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EVALUATION AND ASSESSMENT OF INVENTIONS AND RESEARCH RESULTS FOR THEIR MARKETING AND COMMERCIALIZATION

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INTRODUCTION

Since it became independent, Côte d'Ivoire has undertaken research and technological development activities, especially in the agro-industrial sector, in order to promote and support the country's agricultural development.

In 1962, it set up the Institute for the Processing and Industrialization of Tropical Agricultural Products (ITIPAT), which was replaced by the Ivorian Technological Research Centre (CIRIT) in 1982 and then in 1998 by the National Centre for Agronomic Research (CNRA). Côte d'Ivoire has thus shown its determination to underpin its industrial development by technological innovation and the dissemination of effective processes and techniques for the conservation, storage and processing of agricultural products.

Important results have been achieved, especially by the ITIPAT, but they have only rarely gone beyond the laboratory stage and had the expected industrial development.

The Ivorian Company of Tropical Technology (I2T) was set up in 1979 to provide a satisfactory response to the problem of exploiting the results of applied research and to become the interface between research and industry.

After almost 20 years of activity, I2T has achieved results, some of which have not been developed further because of the economic environment whereas others are being exploited to the fullest.

In order to respond to the question raised by this theme, we shall deal with the following points:

1. results achieved;
2. problems of commercializing the results of research;
3. Research and Development (R&D) methodology: evaluation-promotion;
4. future outlook.

I GENERAL PRESENTATION OF I2T

The Ivorian Company of Tropical Technology (I2T) is a mixed-investment company set up in 1979 by the Côte d'Ivoire and French partners, and with the following objectives in the agricultural and agro-industrial fields:

- to study any technological problem;
- to develop machines or processes;
- to build equipment and facilities directly or indirectly;
- to exploit the results achieved directly or indirectly;
- to carry out any work that will develop its means of production and, in general, any industrial, commercial or financial operations, particularly by taking shares in other companies whose headquarters may be in any country and whose direct or indirect purpose is to facilitate expansion or development.

I2T's capital is CFAF 250,000,000; the State holding 65 per cent of the shares. The capital is however being modified.

The company employs 104 people on two sites, namely:

- the Industrial Testing Centre for Starches in Toumodi, employing 22 people;
- the Port Bouët platform, employing 82 people.

Since it was set up, the company's technical resources have all been funded solely by Côte d'Ivoire. These technical resources comprise the following *inter alia*:

- a Design and Engineering Office with computer equipment for Computer Assisted Design (CAD) and for project design;
- a mechanical workshop;
- a laboratory for preparation, quality control and sensory analysis;
- a documentation centre;
- three testing facilities.

II RESULTS ACHIEVED BY I2T

There are two major stages in I2T's technological research work. The first is the development of large-capacity industrial technology and the second the development of small and medium-scale technology.

1 RESULTS OF TECHNOLOGICAL RESEARCH

1.1 Development of industrial technology

The company has managed to conclude the research programs initiated when it was created, which cover the following:

- **industrial technology for coconut processing** to reduce the labor force needed to produce coprah. An industrial unit with an output of 1,000 kg/h of coprah was set up in Assinie. The fall in the price of coprah and other oilseed products has affected the profitability of this process. The unit was therefore closed for economic reasons after having produced 31,500 tons of coprah;
- **industrial technology for processing cassava flour for making bread:** a pilot demonstration factory has been set up at Toumodi using the process and equipment developed by I2T. I2T's experience in this area is recognized at the international level by organizations such as the FAO and the ECA. I2T produces and sells flour from this factory to a number of agro-food companies which use it as a binding agent in the food industry;
- **industrial technology for processing cassava into dehydrated "attiéké" (fermented cassava):** for this process, a pilot line with an output of 160 kg/h of dehydrated attiéké is operating in Toumodi;

- **production of biogas from cassava peelings:** a digester with a volume of 1,400 m³ has been built and is currently operating in Toumodi. It produces biogas for drying operations in the Toumodi factory;
- **gasification of coconut waste:** 2 gas generators with an output of 1,200 Nm³/h each have been built and have been operating in Assinie for 9 years, to produce gas for coprah drying and electric power using electric generators powered by gas generators which have processed 194,500,000 coconuts. This type of gas generator has been used successfully for the gasification of rubber trees.

The aforementioned programs have given I2T a portfolio of patents with 12 property titles for 39 filings in 9 countries:

1. extraction of content from extended hulls;
2. process for the industrial preparation of coconuts;
3. machine to remove coconut waste;
4. process for peeling/chopping food products;
5. dehusking process for coconuts;
6. drying kiln for food particles;
7. industrial treatment process for cassava;
8. gas generator using coconut waste;
9. gas generator using coconuts;
10. gas generator using rubber trees;
11. extract of cassava pulp using the wet method;
12. extraction of cassava pulp using the dry method.

These patents have been filed in nine different countries, namely:

- a) India;
- b) Nigeria;
- c) Brazil;
- d) Sri Lanka;
- e) African Union (OAPI);
- f) Venezuela;
- g) France;
- h) Philippines;
- i) Mexico.

1.2 Development of small and medium-scale technology

I2T has also opened up new avenues of research and development, for example the development of material for use on a small or medium scale. The following have been developed:

- **coffee dehusking machines with a capacity of 200 to 1,000 kg/h of coffee berries:** 30 dehuskers were built at the request of a distributor in 1995;
- **cassava crusher with a capacity of 800 kg/h of peeled cassava:** more than 50 crushers were marketed in 1995 and 1996;

- **medium-scale integrated unit for the production of fresh attiéké** comprising a crusher, a centrifuge, a granulator and a cooking module;
- **equipment for extracting palm oil** comprising a mixer and a press;
- **equipment for processing coconuts using the wet method** to provide high value-added products such as oil for cosmetics or human consumption and coconut milk powder;
- **development of equipment for the production of cassava starch** on a semi-industrial scale.

2 PROMOTION AND MARKETING OF RESULTS

As a result of the devaluation of the CFA Franc in 1994, the provision of capital by the Ivorian Government, the Ivorian people's entrepreneurial spirit and our promotion activities, private Ivorian and even international operators are becoming more and more interested in the results achieved by I2T. For example, our agricultural processing equipment, especially for cassava, is increasingly in demand. The same is true for our expertise in carrying out project designs, technical audits and training in agricultural processing techniques.

The promotion is based on surveys among potential industrial and agricultural users. It serves as a reference point for I2T.

From 1994 to 1998, the results of the sale of equipment, services and products were the following:

- modular equipment:
 - 167 modules for processing agricultural products, mainly the processing of cassava into fresh attiéké;
- services:
 - 6 project feasibility studies;
 - 19 training courses in cassava processing techniques;
 - 25 other services;
- complete production units:
 - 2 production units with an output of 500 kg of fresh attiéké/day;
 - 2 cassava starch production units with an output capacity of 550 kg of cassava roots/hour.

In the agro-industrial sector (both the food and non-food industries), the Toumodi factory sells its products, especially cassava flour, to Ivorian and African industries (Benin, Mali, Burkina Faso).

In 1999, I2T was building 2 complete units with an output of 500 kg of fresh attiéké/day for a private promoter in Senegal and for an international organization in Côte d'Ivoire. Training contracts financed by the Development and Vocational Training Fund (FDFP) are being executed.

Requests for pro forma invoices and visits to our facilities continue to arrive both from Côte d'Ivoire and even from other African countries.

3 REMARKS

Nevertheless, the following remarks can be made:

3.1 Industrial-type technology

As can be seen, no factory has been established as a result of the development of industrial technology. The main reasons for this are:

- the high cost of investment;
- large capacity of the factories designed;
- investment and production capacity are mainly intended for industrial companies, which usually receive their technology from their parent companies. Local companies interested in the technology developed by I2T are linked to donors, which advise them to buy technology from their countries of origin;
- negative impact of the prices of semi-finished and finished products (in particular, coprah and oilseed products);
- insufficient trade promotion;
- reluctance, lack of confidence and prudence of investors and donors when taking risks on technologies created in developing countries;
- illegal competition from certain European design offices which have copied I2T technology;
- lack of public financial resources in Côte d'Ivoire to support the promotion of I2T with certain potential customers and donors (former Zaire, for example).

3.2 Small or medium-scale technology

In the course of developing small and medium-scale technology, several machines and units were sold. The main reasons for this initial success are:

- low cost of investment;

- low capacity of the machines and production units designed, which correspond to the level of investment and the volume of raw material supplies available to cooperatives and even to persons;
- easily mastered technology and machines.

In Côte d'Ivoire, other research results have not had the expected commercial success.

A number of examples illustrate this:

Development of grain sauce in tins by BLOHORN (TROFAI): launched in 1975	Technological success, Commercial failure at the national level
Development of red palm oil by BLOHORN (LA VILLAGEOISE): launched in 1989	Technological success, Commercial failure at the national level
Development of precooked yam flour by NESTLE (BONFOUTOU): launched in 1989	Technological success, Commercial failure at the national level
Development of groundnut paste in tins by CHOCODI (TARA): launched in 1990	Technological success Commercial failure at the national level

When developing technology or products, commercial success does not always go hand-in-hand with technological success. A close examination of the industrial activities of the agro-food sector in Côte d'Ivoire, clearly indicates that the results of technological research are not sufficiently exploited.

What are the reasons for this?

Even if it is recognized that innovation entails risks and that technological success is not always accompanied by commercial success, what can be done to mitigate the lack of success?

In our view, this is the underlying sense of the theme of the evaluation and assessment of inventions and research results for their marketing and commercialization.

III PROBLEMS OF EVALUATING INVENTIONS AND RESEARCH RESULTS: RESEARCH AND DEVELOPMENT TOOLS

To lessen the risk of seeing research results fail, I2T has adopted a methodology and research and development tools.

1 DIFFERENT PHASES IN THE RESEARCH AND DEVELOPMENT PROCESS

The methodology adopted by I2T comprises the following phases:

- PHASE 1 identification of the project;
PHASE 2 technical-economic evaluation of prospective market or market survey;

PHASE 3	pre-feasibility study and R&D program;
PHASE 4	promotion of the project / search for partners and financing;
PHASE 5	implementation of R&D program;
PHASE 6	technical-economic study, verification of needs, financial study and economic verification of markets;
PHASE 7	feasibility study, promotion-sale of technology.

2 DESCRIPTION OF THE METHODOLOGY

PHASE 1: Identification of the project

This means the idea of the project, which may stem from the following:

- internally, from a study group;
 - externally from a private promoter interested in developing a product or machine.
- a) Evaluation criteria:
- scientific and technological evaluation of the idea.
- b) Evaluation tools:
- technological review;
 - background studies;
 - documentary and bibliographic research.

Only a viable scientific and technological idea may be the subject of a technical-economic evaluation in the following phase.

PHASE 2

- a) Technical-economic evaluation:

This is a brief technical-economic evaluation that enables the most economically viable technical option to be chosen. The selection criteria are the following:

- internal rate of return (IRR);
- net present value (NPV);
- certain ratios, such as the profit/investment ratio, etc.

b) Prospective market study or market survey:

This phase provides the following information on the market:

- assessment of market potential (quality, volume, price, etc.);
- identification of the competition;
- definition of customers; etc.

c) Criteria:

- The product must meet a real need.

PHASE 3

a) Pre-feasibility study:

This is a study comprising the elements collected during the preceding phase in order to undertake preliminary studies on whether or not the project is feasible.

b) Criteria:

- IRR must exceed the capital lending rate;
- NPV must be positive.

c) R&D program:

At this stage, this study shows the preparation of an R&D program and the studies to be carried out, as well as the resources to be found for this purpose.

PHASE 4: Promotion of the project: Search for partners and financing

The pre-feasibility study and the R&D program dossier are used for promotion purposes and the search for financing partners among private promoters or financing organizations that might be interested in implementing the R&D program.

PHASE 5: Implementation of the R&D program

If the financing is found, the R&D program is carried out in order to confirm or contradict the data used in the pre-feasibility study in phase 3.

PHASE 6

a) Technical-economic study:

This dossier contains the real, technical and economic data on the project obtained in the course of implementing the R&D program.

b) Impact assessment – verification of markets:

During the R&D program, samples are produced in order to verify the market data and assess the product's impact on the market.

c) Criteria:

- Relevance of the technical results obtained (quality, capacity, performance, cost, etc.);
- Differences in comparison with expectations (for example, market/product test).

PHASE 7

a) Feasibility study:

This contains the following:

- technical data (technical specifications of the raw materials, description of the processes, products, etc.);
- market survey data (supply of raw materials, quality, quantity, customers, competition, etc.);
- economic and financial data (selling price, interest rate, internal rate of return of the project, various ratios, etc.);
- engineering dossier: outline of the process, description of the technology chosen, description of the personnel and evaluation of its cost, building plans, etc.).

This dossier should give the various partners interested in the project sufficient elements to take a decision on whether to participate.

b) Promotion – Sale of technology:

When a project is commissioned by a private promoter, he is given the feasibility dossier. I2T also provides assistance during discussions with the various donors contacted by the promoter.

If I2T has initiated the project itself, the dossier helps to promote the technology developed. This can be done in several ways:

- participation in exhibitions, fairs, etc.;
- meetings with private promoters (potential targets);
- visits to the Research Centres of I2T (Port-Bouët, Toumodi);
- open days;
- mailing shots, brochures, samples, etc.;
- publicity articles in the press or elsewhere;
- operation of pilot production units for the purposes of marketing test in order to gain a reputation, etc.

3 TOOLS FOR EVALUATING RESEARCH RESULTS

3.1 Research and development tools

The following tools are used by I2T to maximize the chance of success:

3.1.1 Technological monitoring and documentary and bibliographic research

I2T has a Scientific and Technological Information Center which contains the publications necessary for research and is linked to documentation networks in Côte d'Ivoire and France.

3.1.2 Internet

I2T is linked to the Internet, which allows it to obtain information and communicate with partners in other countries.

3.1.3 Search for background material

In new studies it wishes to carry out, I2T will seek background material so as not to duplicate work and to save time.

3.2 Equipment design tools

I2T has the following equipment design tools:

- the CESAM method;
- CAD.

3.2.1 CESAM method

The traditional system for designing equipment in developing countries can be described as follows:

- equipment is manufactured;
- a study is made of the results and the testing;
- modification or the manufacture of other equipment is decided.

This system has limits because the financial resources available to technological research centers are decreasing so they cannot incessantly manufacture equipment and then find out that it needs continual modifications, which are increasingly costly.

In order to overcome this problem, the International Cooperation Center of Agricultural Research for Development (CIRAD) started to experiment with a new system for the design of small and medium capacity equipment, namely, the Equipment Design Method for Countries in the South for Agriculture and the Agro-food Industry (CESAM). I2T is participating in the development of this method under a cooperation program with the CIRAD. This method comprises the following phases:

- PHASE 1: lunching the project / initiating the project;
- PHASE 2: identifying the needs and the state of the art;
- PHASE 3: definition of principles;
- PHASE 4: choice of technical solutions;
- PHASE 5: identification of equipment;
- PHASE 6: making the equipment.

The CESAM method is as follows:

- a group studies the question;
- a decision is taken together (direction, principles, and how to manufacture);
- manufacturing.

This method increases the chances of commercial success for the equipment developed by I2T.

3.2.2 CAD

I2T has electronic data processing equipment and software for computer-aided design (CAD). The software used is PROENGINEER.

3.3 Study tools

I2T has electronic data processing equipment and software for economic and financial feasibility studies of projects. The software is COMFAR (Computer Model for Feasibility Analysis and Reporting).

3.4 Prototype equipment

I2T has modular prototype equipment for producing samples which are used to verify market data and assess the product's impact on the target market.

3.5 Monitoring equipment

I2T has laboratory equipment, microbiological controls, quality control and sensory analysis.

IV EVALUATION OF RESEARCH RESULTS

The various tools listed above makes it possible to evaluate any idea for a project at each stage of its development. For example, it is not possible to go on to phase N+1 unless phase N has been entirely satisfactory.

The use of the various tools at different phases can be illustrated as follows:

EVALUATION OF RESEARCH RESULTS

	PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5
Evaluation tools	Identification of the project	Technical and economic evaluation	Pre-feasibility study	Promotion of the project	Implementation of the program
		Market survey	R&D program	Search for partners and financing	
Technological monitoring	X	X	X		
Internet	X	X			
Background search	X				
CAD					
CESAM method					
COMFAR		X	X		
Prototype equipment					
Laboratory equipment					

V OBSTACLES TO MARKETING

The results of the technical, financial and economic analyses and the market survey are the bases for promoting the results of research.

Despite all the efforts made to obtain these bases for promotion, which should in principle suffice to convince potential investors, it has been found that they do not suffice to ensure commercial success for the results of research.

In fact:

1 AT THE TECHNOLOGICAL LEVEL

Promoters demand but do not always take. They are characterized by the following:

- they usually have only a rough idea of the target market;
- they lack industrial experience;
- they do not have sufficient financial capacity;
- they want to make money quickly whereas an industrial investment is profitable in the long term.

2 AT THE LEVEL OF FOOD PRODUCTS

The problems of boosting sales when launching products are due to psychological and socio-economic factors, for example:

- the effect of deeply-rooted food habits, even among wealthier people;
- the low purchasing power of the majority of consumers;
- the psychological prejudices of Ivorian consumers, who mistrust products made locally and prefer those from abroad (snobbery). This is the case, for example of MAMBA beer, which has been successful in Côte d'Ivoire because it was first launched in Texas, United States of America;
- the small size of the domestic market (low demand).

As can be seen, the marketing of a new product or the exploitation of a new technology always involves a risk which promoters interested in exploiting the results of research do not wish to assume alone. The findings of studies or consumer surveys, with the help of samples from pilot lines, are not sufficient guarantees of the existence of markets for larger volumes. The commercial failure of BONFOUTOU, TROFAI, LA VILLAGEOISE and TARA, despite the large financial resources used to promote them by international groups, shows clearly the considerable risks of developing new products or exploiting new technology.

It is easy to see therefore why promoters interested in establishing production units for new products wish to share these risks.

VI CONCLUSION AND RECOMMENDATIONS

The experience of I2T shows therefore that an important link in the agro-technological research chain in Côte d'Ivoire is missing. The dissemination of results is facing the following problems:

1. The problems encountered by local promoters in finding capital to invest in units using new technology or wishing to manufacture new products. Creating an enterprise on the basis of a new product or technology simply adds another risk to that of creating an enterprise, namely, innovation. It is necessary to find mechanisms for sharing the risks of innovation in order to incite the private sector to exploit the results of research;
2. The problems encountered by research centers in finding capital to build the demonstration units needed to promote technology. Absorbing this type of financing should be one approach to resolving this;
3. The difficulties faced by industrialists in mastering all aspects of markets, especially the qualitative and quantitative aspects.

In order to encourage marketing and commercialization of research results in the economic sector, the following must be done:

1. To establish, where necessary, a mechanism for promoting research results with the aim of participating in the financing of the first production units of enterprises using research results. This would allow the risks inherent in innovation to be shared with the promoters. Such a mechanism could be a public or semi-public structure with special funds (risk capital), which could take shares in enterprises exploiting research findings;
2. To give enterprises assistance not only for market surveys on qualitative and quantitative aspects, but also for technical, economic and financial feasibility studies on projects;
3. To establish financing structures adapted to industrial activities;
4. To adopt fiscal incentives for enterprises wishing to invest in technological research activities.

These efforts have to be made if technologies are to be developed and to be disseminated effectively.

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