opinion of the consultants, a series of aspects to be improved in matters of institutional promotion. The actions begun will contribute, without doubt, to improving the image of the Institute in the business environment.

TECHNICAL CAPABILITY AND PERFORMANCE

A very interesting opinion expressed several times during the interviews was that in Thailand there is a good technological capability that firms should make use of. Regarding TISTR, most of those interviewed believed that this characteristic of good capability means good quality services, with deliveries on time and reliability in the work done.

They also declared that people are confident about science and technology coming from TISTR, where good work is carried out. For example, they can obtain there the development of good products at laboratory scale, a good utilization of natural resources and local raw materials for developing new products, among other technological results.

An important factor that explains this favourable opinion is the fact that, in general, TISTR has very good human resources, technically very well trained and experienced.

Despite this generally good assessment, some of the customers visited emphasized several aspects that all organizations of this type must deal with permanently. Without going as far as to say that TISTR paid no attention to them, they did say that training and updating of researchers was important, because sometimes it had happened that projects were begun without having enough training in the specific matter involved, or failures occurred owing to the use of inappropriate technology.

Another issue mentioned by some clients concerning the execution of projects, related

to reliability in the results obtained, which has not always been at an optimum level. In their opinion, the improvement of testing and of accuracy in analyses is needed. Undoubtedly, taking care of such project-management aspects can be easy, more or less, depending on the case, but, going over these possible failures is critical for creating a progressive and better image of the technical quality of TISTR in the eyes of their clients.

II.4 MECHANISM TO STIMULATE TECHNOLOGICAL DEMAND.

TISTR could help the Government of Thailand to create mechanisms for encouraging the technological innovation that is lacking in this country. These mechanisms, granting subsidized funds to the centres of demand (enterprises) and not only to the centres of supply (universities and institutes), will help enormously to establish a type of examples of technological market which TISTR will be able to take advantage of. (11).

In the case of the chilean Fontec, a state fund, the enterprises present proposals of technological projects. They obtain through a combination of soft loans and subsidies the funds to contract universities, institutes, private consultants or a combination of all of them to carry out the project.

If the project finishes successfully and if the company would like to use the results exclusively, they must pay half of the loan.

Fontec can finance up to 80% of the project cost, depending on several factors such as the total amount, the objective, if it is only one enterprise or several, etc. Companies contributions could be not only monetary but also through man hours, raw materials, equipment use, etc.

The main criteria for project approval are:

- The financial status of the company.
- The technical merit of the project.
- The future impact of the results.

There are trained professionals to evaluate the proposals. They present a preliminary evaluation to a Committee with mixed private and public members.

The data for the evaluation and the reports (advance and final) are kept strictly confidential in order to make future patenting possible.

All of the above is summed up in the change of the marketing approach of TISTR from that of "product-out" to "market-in", which moreover is a basic principle applicable to many other fields of activity in Thailand, given that it is of a general and global character.

The consultants suggest to the TISTR leaders to study such mechanisms and to propose to their authorities a new one adapted to Thai policies and practices.

III. TISTR AS A SUPPLIER OF TECHNOLOGICAL SERVICES

Before analyzing the strengths and the opportunities to improve (weaknesses) and to study new institutional strategies of TISTR more a deeper penetration in Thai technological market, it is necessary to state, that TISTR has many competitors, most of them being the Universities and private companies, and not only these but also other Government Institutions, working with funds provided mainly by the State budget.

In such an environment TISTR's weaknesses become more important especially if all or some of them correspond to strengths of the competitors.

III.1 THE STRENGTHS

Regarding the strengths of TISTR, the principal ones detected are:

- Very well qualified people with pre and post graduate degrees.
- Enough knowledge of Thai economy evolution and main problems of different sectors.
- There are good publications at all Departments visited, also brochures that need only few improvements under a more uniform size and selected institutional colours. (Based on 18 of 20 questionnaire answers)
- Clear diagnosis and consensus of what must be improved (opinions of researchers), at TISTR.
- Vocational attitude to hard work even with difficulties and low salaries.
- Some groups could share internally their success in getting funds from private companies, state enterprises and international cooperation, such as the experience of the Metal and Materials Department.
- The majority of the TISTR Departments report equipment quality and quantity as acceptable. (Based on 16 of 20 questionnaire answers)

To have highly qualified people on all levels but mainly in the heads of Departments, Centers, Offices, etc., it is very important, because to acquire a new positive image of TISTR depends strongly on the image that TISTR people can create in the mind of actual or potencial clients and also among government officials and authorities.

In addition, a good knowledge of Thai economy evolution about future opportunities and problems with peculiarities about sectors, regions, etc. enable TISTR researchers to get good communication with their clients and also to offer solutions to their problems and to help to transform opportunities in realities.

As a complement of the direct and permanent contact that must be established between TISTR´s researchers and their clients, to have brochures and publications would help to mantain TISTR image alive in the mind of the customers. Also it is necessary to let them know TISTR past experience and clients. TISRT has already understood the value of brochures and publications for the above mentioned purposes but until now editions correspond to good individual initiatives. To improve them it is only a matter of selecting different standardized sizes and one or two combined institutional colors to present a common institutional image.

Consultants are not suggesting that all of them should be equal but to design different editions following a harmonious base line.

As an example of a TISTR Department that is successful nowadays but could be even more successful,it is worthwhile mentioning the Metal and Materials Department .

Consultants detected success in getting funds from private companies, state enterprises, international cooperation, good training opportunities specially for young people, publications of excellent quality and content, interest in searching ways to give to their clients new and better services doing a comparison with other suppliers, and to get a recognition from the customers and with all the above mentioned mixture to obtain an excellent positioning that is very important to mantain the clients and to get new ones.

Experiencies such as those described above constitute a very important strength of TISTR, and must be shared with other Departments and Centers creating an internal network from where even the Metal and Materials Department could obtain suggestions from other TISTR´s colleagues.

III.2 THE OPPORTUNITIES TO IMPROVE

Currently the weaknesses of TISTR, mainly those that could be taken into account during the revitalization process, are:

HUMAN RESOURCES

- Low salaries in comparison with the private enterprise. (TISTR professional opinions based on 12 out of 20 questionnaire answers)

- Incentives of all types, including monetary ones, are missing for those who obtain or work in projects financed by private companies, or other type of

incentives.

- There is not enough training and retraining for TISTR professionals, including concepts of management, marketing and other complementary matters, in addition to their own particular technical field. (Approximately 10% of the Technical Department personnel per year).

- Frequent rotation of young people, who stay at TISTR for very short periods, such as in the case of the Packaging Centre.

MANAGEMENT

- Little delegation for self correcting and for taking decisions which are not extremely strategic.

- Few cases of linking between technical Departments, to generate ideas or to work jointly in some projects.

- There is no system to share computer hardware, software and related devices, among Departments where these tools are available. In other cases, there are people at TISTR that are yet not using this type of tools.

- Some Departments such as Electronics, Automotive, and Research Service have a very small size (3 or less professionals). Consultants use, from their experience, a critical mass of at least 5 professionals.

- Small and fast transportation vehicles for delivery of results of services in the Bangkok area are used only in one of the Departments visited.

- Few cases were reported during the internal interviews of commercial relations on a contractual basis, with professionals working at Universities or Private consultant enterprises both individually or institutionally. This does not mean that there are not frequent and good personal relations and exchange of information.

MARKETING

- Very few visits of TISTR professionals to industries are planned and executed by the technical Departments (less than one per month per Department).

- Few professionals of the Technical Departments are involved in marketing activities, together with marketing and administrative people. (less than 10% of the time of TISTR professionals as average)

- Few facilities exist to permit visits of TIST professionals to potential clients outside Bangkok. They report difficulties for obtaining funds and authorization for travel and lodging expenses, as in the case of the Food Industry Department.

- The Marketing activities are not coordinated under a specific Division.

  There are activities related to marketing in the following Departments: Special projects, Research services and Industrial promotion.

- Great proportion of the work, is carried out through in house projects with no business sponsorship from the beginning of the project. (approximately 80%)

- From the external image point of view, to present TISTR having too many specialities and Departments (20) gives an impression of a lack of specialized expertise and excellence, which in fact is not true.

PHYSICAL FACILITIES

- For image improvement purposes, modern decoration is missing at TISTR entrance.

- Some infrastructure is missing to receive visits of potential clients at TISTR, such as small rooms for meetings of no more than 5 or 6 people, a place to offer breakfast or lunch in working meetings with enterprises, etc.

- Four departments report their infraestructure, including equipment, as not good enough.

The opportunities to improve and the strengths were analyzed with the help of internal interviews and information provided by the questionnaire completed by all TISTR Departments and tabulated in Annex 3.

Taking into account the above listed weaknesses several comments and suggestions are written in the following pages of this chapter.

III. 3 ACHIEVING A POSITIVE IMAGE FOR THE INSTITUTE

The relative positioning of TISTR in the minds of authorities and users, in relation to or in comparison with other Thai bodies that provide similar services, has two components.

The substance is made up of the sum of the technical and administrative performance

of its people.

The second component is the image, which does not always coincide with the same relative position taken by the substance.

Thus, for example, there are institutions with a lot of substance and a poor image, and vice versa.

Very great differences in positioning do not last long.

The view of the consultants is that, in the case of TISTR, the substance is significantly better than its image, even though this substance could be improved.

Due to the above, a campaign for improving the image is recommended. The personnel were warned of the inadvisability and problems of overselling the image until some changes in the substance start to bear fruits that justify it, otherwise there will be a dangerous rupture in the confidence held in the mind of the authorities and customers.

The following ways for improving image were outlined:

- Improvement to the building, with low-cost touches that give a modern aspect.

- Uniform presentation cards with a more modern design

- A short and positive slogan, "Growing together", as an example

- Choice of institutional colours that are compatible with the concept of technological development and represent positive values in Thai society, such as royal blue or orange. Examples: green for environment, red-green and yellow for foods, etc.

- To this was added the need to make the colours of the brochures and publications of the centres compatible with the institutional colour.

- Within the concept of image it was explained that the attitude of people (friendly, responsible, etc), and the opinions that TISTR's own personnel state while outside, even in family settings, especially if negative, can be tremendously damaging for the institutional image.

- Finally, to get frequent and permanent access to the local press, is very important. Relevant visitors, special event such as courses, seminars, etc. the signature of an important agreement or contract, the official inauguration of a new plant or process where TISTR has participation, a new product in the

market developed with TISTR assistance, new regulations in foreign market that have effects on Thai exports including their technical explanation, are examples of news where TISTR must be in the most important local newspapers. Special attention must be given to those news where a direct contact of TISTR with private enterprises could be shown.

III.4 MARKETING OF TECHNOLOGICAL SERVICES.

The success of modern enterprises has four elements, one of which originates in marketing: – "Focus on customers"

Just as examples, the others are pointed out:

- Total participation of people at the appropriate level
- Continuous improvement of activities (processes)
- TQM methods and tools applications.(15)

For a technological institute acting and progressing within a market, the basic external customers are government authorities and enterprises (whether public or private). An institute would have difficulty in attaining success if it does not listen to the voice of its customers (market-in approach).

The institution or enterprise that does not satisfy the current or potential needs of its customers exists as if it had decided not to be successful, in fact such a decision would be for self-destruction.

It is true that the traditional rules of marketing should be adapted for their application to the work of a Technological Institute (TI). But the experience of Chile, and the knowledge that can be gained of many cases of success around the world, indicate that together with the technical performance, a TI without an adequate marketing strategy and modern management, progresses only a little and with difficulty.

To a small extent this is what has happened to TISTR, with its technical capability, in relation to an optimum ideal, much better in relative terms than its management and its marketing. The former three elements could be better, but from these the last two much more.

The interviews made by the consultants gathered opinions and facts from which one can see that, in management and marketing, the weakness extends far beyond TISTR, being a tendency of an almost national nature.

In the field of Marketing and related functions it is necessary to distinguish:

- Promotion. Activities for creating a positive image and positioning TISTR in many spheres of public opinion, with a high level of recognition.

- Commercialization, corresponding to the 'product-out' approach, where it is aimed to sell projects already done by TISTR, and, finally,

- Marketing, understood as the group of activities which includes the sensing of customer needs, the design of services and their performance, including prices, delivery and follow-up, to the full satisfaction of the clients.

Although this may be very self-evident, it is emphasized that this last cycle, completed repeatedly in satisfactory form, is that which creates a positive base which complements and improves the image.

The consultants made special reference to this last part concerning marketing, which, of these three components, is the least developed at TISTR. It requires special training programs because, as is common, this aspect initially provokes negative reactions from professionals of technical Departments. Nevertheless, at least two internal cases (within TISTR) were detected where, without previous training of any kind, excellent marketing is being realized in a natural way, which could serve as a practical example in a training program(the Packaging Centre and the Metal and Materials Department).

III.5 MARKETING ACTIVITIES

Among the marketing activities, to prepare a proposal for a potential client, is one of the most important. Even more important for selling R and D projects than other technological services.

It must be prepared to give answers to different members of the client's staff who have different background, interests, priorities etc.

Because of that, potential economic benefits of the project must be written together with technical aspects such as bibliographic data, methodology, action plan, etc.

The objectives must be very clear. There are two possible types of objetives:

- Those that offer a solution where the methodology is only an antecedent.

- Those that offer to carry out a work plan under a specific methodology where no solutions are offered and the results are those obtained from the work plan.

With respect to the price there are three alternatives:

- To charge the reference price obtained from a cost study of men/hours and

other charges.

- To charge less than the reference price if it is a new client, a potential large client, a long term project of high price, etc.

- To charge more than the reference prices if TISTR's expertise permits to carry out the project in less time, with less effort than the other suppliers, and because it is possible to get good results through a combination of few hours of supervision and a mixture of young researchers and technicians.

After a negotiation process where the objectives, price, and schedule are clear and agreed with the client, it is necessary to take into account how payment will be made.

There are many options. Among them there are two which are more frequent:

To charge a lump sum in one or several quotas according to the work plan or to give unitary prices and to charge the real cost by month or by phases where the client has the opportunity of auditing the components. For this purpose, among others, a very good cost system is suggested.

Also the cost system permits to analyze a project when it is in progress or at the end, to get experience for new proposals.

In the case of in-house projects, a payment through lump sum, royalties applied to the sales or a percentage of the business profits could be applied.

When the project starts, a programme of all the TISTR people that will be required for the project, must be prepared by the head of the project, including hours of other Departments. A centralized system receives data that could be used for many purposes. It is very important for the Marketing Division to know the availability of people in order to reorient the marketing programme.

The system provides information to see where and with whom it is no easy to carry out other projects being necessary to subcontract people or institutions such as universities, private consulting companies, other state institute, etc.

If the market does not provide enough work it could be necessary to increase promotion to analyze marketing strategies, to listen better the voice of the clients, to study the competitors, to formulate new pre-competitive in house projects, etc.

The work briefly described could be centralized or coordinated by a Marketing Division.

Example of those centralized activities are:

A cost study to stablish hour price of different levels of professionals and technicians and standard services prices, to use as reference to prepare proposals.

Criteria to charge less or more than the reference price is also advisable to be managed by the Marketing Division.

Standards to edit proposals,edition criteria for brochures and publications, the way to suggest a payment plan to the clients, how to stimulate the participation of more than one Department, to receive requeriments from clients that do not know which Department of TISTR has the answer, and to prepare and negotiate contracts.

Finally, to collaborate with the Governor when preparing institutional strategies and action plan, giving a marketing point of view, are examples of typical activities of a Marketing Division.

Other activities only need to be coordinated by the Marketing Division because the participation of researcher staff is important and the purpose of the coordination is to have common criteria and to share experiences.

Examples are: a proposal preparation, to visit clients, to receive clients at TISTR's premises, to prepare a project budget, to discuss the technical content of a proposal with the clients, etc.

To receive visits at TISTR premises and to frequently visit client offices and plants, is one of the mechanisms that is not very much used at TISTR.

To visit client factories is very good for many purposes, mainly, to learn in the field how they are really working, to detect problems, and then to elaborate proposals with solutions.

The best way to generate ideas of new projects to sell, is to get them directly from the customers.

When professionals of the TISTR Departments and Centers are doing visits of such type or showing their facilities to potential clients they are doing marketing activities.

Also there are marketing purposes when attending to a meeting, organizing events (seminars, workshos) or promoting the establishment of networks with clients and other suppliers.

III.6 MODERN TECHNIQUES OF MANAGEMENT

The general principles and methods that have proved to be successful in modern administration have application for TISTR in general including marketing activities.

Regarding the principles, the following can be pointed out:

- The commitment and leadership of the upper management (C.E.O., Chief Executive Officer) in the application and spread of knowledge of these same principles.

- The essential stimulation of teamwork and the application of techniques that favour it. On this issue it was mentioned that, with reference to TISTR, the consultants had seen good teamwork within each of the technical units of TISTR, but nevertheless there was much to be improved in the harmony and interactiveness between the different technical units in their work and between these and the administrative and commercial staff.

  One product of the lack of interaction is the duplication, in some cases, of capabilities that already exist in neighbouring units.

  On the other hand, the integral synergies that are generated in multidisciplinary and multisector work bring incredible benefits to the Institute.

- The concept of internal and external clients was explained after pointing out the importance of listening to the customers and designing products (services and projects) that satisfy their current or potential needs. This was a restatement of the "market-in" concept instead of the "product-out" approach. The latter is most currently used by TISTR.

  Concerning internal clients, it was explained that this also has to do with giving full satisfaction to the requirements that arise from within the Institute, ensuring quality in the service as much in the technical content as in the consumption of resources and in the moment of delivery.

- Continuous improvement was emphasized as a fundamental concept, which requires that the necessary delegation (empowerment) from the upper management is applied so that each person, at his own level, can apply corrections by himself.

Regarding the tools that support the above-mentioned concepts, some of them are very useful. These include the Pareto method for ranking problems by their scale and importance, the Ishikawa system for finding the root of the problem, and, finally, the K.J.

method for finding consensus or making proactive group designs.

This type of techniques are useful not only for improving the management of the Institute but also as very useful and practical tools for research work, and, moreover, as being able to be taught and applied in industry (15)

IV. TISTR'S COMPETITIVE ENVIRONMENT

The potential users (demand) of TISTR, have in the country other alternatives for technological services, including R and D projects.

The following are the principal ones.

IV.1 NATIONAL SCIENCE AND TECHNOLOGY DEVELOPMENT AGENCY (NSTDA)

In the future, when they operate with laboratories to carry out R, D and E activities:

- The National Center for Genetic Engeneering and Biotechnology (NCGEB) of NSTDA
- The National Electronic and Computer Technology Center (NECTEC) of NSTDA
- The National Metal and Material Technology Center (NMMTC) of NSTDA

IV.2 UNIVERSITIES

At present there are 16 public universities

The practical R and D carried out for solving practical problems,is still of little magnitude.

IV.3 RESEARCH LABORATORIES IN VARIOUS GOVERNMENT DEPARTMENTS.

- Royal Irrigation Department
- Department of Fisheries
- Department of Livestock
- Royal Forest Department
- Department of Agriculture
- Department of Highways
- Department of Medical Science, Ministry of Public Health
- Department of Mineral Resources

For the last 8 cases, "competitors" is understood in two senses:

- If they are doing research or can provide technological services for their own needs, they are not going to be demand for TISTR.

- Some of them could give services to private or State companies, obtaining income instead of TISTR or other suppliers.

IV.4 RESEARCH LABORATORIES IN STATE ENTERPRISES

Such us:

- The Electricity Generating Authority of Thailand (EGAT)
- The Preserved Food Organization (PFO) factory
- The Dairy Farming Promotion Organization of Thailand.
- The Telephone Organization of Thailand (TOT)
- The Communication Authority of Thailand (CAT)
- The Metropolitan Electricity Authority
- The Provincial Electricity Authority
- The Government Pharmaceutical Organization
- The Petroleum Authority of Thailand.

"Some of these enterprises have been criticized for focusing primarily on providing services to customers and not giving enough attention to developing their own technical understanding" (14).

The above comment indicates how the potential demand for TISTR can diminish.

IV.5 DEPARTMENTS OF THE MINISTRY OF INDUSTRY (MOI).

They are also responsible for providing technical and management consultancy services to small and medium size firms, such as:

- Industrial Services Division (ISD)
- Department of Industrial Promotion (DIP)
- Thailand Management Development and Productivity Center. (TMDPC)
- Metalworking and Machinery Industries Development Institute (MIDI)
- The Textile Industry Division.

The existence of such Departments affects possible future decisions of TISTR to supply R and D, together with other services with technical content, such as training to small and medium firms, modern techniques of management, technical information, etc.

In the case of MIDI, the potential demand for TISTR from metal-working and machinery industries, will be limited.

In particular, services supplied by the Textile Industry Division could be competitive not only with future but with present TISTR services.

IV.6 PRIVATE ENTERPRISES

In relation to R and D carried out by private enterprises, there are several examples:

- Shell Company of Thailand
- Esso Standard Thailand Ltd
- Siam Cement Group
- Bangkok Bank
- Civil Design and Consultant Co.
- Siam City Bank Ltd.

"Much of the activity of the private sector is however not so much research in the sense of technological R and D (Shell and Esso) or economic research (Bangkok and Siam City Bank)" (14).

In the case of the private sector, the consultants experience shows that it is not possible to conclude less demand for TISTR just because of the existence of R and D departments in the private companies.

Some services diminish, some others become bigger, because inside the companies there are professionals similar to those of TISTR that permit better communications and TISTR could be subcontracted by them.

The demand decreases only when those R and D departments start offering services to other companies.

There are many private laboratories, located mainly in the Bangkok area, that are related to other technological services, such as analysis, testing and certification.

IV.7. MOSTE DEPARTMENTS:

- The Technology Transfer Center (TTC) affects future services of TISTR when assistance for foreign technology acquisition and local adaptation would be offered by TISTR.

- Department of Science Services (DOSS) provides a variety of testing, certification and information services to the industrial sector many of which overlap somewhat with some of the functions of TISTR. (5)

IV.8 TECHNICAL INFORMATION SUPPLIERS

In terms of providing technical information to private enterprises through the Thai National Documentation Center of TISTR, there are other options such as at least the following:

- DOSS (MOI)
- Technology Information Center of the Technological Promotion Association (TPA).
- The Rural Industry Information Services Center (DIP-MOI).

For the consultants it is not possible to give numbers to compare supply and demand in the technological market of Thailand, with regard to present and possible future activities of TISTR.

Nevertheless, the consultants' experience allows them to estimate a very large supply for a small demand that is growing fast.

According to such a concept, TISTR is working in a very competitive environment where most of the competitors are Government Departments.

In such an environment, the private customers are very sensitive to the following variables:

- Service Prices
- Service Quality
- Speed of response

Of course, services with lower prices, better quality and shorter response times, have better options in this market.

Consultants suggest that TISTR analyzes and implements actions by comparing the strengths and weaknesses of TISTR with the ones they and the customers detect in other

suppliers. The opportunities to improve for TISTR will be found where other suppliers show clear strengths and they find clear TISTR's weaknesses.

By the contrary if TISTR detects services or specialities where they have strengths in comparison with other suppliers that have weaknesses in the same field, TISTR could base a program of image improvement on those strengths without mentioning the weaknesses of the others.

V. MARKETING OF PROJECTS ON PRODUCTS AND/OR PROCESSES DEVELOPED INTERNALLY

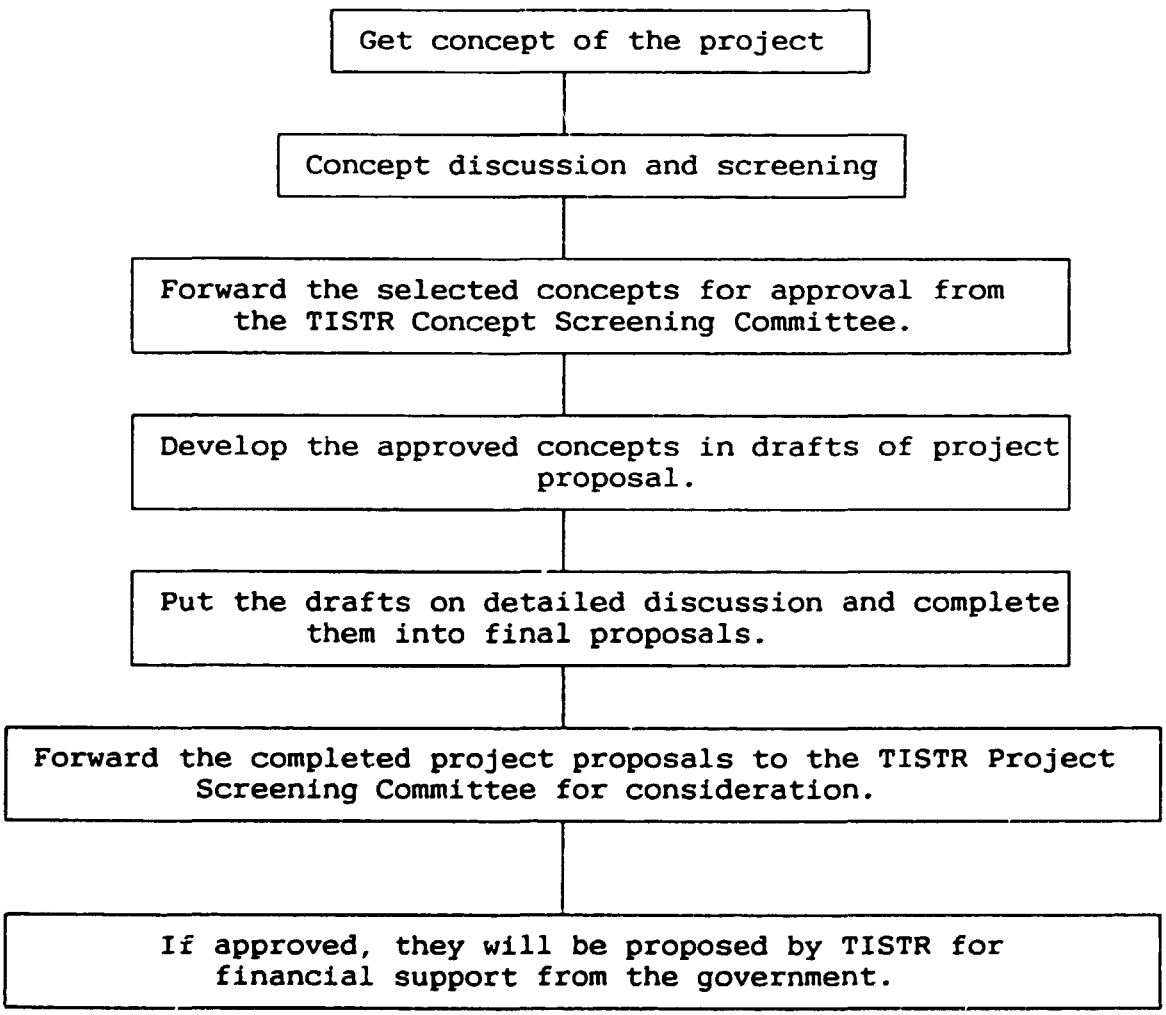
V.I TISTR METHOD FOR SELECTING IN-HOUSE PROJECTS

Regarding the methodology used to analyze and approve an internal project, as shown in the following page, the procedure is correct. This is especially because there are different stages of discussions and decisions, without spending too much time at the first stage on preparing a complete project proposal. As a complement to this TISTR is utilizing the following criteria for project selection:

- The projects must be in accordance with the Seventh Five Year National Economic And Social Development Plan (1992-1996).
- They must be technologically and socio-economically sound.
- The project outputs must have a high potential in application and acceptability in the markets.
- Output users must be taken into account in project selection.

Eventhough user's opinions are taken into account in the method TISTR is applying nowadays, in the following paragraphs there are several recommendations to improve their participation, as a way to achieve more sucess in the marketing process of their in-house projects.

DIAGRAM FOR SELECTING INTERNAL TISTR PROJECTS



V.2. RECOMMENDATIONS TO IMPROVE THE FORMULATION OF A NEW IN HOUSE PROJECT.

a) In order to take into account the potential users' opinions, a pre-proposal containing technical, economic and market information, could be delivered to several potentially interested businessmen, at least one month before a meeting workshop organized by TISTR could be held with the group of users. The purpose is to get favorable and unfavorable opinions, and a probability of success in obtaining future payment sponsorship.

b) A similar method could be applied to obtain ideas for new projects. These ideas will mainly be related to the choice of problem solutions.

In both cases it is convenient to organize the meeting-workshop with a group of no more than 20 users of the same sector and business size.

In order to achieve success with the application of such method, the following should be taken into account:

- To select ideas, the group must be homogeneous.
- The users' opinions will be more free if they are anonymous.
- Several techniques to get group consensus could be applied.
- Before getting consensus a presentation must be prepared by a TISTR specialist.
- Also before applying the consensus search method, each participant must have the opportunity to express his ideas at least once.

c) After the project is approved a work plan by stages is suggested in order to analyze preliminary results and to have the opportunity to take the decision to stop it or to change methodology, work plan, etc.

d) Also, to form a leading committee of no more than five people, with the participation of potential users could be very useful. This committee could have meetings for example every two or three months. The project leaders could present to the leading committee a brief report of the project advance and receive suggestions from the committee. If there are possibilities of obtaining a patent the committee must work under an agreement of secrecy.

e) In addition, tne consultants suggest the involvement of enterprises as sponsors from the initial stage, even when this means only small financing support. For those users interested, special advantages could be offered to those who support the idea from an early stage, co-financing the project.

f) Complementarily, from another angle, the consultants recommend that TISTR progressively changes the proportion of in house projects to those that are with external sponsorship and finance. That is to say, it should increase the latter and reduce the former.

g) Additionally, other types of internal projects are recommended, such as those for development of technologies that prepare TISTR for competitive activity. The development of technologies preparatory to competition is understood as the group of activities that allow a group to create a new capability of TISTR for future sales (competitive phase). Moreover, it should be understood that the pre-competitive phase is not financed by the producing sectors of industry and needs to be performed before sales can be made for specific applications for particular industries. The concept of the pre-competitive phase is used, as consultants know, in U.S.A. and Mexico.

The objective of a project of the pre-competitive phase is not related to any specific application for a particular enterprise. It is a practical development that is used as a base on which many specific applications could be developed.

The application of such a method is useful also for on- the-job training of TISTR professionals.

In the case of pre-competitive projects it is also important to take into account the opinions of future clients of specific applications.

VI. MARKET STRATEGIES

VI.1 STRATEGY FRAMEWORK

Thailand is experiencing one of the best periods in its history. The economic conditions are right for achieving a sustained improvement in the quality of life of all its population and for laying the foundations for permanent integration into the development process.

In the economic sphere Thailand has made significant advances. In just the last five years the economy of the country has grown at a rate of approximately 10%, with exports increasing in the same period by 20%.

Although the advances of Thailand in the economic field are considerable, the challenges to be faced are even greater. Now, there are no free areas to be gained or held exclusively by anyone in the world, industries flourish and decline if they are not renewed, competition increases. In this environment, modernization, flexibility, and innovation are the key conditions for keeping on the way to development and acquiring lasting competitive advantages.

The capability for innovation is at the centre of the challenges that Thai society and the economy should face in the coming years. This flexibility and innovation are understood as the capacity to adjust to changes quickly and with agility.

This is the response to the challenges that the international competition is presenting in a globally interdependant world. It is also the key to ensuring a sustained growth over time, with greater levels of equity.

To persist and to innovate are two current concepts that are present in the economic task facing Thailand today. They have, in their current state, required and incorporated more and more knowledge and creative spirit, with the aim of increasing productivity.

But even though these advances are considerable, the challenge of expanding innovative activity is still to be faced. This activity is to be brought to businesses and institutions together, especially in the sphere of the small- and medium-size ones.

In this sense, the pillars on which rest the creation in the country of an environment that promotes and stimulates innovation can be summarized as follows:

* Induce a climate of competition that allows business initiatives to multiply and that favours the creation of economic opportunities. Competition is the first factor that stimulates a propensity to innovation. With regard to this, the tasks to take on are: the development of the markets so that they can better orientate the decisions of businesses and individuals, the creation and strengthening of

smaller businesses, and the need to develop a spirit of cooperation. Competition and cooperation are not incompatible opposites. For an economy open to foreign markets, as Thailand's is, cooperation between companies has become a powerful source of innovation.

* Strengthen integration into foreign and world markets. An enormous source of inspiration for innovation derives from frequent exposure to foreign influences, facing up to different realities, manners of conduct, and practices.

* Incorporate expertise into production and establish incentives for a more solid link between them. For this, education, training, and technological research and development linked to industrial activities are the forms of investment that would significantly instil the potential for increases in productivity. Market, opportunity, and expertise are the bases for stimulating innovative actions, but these actions depend on individual people. For this reason it is especially relevant to promote a culture of innovation able to stimulate an attitude favourable to change and creativity in all spheres. In addition to the continuous updating of knowledge, there are several skills that must be introduced, spread, and extended generally, starting with the professionals, but not being limited to them only.

Innovation is a permanent task, directly linked to the challenges facing Thailand, and in particular to the capacity of Thailand to generate a long term project of development, a project for the whole country.

Experience throughout the world demonstrates the great power of technological innovations in the improvement of productivity, product, process and management quality, in other words, in competitiveness. Moreover, technological innovations that follow an appropriate path are responsible for enormous increases in the levels of the quality of life of the poorest classes of people, and for rural development.

Among these technologies there are some generic ones that deserve special mention such as: information technologies, telecommunications, microelectronics, automation, and other related technologies, these having seen a tremendous development in the past and are also viewed as leading technologies for future changes.

In addition the current situation regarding the health of human society and the equilibrium of nature makes it necessary to emphatically demand environmental technologies. The application of technical and legal measures to protect the environment are also basic requirements for international commercial success.

Finally, exports based on raw materials and manufactures must also be placed within a process of continuous improvement with technological innovations and modern management techniques in order to succeed in international markets.

Those above-mentioned main challenges of Thailand, clearly commented on in the seventh National Economic and Social Development Plan (1992 - 1996) (5), give TISTR a clear message with a direction for its revitalization plan and targets.

VI.2 HOW TO ORGANIZE A TECHNOLOGICAL INSTITUTE FOR THE NEW WORLD.

There are at least four known possibilities for organizing the work of a technological institute.

I) By disciplines
II) By producing sectors of industry
III) By problem or thematic areas
IV) By discipline - problem or thematic area (special case in high technologies)

I) The scheme by disciplines derives from the universities, generally organized in scientific and technological departments. Examples of Scientific departments: Biology, mathematics, ecology. Examples of technological departments: Engineering, mechanics, electronics.

This type of division of work is not adequate for a centre of technological research.

Having been conceived as much for scientific research as for technological research, TISTR has therefore a natural internal difficulty when concentrating upon the design of a new organization.

II) Until the end of the 1980's the most traditional way of organizing technological institutes was by sectors of industrial production. Many institutes are dedicated to one specialization in order to serve a specific sector. Examples: Mining, agriculture, forestry, and, concerning work with manufacturing industries, there are those of foods, the chemical industry, metals and mechanical industries, leather, textiles, etc.

III) As a way of obtaining an optimum technical-economic balance, some institutes, among them the Chilean one, have progressed by organizing their supply of services more and more in a multidisciplinary and multisector way, guided by a focus called the 'problem area'. Examples of these are: environmental technologies and flexible automation.

In this case some divisions by sector prevail when the sectors have a large market, and some divisions by discipline are maintained when their support is very much needed internally.

It was pointed out that, for each case, the group should be prepared for a dynamic and

flexible organization continuously capable of rapid adaptation to new times and, of course, to the market.

IV) Finally, the development of the latest technologies such as biotechnology or advanced information technologies which have evolved faster than they used to, and scientific knowledge for commercial applications, have given rise to their own organizations which often become centres of excellence, such as those that the MOSTE of Thailand has in a development stage within NSTDA.

In the world at large, universities are responsible for most work of this kind, even when private centres already exist.

VI.3 ANALYSIS OF THE CHOICE OF A MISSION FOR TISTR.

So that a technological institute can progress, it requires a set of supports, among which the following are pointed out:

- Time and money for working with pre-competitive technologies that prepare TISTR for competition, permitting the preparation for attending to future demands for applications which make external finance available.
- Recognition by the authorities
- Recognition by public opinion
- Support from international cooperation
- The respect of clients
- Others

As a product of the above and of a substance which can be continually improved, the institute will appreciate receiving fully or partially the above-mentioned support when people refer to it as: 'useful', 'positive', 'high-quality', 'having an impact with its work' etc.

Obtaining this type of support often depends upon the institution's choice of mission. In the past, missions were fixed permanently, that is to say, they applied throughout the whole life of the business or institution. Today, the environment for them – even for countries and for individuals – is so changeable, as well as the other bodies with which one has to interact, that one has to be ready, alert, and continually changing. Sometimes one reacts to changes caused by others, and to some extent the cases in which one acts cause changes.

In accordance with such general principles the consultants recommend to whoever should study and make decisions on these matters, including strategy experts among them, the option called "Rural Development". This is meant as a synonym of regional development, that is to say, development of the north and south of the country, outside the capital, on account of this being of high priority in the National Plan. Added specially to this, the technological contribution of TISTR would be concentrated on the current and future exportable supply, both in primary sectors (such as farming) and in secondary sectors (such as some manufacturing subsectors). TISTR has had success in projects for rural development already.

Thai exports are commercialized in a highly quality sensitive market. For almost all TISTR Departments there are opportunities, in the regions and in the Bangkok area for supporting small- and medium-scale enterprises(primary and secondary sectors) to get ISO 9000 certification.

Even when in the short term working for clients and problems of the Bangkok area will be easier, in the long term the strategy focused on the regions is foreseen as better.

The above implies a very good working relationship between TISTR and the authorities, businesses, and universities of the regions, also administrative changes which allow an easy and capable movement of TISTR personnel outside Bangkok. As an example, one can highlight the current activity of the institute in post-harvest treatment for fresh fruit and vegetable exports, likewise the services of the packing and packaging centre.

As options currently under way, one can point to the exploitation of non-metallic resources.

The environmental option is of a generalized nature and useful for all spheres of activity.

The contributions of areas such as biotechnology in its more traditional version - excluding genetic engineering - are also of great usefulness.

TISTR has even been carrying forward work in the area of construction, especially in the search for economic solutions for low income sectors of the population, as this supports improvements in the quality of life of those who constitute the poorest part of the nation. This will also be useful for rural development.

The change from production of raw materials to that of manufactured products requires substantial technological support that cannot always come from within the country in question, but the country's capability should be able to serve businesses in improving the purchase and installation of foreign technologies. For example, by avoiding price rises and the purchase of obsolete or contaminating technologies, etc.

For the moment the option of high technology is left aside while waiting to see how the

establishment of the NSTDA centres evolves.

The strategic vision described from the viewpoint of marketing experts, cannot be the definitive one, because other approaches or strategies unknown to the experts, could advise of a better alternative.

VI.4 OBJECTIVES FOR TISTR

There are many courses of action to follow in order to study and to decide the future objectives, for TISTR, under a preselected mission.

The consultants understand that authorities:

- Appreciate results of TISTR that have more impact on the competitive progress of current and future productive activities, mainly exports, specially small and medium size enterprises.

- Would also like to get a greater contribution from private companies for TISTR's incomes.

Two complementary groups of objectives are suggested:

a) Support for Rural Development Objective.

The size and grade of development of the enterprises are very heterogeneous.

Small and medium ones are going to be related to exports of agriculture, fisheries, forestry and mining products both fresh and processed (industrialized).

The main products of TISTR for them, are services of analysis and testing, technical information, certification of quality, technical assistance, training through workshops, and demonstrative centers of technology transfer.

With respect to R and D projects, there are more opportunities for primary than for secondary sectors. Also there are better options for multiclients than for individual companies.

In few cases, high technology such as biotechnology and microelectronics will be part of the solutions.

Projects related to Environment, Transport, Energy, etc. are probably going to be a mixture of R and D and Engineering studies and the most likely customers will be the Central or Regional Government Authorities, or large state companies.

Services for large private enterprises, including those established with foreign investment, are very similar to the ones described above. But these enterprises do not need demostrative centers and technical assistance to buy foreign technologies. Even when they usually have their own laboratories in the country and abroad, they could be good clients of testing, sampling, analysis, and certification, when they appreciate excellence in local suppliers.

They also are good potential clients of TISTR for training their personnel at different levels through workshops and seminars. They have special interest when qualified experts from abroad are participating as lecturers in TISTR's events.

They are more prepared to pay for foreign R and D and Engineering than to utilize national capabilities for these purposes. In few cases they subcontract local institutes for narrow objectives under their managment.

b) Support for Manufacturing Enterprises of Bangkok and Objectives.

The marketing approach will show in this case a growing demand in environment (water, soil, air, etc.). Customers are going to be mainly state institutions, asking for services and R and D projects.

Also demand from industries is going to be greater than now, searching for solutions in order to comply with new regulations that probably are going to be more strict (clean technologies and end-of-pipe treatments).

Services for sampling, analysis, R and D, engineering and technical assistance including advisory services for foreign technology acquisition will be useful.

Great demand will exist for quality systems: ISO 9000, TQM, and others.

Specialities with greater demand will be those related to export industries (food, textile, chemical, and others) but much less than the demand for environmental and quality system technologies.

In a few cases where productivity improvement needs higher technology, there are possibilities for development or transferring technology for automatization.

Just as great as the above will be the demand for adopting information technologies. Not necessarily to develop software and to design hardware, but in a first phase to help small and medium enterprises to buy and to apply those foreign technologies in the appropriate way. Training at different levels, from managers to workers, will also be useful.

TISTR does not need to take care of all the objects suggested at the same time and working alone.

A network to subcontract or to be subcontracted by Thai Universities, private consultants, other Public departments will be very useful. Also to extend that network to international contacts, selecting partners when it is necessary.

VI.5 MARKETING TACTICS

For the consultants it is not possible to suggest new services of TISTR for segments and specialities not covered by other suppliers. Due to this, the best tactic to penetrate the market is differentiation.

Differentiation means to re-create not only a positive image but associated to a very narrow scope of specialities. Also it means high quality of the services including agility in attending requirements, searching solutions and implementing them.

The idea is to present to current and potencial customers,not only a TISTR much better than other competitiors, but different. It is not possible to apply this tactic for all the specialities and services that are provided nowadays by TISTR. It is necessary to select those services where TISTR could be successful in a short period of time.

The following suggestions could be applied:

- To select segments and specialities that could be useful for both objectives (VI.4).
- Specially those that has already a market, where results of self financing are the best.
- To improve quality of those services following the suggestions of the current customers (reliability, prices, time of delivery, etc).
- To promote those changes by means of brochures, special events and with press news.
- To select a group of representative customers to orient the differentiation program.
- To detect if changes are appreciated by enterprises and authorities.

After arriving to a satisfactory level then to select a new group of segments and specialities, and to reproduce the process.

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ANNEXES

ANNEX 1

LIST OF EXTERNAL INTERVIEWS AND CONTACTS

N°	COMPANY/INSTITUTION	NAME	POSITION
1	UNIDO BANGKOK	ANDERS PALUDAN MULLER	PROGRAMME OFFICER
2	HI-TECH AGRICULTURE (THAILAND) CO., LTD.	ARAYA ANANTASILP	MANAGING DIRECTOR
3	THE GOVERNMENT PHARMACEUTICAL ORGANIZATION	ASPIRADEE KASHEMSANT	DEPUTY DIRECTOR
4	MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT	CHODCHOI EIUMPONG	DEPUTY PERMANENT SECRETARY
5	DEPARTMENT FOOD, BIOTECHNOLOGY CHEMICAL PHARM.	EKACHAI SUNTORNPONG B.	SENIOR SPECIALIST
6	THE SIAM PULP & PAPER CO., LTD. MANUFACTURING DIVISION	KANEUNG IN-DRATANEE	MANAGER
7	MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT	KASEM INIDVONGS	PERMANENT SECRETARY
8	OFFICE OF SCIENCE, TECHNOLOGY AND ENERGY POLICY AND PLANNING, MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT	KOBKEAO AKARAKUPT	DIRECTOR
9	OFFICE OF AGRICULTURAL INPUTS DEVELOPMENT AND PROMOTION DEPT. OF AGRICULTURAL EXTENSION	KUKIAT SOITONG	CHIEF, SOILS FERTIL PROMOTION
10	BIOTECHNOLOGY AND GENETIC ENGINEERING UNIT INDUSTRIAL TECHNOLOGY DEVELOPMENT DIVISION, UNIDO, VIENNA	MALEE SUWANA	CHIEF
11	SAHALOHAKIJ KANCHANABURI CO., LTD.	MITREE NOKLEK	MANAGER
12	UNIDO INDUSTRIAL DEVELOPMENT ORGANIZATION-BANGKOK	MJ MEIXNER	COUNTRY DIRECTOR

13	OFFICE OF AGRICULTURAL INPUTS DEVELOPMENT AND PROMOTION DEPT. OF AGRICULTURAL EXTENSION	MONGKOL CHUNTRAPEN	DIRECTOR
14	PNC GROUP	NARACHET DEIMA	MANAGING DIRECTOR
15	UNIDO	NILS RAMM - ERICSON	CONSULTANT
16	NATIONAL SCIENCE AND TECHNOLOGY AGENCY THAILAND DEVELOPMENT RESEARCH INSTITUTE (SINCE 1/11/93)	NIT CHANTRAMONKLASRI	DEPUTY DIRECTOR
17	UNIDO VIENNA	PETER ELLWOOD	
18	BETTER LIFE CO., LTD. DEVELOPMENT AGENCY	PRASOPSUK PHUCHONGCHAROEN	MANAGING GENERAL
19	BETTER LIFE CO., LTD.	ROY MIKKELSEN	CONSULTANT
20	THE GOVERNMENT PHARMACEUTICAL ORGANIZATION	TUMRONGWUT KOOTIRATRAKARN	CHIEF
21	THE GOVERNMENT PHARMACEUTICAL ORGANIZATION	WANCHAI SUBHACHATU	DIRECTOR PRODUC

ANNEX 2

LIST OF INTERNAL INTERVIEWS AND CONTACTS

N°	COMPANY/INSTITUTION	NAME	POSITION
1	THAI PACKAGING CENTER	AMORNRAT SWATDITAT	DIRECTOR
2	THAI PACKAGING CENTRE R AND D LAB	ANCHALEE KAMHAENAKUL	
3	TECHNO-ECONOMICS STUDY GROUP	ANEK TAMRATANAPORN	CHIEF
4	ENVIRONMENTAL AND RESOURCES MANAGMENT		
5		CHAIYUTH KLINSUKONT	DIRECTOR
6	TISTR	CHALERMCHAI HONARK	ACTING GOBERNOR
7		EKACHAI SUNTOINPONG	SENIOR SPECIALIST
8	CHEMICAL FORMULATION AND PROCESSING LABORATORY CHEMICAL INDUSTRY DEPARTMENT	KANNIKA STHAPITANONDA	DIRECTOR
9	METAL AND MATERIALS TECHNOLOGY DEPARTMENT	LADAWAL CHOTIMONGKOL	DIRECTOR
10	FIBRE AND TEXTILE CHEMICAL LABORATORY CHEMICAL INDUSTRY DEPARTMENT	NAIYANA NIYOMWAN	DIRECTOR
11	MATERIALS PROPERTIES ANALYSIS AND DEVELOPMENT CENTER	NONGLUCK PANKURDEE	PROJECT DIRECTOR
12	THAI NATIONAL DOCUMENTATION CENTRE	NONGPHANGA CHITRAKORN	DIRECTOR
13	MATERIALS PROPERTIES ANALYSIS AND DEVELOPMENT CENTER (MPAD)	PRATIP VONGBANDIT	PROJECT ENGINEER
14	ENVIRONMENTAL RESOURCES LAB.	PRAMUK KAEONIAM	
15	FERMENTATION TECHNOLOGY LABORATORY BIOTECHNOLOGY DEPARTMENT	PRAPHAISRI SOMCHAI	DIRECTOR

16	ENVIRONMENTAL ENGINEERING LAB.	PREECHA PLOYPATARAPINYO	CHIEF
17	INDUSTRIAL COOPERATION AND PROMOTION CENTER	SACHEE PIYEPONGSE	DIRECTOR
18	FOREIGN RELATIONS DIVISION	SALAISOPHIN KOMARAKUL NA NAKORN	DIRECTOR
19	PHARMACEUTICALS AND NATURAL PRODUCTS RESEARCH DEPARTMENT	SASITHORN WASUWAT	CONSULTANT
20	POSTHARVEST TECHNOLOGY LABORATORY	SING CHING TONGDEE	
21	PROCESS DEVELOPMENT LABORATORY FOOD INDUSTRY DEPARTMENT	SRISAK TRANGWACHARAKUL	
22	FATS AND OILS LABORATORY CHEMICAL INDUSTRY DEPARTMENT	SUMALAI SRIKUMLATTHONG	DIRECTOR
23	OFFICE OF POLICY AND PLANNING	SUNANTA RAMANVONGSE	DIRECTOR
24	FOOD TECHNOLOGY LAB.	SUWANNA SRISAWAS	DIRECTOR
25	PHARMACEUTICALS AND NATURAL PRODUCTS DEPARTMENT	TAWEESAK SUNTORNTANASAT	ACTING DIRECTOR
26	PROJECT MANAGEMENT OFFICE OF POLICY AND PLANNING	THANAKORN PALACHAI	HEAD
27	INDUSTRIAL COOPERATION AND PROMOTION CENTRE	SACHEE PIYEPONGSE	DIRECTOR
28	MATERIALS PROPERTIES ANALYSIS AND DEVELOPMENT CENTER (MPAD)	WIRACH CHANTRA	PROJECT ENGINEER

ANNEX 3
QUESTIONNAIRE TO TISTR'S DEPARTMENTS AND ANSWERS

Department

Number of people
Professionals
Technicians
Others

Annual budget (origin)
% self financing through contract or service payments
approximate number of competitors.
type of competitors (universities, private consultancies, others)
qualitative comparison of the group with the competitors (Quantitative information would be better if available)
Type of services ordered by degree of demand

Does the group use one or all of the following marketing tools?
- brochure
- curriculum of works already completed
- curriculum of main professionals
- courses, seminars, workshops etc. per year as a tool for contact and disseminating information.
- relations with company associations.
- number of professionals involved in marketing activities, percentage of time
- number of visits to industries per month (main objectives)
- number of visits from companies to TISTR departments per month (objectives)

Type of customers
Internal (other TISTR departments)
External (government and companies)

What is the customers'perception of:

service quality (excellent, good, bad)?
prices of services (high, acceptable, low)?
speed of response (fast, acceptable, slow)?
quality of personnel (excellent, good, bad)?

Does the head of the department agree with these opinions? (yes, if not please explain)

What is the perception of the personnel concerning salaries in your market? (excellent, acceptable, bad)

How many possibilities of training do the personnel have per year? (main topics)

The choice of training is made by (the people, the head of the group, both)

What do the groups think about quality and amount of infrastructure? (excellent, acceptable, bad).

A brief explanation of the method of selecting TISIR internal projects would be very useful.

A personal and private point of view of no more than half a page must be outlined by the head of department. How he or she imagines the group in 1998. Similar to now or different, bigger than now or smaller, etc.

ANSWERS BY DEPARTMENTS TO THE QUESTIONNAIRE

Dept.	Total Personnel	Profs.	Techs.	Others	Salaries	Infrastr.	Trained people per year	Number of Competitors	Type of Competitor	Brochure	Curric. Depts.	Curric. People
ATC	4	2	0	2	bad	bad	none	many	U	yes	yes	yes
ATD	26	18	4	4	acc	bad acc	few	many	UGP	yes	yes	yes
BID	40	25	13	2	bad	acc	3	4	UG	yes		
BTD	19	15	2	2	acc	acc	none	none	No	yes	yes	yes
CID	23	15	6	2	bad	bad	1	2	G	yes	yes	
ECSC	7	4	2	1	acc	acc	2.5	20	UP		yes	yes
EID	4	3	0	1	acc	acc					yes	
END	13	5	5	3	bad	acc	4	none	No	yes		
ERD	15	13	1	1	bad	acc	2.5	1	G	yes	yes	yes
ERMD	32	17	9	6	bad	acc	7	30	P U	yes	yes	yes
ETD	25	11	4	10	bad	acc	2	12	UPG	yes	yes	yes
FID	26	13	8	5	bad	2.5	acc	9	UG	yes	yes	no
ICPC	6	3	1	2	acc	acc	1.5	6	U O	yes	yes	
MMTD	33	21	12	0	bad	bad acc	5	yes	U P G O	yes	yes	yes
MTC	111	68	19	24	bad	acc	yes	4	G	yes		
PNPD	33	18	12	3	acc	bad	2.5	4	UPO	yes	yes	yes
RSC	2	1	0	1	acc	acc		yes	U O	yes		
SPC	14	6	3	5	bad	bad acc	none	6	G U P	yes	yes	yes
TNDC	30	17	13	0	acc	acc	several	20	UPG	yes		
TPC	16	15	0	1	bad	acc	2.5	4	UPG	yes	yes	yes

No answer

U University
G Government
P Private Enterprise
O Other

acc: acceptable
exe: excellent

ANSWERS BY DEPARTMENTS TO THE QUESTIONNAIRE

							Departments perceptions about customers opinions:				
Dept.	Diffusion Activities per year	People in marketing	Visits to enterprises per month	Visits from enterprises per month	Internal clients	External clients	Quality of Service	Price	Speed	Quality of people	Budget Mill BATH
ATC		2	variable	2.5	no	yes	good bad	low	fast	good	1
ATD	yes	10%	very few	very few	yes	G.P	good	acc	acc	exc	2
BID	yes	30%	0.5	5	yes	G.P	good	acc	acc	exc	36
BTD	yes			4	yes	G.P	good	low	acc	good	5
CID						G.P	good	acc	fast	good	6.4
ECSC						G.	exc	acc	fast	good exc	
EID						yes	good	acc	acc	good	
END			5	10		G.P	good	acc	acc	good	4
ERD	yes	yes	yes		few	P.G	exc	high	fast	exc	2
ERMD	12	no	no	0.33	yes	G.P	exc good	acc	acc	good	7
ETD	yes		no	2	yes	G.U.P	good	acc	acc	good	2
FID	yes	no	yes	1.5	yes	G.P.U	good	acc	acc	good	6
ICPC	yes		yes	yes		yes	exc	acc	acc	good	0.2
MMTD	3	10%	2	3	yes	G.P	exc	acc high	fast	exc	2
MTC	3		6	8	yes	G.P	good	acc	acc	good	28
PNPD	yes	no	no	no	yes	G.P	exc	acc	fast	good	2.3
RSC				yes		yes	exc	acc	acc	good	
SPC	yes	33%	0.25	3.5			good	low	fast acc	good	3
TNDC	yes		yes		yes	G.P	good	acc	fast	good	1.6
TPC	5		1	1	yes	G.P	good	acc	acc	good	5

No Answer

U: University
G: Government
P: Private Enterprise
O: Other

acc=acceptable
exc=excellent

ANNEX 4

THAI EXPORTS
SELECTED SECTORS AND PRODUCTS
(Millions of Baht)

Sectors / Years Products	1988	1989	1990	1991	1992
Manufacturing (total)	**265,639**	**354,154**	**440,395**	**553,186**	**634,385**
Textile products	58,625	74,027	84,472	109,524	111,837
Machinery and mechanical appliance	16,494	31,154	45,431	57,455	70,423
Precious stones and jewellery	23,683	28,393	34,858	35,903	36,582
Electrical apparatus for making and breaking electrical circuits	29,888	26,521	32,785	44,209	56,702
Footwear	9,658	13,524	20,213	23,798	25,639
Electrical appliance	6,274	18,851	32,523	47,875	60,356
Furniture and parts	6,635	9,746	11,511	13,626	15,069
Plastic products	5,470	7,606	9,116	12,952	15,272
Canned crustaceans	5,048	4,775	6,983	8,527	10,339
Sugar	9,664	19,244	17,694	14,782	18,920
Rubber products	4,413	5,464	6,548	7,116	9,151
Ceramic products	2,124	3,208	3,741	4,468	5,677
Clocks, watches and parts	1,364	2,484	4,887	7,556	8,533
Transformers, generators and motors	1,175	2,073	2,997	4,947	6,498
Insulated electric wire cable	1,899	3,545	4,565	4,821	6,842
Vehicle parts and accessories	3,770	4,431	5,541	6,885	8,730
Optical appliance and instruments	848	1,123	1,565	2,566	5,075
Chemical products	1,234	1,322	2,146	4,043	4,609
Toys, games	2,429	4,218	5,964	7,800	8,780
Sport requisities	426	1,222	2,583	4,102	6,974

T H A I E X P O R T S
SELECTED SECTORS AND PRODUCTS
(Millions of Baht)

Sectors / Years Products	1988	1989	1990	1991	1992
Agriculture (total)	**104,530**	**118,508**	**100,003**	**109,279**	**123,809**
Rice	34,676	45,462	27,770	30,516	36,214
Rubber	27,189	26,423	23,557	24,954	28,925
Tapioca products	21,844	23,974	23,136	24,368	29,611
Frozen fowl	5,005	6,069	7,752	10,540	10,830
Tobacco leaves	1,351	1,393	1,842	2,864	3,600
Fisheries (total)	**20,826**	**28,538**	**32,507**	**43,704**	**48,793**
Shrimp, fresh and frozen	9,698	16,057	20,454	26,681	31,696
Fish, fresh and frozen	3,181	3,803	4,540	8,140	8,072

Source: Customs Department