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MISSION REPORT .

DEVELOPMENT AND COMMERCIALIZATION OF PREFABRICATED
MODULAR TIMBER BRIDGES .
(IS/KEN/74/035)

by

Antoine V. Bassili
UNIDO Official-1

27 November - 7 December ~~1976~~ 1975

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1. INTRODUCTION

The undersigned, Antoine V. Bassili, Industrial Development Officer in the Industrial Operations Division went on a mission to Kenya to review the project "Development and Commercialisation of Prefabricated Modular Timber Bridges" (IS/KEN/74/035) from 26 November to 7 December 1975.

2. PREFABRICATED MODULAR TIMBER BRIDGE PROJECT

The work done on this project was discussed in depth with the Principal Expert, Mr. J.E. Collins, the Associate Expert, Mr. K. Petersen, the Senior Industrial Development Field Adviser, Mr. W.R. Millager, and with Mr. John Wawiye, Conservator of Forests, Ministry of Natural Resources.

It is proceeding satisfactorily, the delays encumbered are motivated by reasons given in the draft of the project document for the project "Development of Timber Engineering Industries" (DP/KEN/75/027) prepared in collaboration with Mr. Collins and attached to this report as Appendix I. Three bridges (at Isiolo, in the Mt. Kenya Nijango area and in the Ngong forest) were inspected during the mission. The workshop producing the elements was also visited and the site of one other bridge to inspect the foundation. The suggestion to include designs of wooden railings for the bridges as part of the system was made by the author, and the contents of the manuals reviewed and discussed with the Principal Expert and the Associate Expert.

Problems of logistics (supply of sufficiently dried timber and/or transport of elements to the site) over which the project staff have no control, have recently been less acute than in the past.

The possibility of designing and introducing abutments (foundations) using pressure impregnated timber piles was discussed with Mr. Collins. This would eliminate problems of supply of cement and hollow cement blocks, subcontracting of the concrete work, etc. and limit the skills required for the erection of the bridges to those of carpenters.

Mr. Collins is to study this possibility in depth, and, if feasible, incorporate it in his work plan for 1976. The problem of pressure impregnating the timber piles with preservatives for the prototype bridge with such abutments does not arise since the Forestry Department has a large pressure impregnation cylinder in its plant Nakum, which, at the time of the mission, was being installed.

In the future the location of some of the bridges to be erected will probably render the wooden abutment system uneconomic because of high transport costs involved. The author suggested the use of mobile pressure impregnation cylinders developed in India.

He discussed this problem with the Chief Conservator of Forests, Mr. O. Mburu, and with Mr. J. Wawiye, Conservator of Forests, and stated that it might be possible for UNIDO to supply such a pilot (or demonstration) unit from its General Trust Fund, if a formal request were made by the Government of Kenya through the official channels.

3. DEVELOPMENT OF TIMBER ENGINEERING IN KENYA

The work done by the expert in developing the bridge and the roof trusses for the Kenya industrial estates has led to the realization by all concerned of the potential for timber engineered structurss in Kenya. This was confirmed to the author in discussions he had with Mr. Peter A. Campbell, Professor of Civil Engineering at Nairobi University.

Consequently, the project document drafted during the mission foresees not only the completion of the design work on the bridges and the design of a 100-meter span bridge but also the design of timber structures for industrial buildings, agricultural buildings, marine installations, roof trusses for dwellings and laminated structures. Design, production and erection manuals will be prepared to assist the propagation of these systems.

..... The project document drafted, attached to this report as Appendix I, was foreseen for only one year, to coincide with the end of the First Country Programme. It was realized that the assistance to assure the development of Kenya's timber engineering industries could not be completed within such a short period, so a project proposal for assistance for a further 18 months, starting in February 1977 was drafted (see ..... Appendix II attached). The assistance would cover the following fields:

Design of timber fire watch towers, development of a low-cost wooden modular building system, design and production of glued-laminated components and the design and production of marine structures. The development of the timber engineering industry in Kenya calls for the drafting of a design manual and code of practice for local designers and producers. Timber engineering also calls for kiln dried sawn wood and low-cost adhesives. It is foreseen that the project will undertake work on the development of solar kilns for drying and sawn wood, and undertake research on the use of naturally occurring resins obtained from cashew nut shells and wattle bark to replace - to the extent possible - imported resins. (This research will be carried out at the University of Nairobi's engineering laboratories.)

4. DEVELOPMENT OF THE FURNITURE INDUSTRY

During discussions that the author had with Mr. John Wawiye, Conservator of Forests, he was informed that the Forest Department will expand the wood-working shop at the Forest Industries Training Centre at Nakuru and use it for industrial production. Mr. Wawiye was interested in obtaining UNIDO assistance in this field at the appropriate moment. He was given job descriptions for a furniture production specialist and a furniture designer for an eventual request when the plant will start operating.

Problems facing the furniture industry were also discussed with Messrs. Olof C. Karsegard, Project Manager of the UNCTAD/GATT/ITD Export Promotion Project, and Herman Bekker, UNIDO product adaptation expert in that project.

While some exports of hotel furniture to Somalia have taken place in the past, the present buoyant local market has led to a decrease in the will to export. Problems that have to be overcome to export are: wood drying to low moisture contents, design of knocked-down furniture and know-how for serial production has to be acquired. Whereas exports to Europe are most unlikely, a good potential market would be the Gulf states. They would absorb furniture for medium income groups. Technical assistance would, however, be needed to achieve this.

5. FEASIBILITY STUDIES FOR THE KENYA INDUSTRIAL ESTATES

The author met Mr. Alfred M. Shikule, Deputy General Manager of the Kenya Industrial Estates Ltd.

He was informed of K.I.E.'s interest in obtaining from UNIDO feasibility studies for the following industries to be established in the industrial estates to be located in rural areas:

(i) an integrated woodworking complex to saw about 10,000 cu.ft. of softwoods and/or hardwoods per annum;

(ii) a rural tannery;

(iii) small scale sugar production;

(iv) a tool room.

Draft terms of reference for the first study were prepared and handed over to Mr. Shikule. They are given in Appendix III attached. The cost of such a study would be of the order of US$ 50,000. Financing these might be difficult because of the present UNDP financial crisis but these studies could be financed from funds approved for the sub-contract component of the Industrial Survey and Promotion Centre Project.

6. TECHNICAL COURSE ON CRITERIA FOR THE SELECTION OF WOODWORKING MACHINES

Various persons who could be potentially interested in the above course were given information on its aims, programme and procedures for applying.

7. OTHER MATTERS

A. Possible UNIDO assistance to the wood processing industries sector of Mozambique

The author discussed this topic with Mr. W. R. Millager, the Senior Industrial Development Field Adviser, prior to the latter's mission to that country and a position paper was prepared and handed over to him.

B. Development of the use of wood in housing in Indonesia

In discussions the author has had with Prof. Peter A. Campbell, he was informed of the work done in Kenya to develop low cost wooden housing and the use of pole constructions. These systems would be applicable to Indonesia, and Prof. Campbell would be willing to undertake a one month mission to the large scale project UNIDO is implementing in the field of development of building materials to help the project manager and the counterpart staff draw up a plan of action in this field.

C. Information on the production of fibreboard by the wet, discontinuous (Deckle Box) process

The author visited the Sokoro Fibreboard Mills Ltd. in Elburton with Mr. Collins to obtain from Mr. M.M. Barrat, the plant manager, certain technical information for inclusion in the report of the Workshop on Wood Processing which UNIDO convened in Vienna in November 1975.

8. Publicity for the modular wooden bridges

The author discussed with Mr. Collins the possibility of filming a short 10-15 minute film on the design, testing, production and erection of these bridges. He was to discuss with UNIDO's Head of Information Services the possibility of providing the necessary equipment upon his return to Vienna.

9. ACKNOWLEDGEMENTS

The author wishes to thank the expert, Mr. J.E. Collins, and all the persons he met during his stag in Kenya for their help. Without their assistance he could not have undertaken his mission.
(The list of persons he met are given in Appendix IV, attached.)

cc: Mr. G.P. Veliky
Mr. K.H. Englund, Resident Representative UNDP, Nairobi
Mr. W.R. Millager (Nairobi)
Mr. J.E. Collins (Nairobi), Mr. Kohut (Nairobi)
Mr. M.M. Aref
Mr. M.A. Siddiqui
Miss L. Doss
Mr. C. Rydeng
Registry

APPENDIX I

3 December 1975

PROJECT PROPOSAL

UNITED NATIONS DEVELOPMENT PROGRAMME

Project of the Government of Kenya

Title: Development of Timber Engineering Industries

Project No: KEN/75/027 **Project Duration:** One year

Sector: 35 Industry

Subsector: 3520 Establishment and Extension of Industries

Government Co-operating Agency: Ministry of Natural Resources **Executing Agency:** United Nations Industrial Development Organisation (UNIDO)

Date of Submission: **Project Starting Date:** 1 February 1976

Government Contribution: _____ **UNDP Contribution:** $60100

Approved:

_____ **Date** _____

on behalf of the Government (signature)

_____ **Date** _____

on behalf of the Executing Agency (signature)

_____ **Date** _____

on behalf of UNDP (signature)

I BACKGROUND AND SUPPORTING INFORMATION

A. Justification for the Project

This project is conceived as having two functions. The first is the completion of existing work on the project for Development and Commercialisation of Prefabricated Timber Bridges (IS/KEN/74/035); the second the extension of the work to other timber structures and to increase the range of application of the standard bridge design.

The prefabricated bridge has won acceptance by public bodies in Kenya and bridges ordered by the Ministry of Works, the office of the President and other government institutions, are under construction. As of 1 December seven bridges have been erected, five are under construction and negotiations are underway for a further six. Another eight are at the preliminary enquiry stage. This initial stage has taken longer than originally envisaged and erection and evaluation of some of these first production bridges by the institutions concerned will not be complete within the present project. The reasons briefly are:

1. Late recruitment of government counterparts and the UNIDO Associate Expert.

2. Delays in purchasing material for bridges.

3. Delays in erecting bridge foundations.

However, these initial difficulties are now overcome and wide application is now ensured, full supervision of structures already ordered is still needed, and full commercialisation is expected to follow.

The project has generated interest in the possibility of providing an extended version of the bridge for spans in excess of 30 metres and bridges to carry water pipelines.

It is proposed within the term of the project to design a 100 m span bridge for a specific site in Nyanza Province to act as a prototype for similar spans. Manufacture of this bridge will be financed from funds already allocated to the office of the President for the financial year ending June 1976. Work will also be carried out in the design of wooden piling systems for abutments.

The interest shown in this timber structure provides an opportunity for the extension of the work to other structures including complete industrial buildings, agricultural buildings, marine installations, roof trusses for dwellings and laminated structures. There is already application for the first of these in the construction of Industrial Estates by Kenya Industrial Estates Ltd. and a prototype timber built factory with 21 meter clear space designed by the principal expert of the bridge project is expected to be erected within the life span of the bridge project. The timber structure designed costed one third of the cost of the concrete structure it was designed to replace and 40 percent of one using rolled steel sections.

These estates will provide a demonstration for a full industrialised building system and KIE have expressed their considerable interest by their adoption of a first design.

This system is expected to prove considerably cheaper than any alternative, will reduce reliance on imported materials and will provide employment opportunities in rural centres. The example quoted will cost 40% of estimates given by conventional construction companies and it is thought that this will prove typical.

The erection of system prototypes on these industrial estates will present an ideal opportunity for local manufacturers to adopt the system and initiate commercial production.

As with the bridge, a design and erection manual will be written to assist propogation of the system.

The bridge project and its extension and the design and commercialisation of an industrial building system are planned for completion during the one year of the project. Further work after that time will be by government counterparts who by then will have received fifteen months training in the techniques involved.

However, it is a field capable of further application and areas to be investigated for possible future application during the project will be marine installations and glue laminated products. Allied to these will be an appraisal of preservative methods, use of locally produced naturally occuring adhesives and non conventional kiln drying methods such as solar kilns. In addition there is a requirement in Kenya for a Timber Engineering Code of Practice and a Design manual for local conditions. The project will compile the necessary information for their eventual production. This project has an excellent investment potential for small labour-intensive plants which could be located also in rural areas.

B. Institutional Framework

The project will be attached to the Ministry of Natural Resources as the first bridge project. There will be close liaison with Kenya Industrial Estates Ltd. on the design and construction of the building systems and their production industrially.

.../

C. Provision for Government Follow-up

At present two Kenyan graduates are attached to the bridge project and it is intended that these will receive sufficient training within the project period to apply the two systems to be designed without further outside assistance.

D. Future UNDP Assistance

Depending on the feasibility studies to be carried out during the project it is expected that assistance will be requested for implementation of further design and commercialisation of timber structures.

II OBJECTIVES OF THE PROJECT

This project is included in the Kenya/UNDP Country Programme for 1972-76.

A. Long Range Objectives

This is to assist the Ministry of Natural Resources to promote the engineering use of commercial timbers within the country with the object of providing an alternative material for the building industry and of encouraging the growth of a timber engineering industry based on locally occuring natural resources.

B. Immediate Objectives

1. Complete development and commercialisation of prefabricated timber bridge project (including piling for abutments).
2. Design extended span bridge and supervise erection of prototype. incorporate in bridge handbook.
3. Design range of low-cost modular timber industrial/agricultural buildings and assist KIE in production of prototypes.

4. Write design handbook for the above.
5. Assist local enterprises in commercialising production of industrial/agricultural buildings system.
6. Conduct feasibility studies and outline design studies for other timber structures including marine structures and glue laminated structures.
7. In collaboration with the University of Nairobi develop a programme to investigate the use of locally produced naturally occuring adhesives for use in conjunction with timber.
8. Determine exact requirements for a general design manual for timber structures and a timber engineering code of practice and compile the necessary information.

III WORK PLAN

A. Project Activities

	Activities	Location	Duration and Starting Date
1.	Complete development and commercialisation of pre-fabricated timber bridge project.	Nairobi and field locations	Twelve months beginning 1 February 1976
2.	Design and supervise construction of prototype long span bridge and incorporate in handbooks completed in (1)	Nairobi and field locations	Six months beginning 1 February 1976
3.	Design range of low cost modular factory and agricultural buildings and assist in construction	Nairobi and field locations	One year beginning 1 February 1976
4.	Write handbooks for (3)	Nairobi	Six month beginning 1 July 1976

	Activities	Location	Duration and Starting Date
5.	Obtain information on "state of the art" in production and use cashewnut shell adhesives for timber.	UK and Australia	Two months beginning 1 July 1976
6.	Negotiate for commercialisation of building systems designed in (3).	Nairobi and field locations	Six months beginning 1 July 1976
7.	Carry out a technical and economic feasibility study on marine structures and glue laminated components, and if positive, initiate work on preservation of softwoods for use in those structures.	Nairobi and field locations	Nine months beginning 1 April 1976
8.	Develop a programme for Research to be carried out by the University of Nairobi on the use of naturally occuring resins for use in timber.	Nairobi	Three months beginning 1 November 1976
9.	Determine exact requirements for timber design manual and code of practice	Nairobi and field locations	Six months beginning 1 August 1976

B. UNDP Inputs

1. International Staff

Structural Engineer - The expert requires extensive experience in design, manufacture and erection of timber structures.

Associate Expert - Degree in civil or mechanical engineering desirable. Assignment will include supervision of manufacture and erection of prototype timber structures.

2. Fellowships

A two month fellowship will be provided to a technician from the Faculty of Engineering to enable him to obtain information and training on the preparation of cashewnut shell adhesive.

.../

3. Equipment

The following equipment will be provided:

a) Strain gauges for monitoring performance of long span bridge.
b) Locally produced prototype and test equipment.
c) Electric typewriter .
d) Electric moisture meter (portable).
e) Reference books.

4. Miscellaneous

a) Travel costs (by air) to remote locations.
b) Printing costs.

C. Government Inputs

1. Kenya Staff

Counterpart staff assigned to the first bridge project will continue with the expanded project. In addition supporting technician staff, skilled and unskilled workers and secretarial support will be provided.

2. Supporting Services

Office space will continue to be made available to the project together with normal office equipment and supplies. The project vehicle provided under the first bridge project will continue to be fuelled and maintained. Facilities of the Forest Department will be made available and may include but are not limited to supplementary transport services, manufacturing space and supplies of components for testing.

.../

House Allowance

House allowance at the appropriate rate will continue to be paid to the associate expert..

IV PROJECT BUDGET COVERING UNDP CONTRIBUTION

		TOTAL		1976		1977	
		m/m	$	m/m	$	m/m	$
10.	PROJECT PERSONNEL						
11	Expert						
11.01	Structural Engineer	12	48,000	11	44,000	1	4,000
11.02	Associate Expert	6	p.m.	3	p.m.	3	p.m.
16.00	Mission Cost	½	2,000	½	2,000	-	-
	Component Total	18½	50,000	14½	46,000	4	4,000
20.	TRAINING						
21	Fellowships	2	3,200	2	3,200	-	-
	Component Total	2	3,200	2	3,200	-	-
40.	EQUIPMENT						
41	Non-expendable equipment		4,000		4,000		-
	Component Total		4,000		4,000		-
50.	MISCELLANEOUS						
51	Printing Costs		1,000		1,000		-
52	Travel Costs		2,000		2,000		-
	Component Total		3,000		3,000		-
99.	GRAND TOTAL		60,200		56,200		4,000

APPENDIX II

4 December 1975

Project Proposal

Project Title: Development of Timber Engineering Industries
Code Number: KEN/75/027
Duration: 18 months from February 1977

This is a project which is expected to develop from the newly proposed Development and Commercialisation of Timber Structures (I) project which should be completed by February 1977. In this project development and commercialisation of timber bridges and industriel buildings will be completed and a feasibility study undertaken into other timber structures including marina installations and glue laminated components. In addition requirement for a generel design manual for timber structures and a timber engineering code of practice will be established.

Justification for a project based on these studies is as follows:

1. Design of timber fire watch towers and development of a low-cost wooden modular building system.

The country is embarking on a forest fire protection programme and is receiving UNDP/FAO assistance in this field. It appears from preliminary findings that firewatch towers are needed. A rational and safe timber design would reduce the timber needed, and create employment in rural areas to produce these towers and man them subsequently. Many of the existing towers need replacement and there is a need for new ones.

Timber dwellings are common in many rural areas in Kenya. They are often either badly designed or overdesigned and built using wrong building methods.

It is proposed that under this project the Forestry Department will design and develop a low-cost wooden modular building system to popularise this system, to introduce sound design and construction methods and to popularise the idea among both potential purchasers and producers thereby

promoting the vertical integration of Kenya's sawmilling industry.

UNDP/UNIDO is to provide assistance in this field. Prototypes will be built by the FIC sawmill.

2. Laminated Components

Laminated structures have been produced in Kenya on a limited scale but at high cost and generally for prestige projects where a special architectural effect has been required.

However recent experience in other countries has shown that standard laminated components can make a useful contribution to the building industry as locally produced alternative to imported steel sections. They are in fact as strong as steel in comparison to their weight and have distinct advantages where handling and fitting are concerned. The high cost in Kenya at present is mainly due to the high world cost of resin based adhesives and non-standard production.

In the Ivory Coast a plant exists which produces large glued-laminated beams using a species that is otherwise difficult to market overseas and has even managed to export a very large structure to Senegal against European competition.

3. Marine structures

No specific allowance has been made for coastal jetties in the Kenya Government 1974-78 development plan. One jetty at Lamu is nearing completion and a very small sum has been allocated to the fisheries department for fish landings. However the fishing industry is severely handicapped at the coast by a complete lack (except at major ports) of jetties to allow deeper draught vessels to come inshore with their catch. Along most of the coast the only vesselsoperating are the small 'ngalawas' or outrigger canoes.

.../

These can only fish close inshore leaving the more lucrative catches to foreign vessels.

What is proposed is a modular timber design which is cheap enough to be built from local development funds or on an 'harambee' basis. Difficulties with marine borers can now be overcome with heavy pressure impregnation of timbers and durability can be assured.

4. Design manual and code of practice

The various timber development projects will accumulate a large quantity of design information which will be described in various construction handbooks. These cover particular design problems. The manual will be intended to provide a general guide to design in timber in the tropics but could incorporate the various handbooks already developed.

5. Use of naturally occuring resins

Kenya produces considerable quantities of cashew nuts. Research in some countries has shown that cashew nut shells could produce an adhesive which has adequate properties for some applications in timber processing. The country also produces considerable quantities of wattle tannins and tannin extracts have also been used successfully as an adhesive in Australia.

Production of tea chest plywood is an important industry in Kenya and production of tea is planned to increase by 83.9 per cent in the period 1972/78, i.e. by 10.7 per cent per annum. This type of product does not need high adhesion properties. It is proposed to carry out research work on this topic to develop these adhesives for eventual commercial use and to test the samples at the University of Nairobi's Mechanical Engineering Laboratories. If these adhesives have sufficiently high properties they could be used for some timber engineering applications - in conjunction with nailed joints.

6. Development of low-cost kiln drying methods

The timber engineering products designed in the course of the previous two projects all call for using dry timber. One of their haracteristics is that they can be produced using non-sophisticated equipment which would be available in rural areas. Adequately sawn timber exists in these areas, but it is not available sufficiently seasoned.

The project will carry out work on the development of a solar kiln to be used in drying the timber needed for structural purposes. An experimental solar kiln was built in Uganda in the late sixties, but work on its development has been discontinued since. It is proposed to build a prototype solar kiln, and use it to obtain drying schedules for the drying of Kenyan timbers.

Project Budget

		Total m/m	Total $	1977 m/m	1977 $	1978 m/m	1978 $
10. Experts							
11.01	Structural Engineer (team leader)	18	72,000	11	44,000	7	28,000
11.02	Production Expert	6	24,000	6	24,000		-
11.03	Expert in timber adhesives	2	8,000	1	4,000	1	4,000
11.04	Consultants	6	24,000	3	12,000	3	12,000
11.05	Associate expert in timber engineering	15	p.m.	9	p.m.	6	p.m.
19	Total	47	128,000	30	84,000	17	44,000
20. Training							
21.01	Training in timber drying	3	3,150	3	3,150		-
21.02	Training in timber preservation	3	3,150	3,	3,150		-
29	Total	6	6,300	6	6,300		-
40. Equipment							
	1 ton pickup		8,000		8,000		-
	Plastic film, motors etc for prototype kiln		2,000		2,000		-
	Reference books etc.		500		500		-
	Local subcontracts		10,000		6,000		4,000
49	Total		20,500		16,500		4,000
50. Miscellaneous							
	Printing		3,000		1,500		1,500
	Travel by air to remote locations		3,000		2,000		1,000
59	Total		6,000		3,500		2,500
99	GRAND TOTAL		160,800		110,300		50,500

APPENDIX III

Draft Terms of Reference for a Feasibility Study for an Integrated Wood Processing Complex and the Subsequent Evaluation of Offers for the Establishment of the Complex

I. Introduction

The United Nations Industrial Development Organisation is to provide the Government of Kenya (through its Industrial Studies and Promotion Centre acting for the Kenya Industrial Estates Ltd.) with technical assistance in the form of a complete techno-economic feasibility study for the establishment of an integrated wood processing complex and the subsequent evaluation of offers for the establishment of the complex.

The project is to be implemented in two phases using the services of a firm of consulting engineers specialized in such studies - referred to hereafter as the "Contractor". However, UNIDO reserves the right to implement only phase 1 of its contract with the Contractor.

II. Duties of the Contractor

Phase 1: (Feasibility study)

The proposed techno-economic feasibility study is to cover the following main topics:

- assessment of the raw material situation with respect to quantity, quality and cost;
- assessment of the existing and potential demand for semi-manufactured wooden products (sawn wood) and manufactured wooden products (such as but not limited to: furniture, joinery, prefabricated wooden housing components, timber engineering products, parquet, wooden containers, miscellaneous wooden products, etc.);
- elaboration of a specific proposal for the establishment of an integrated wood processing complex.

In particular he will:

A. Raw material survey (tentative duration of field work one man/month)

1. Study the long-term availability of logs (both hardwoods and softwoods) in the various locations suggested by the Forest Department both quantitatively and qualitatively.

2. Study the infrastructure (forest roads, etc.) of these sites.
3. Estimate logging costs and equipment requirements.
4. Based on the above determine the ex factory cost of logs of various species and grades at the various possible mill sites.

B. Market survey (tentative duration of field work: two man/months)

1. Study the statistics for past production, apparent consumption 1/ and price of primary wood products (sawn wood) in Kenya and in the region with an aim to identify possible export markets.
2. Determine the growth rate and project future demand for these products.
3. Study the present production capacity for primary wood products in Kenya, and, if possible, plans for its development.
4. Undertake similar studies for furniture (in the low cost and medium price ranges) for the local markets, and eventually also for export of some specific products to neighbouring countries and the Persian Gulf.
5. Repeat this exercise for joinery (doors, windows, partitions, parquet flooring), timber engineering products (trusses, beams, etc.) and prefabricated wooden houses and their components.

C. Techno-economic feasibility study (tentative duration of field work one man/month)

Based on the information contained in the raw material and market surveys, the Contractor shall prepare a complete techno-economic feasibility study for a small, yet modern and efficient, integrated woodworking complex.

In this study he shall:

1. Recommend, based on the market survey, the capacity of the proposed sawmill and secondary wood processing plant(s) attached to it, its location as well as the product range and specifications of the proposed products to be manufactured.
2. In selecting the site for the proposed mill, the Contractor shall take into account the following factors:

1/ Apparent consumption is assumed to be production plus imports less exports.

(a) Location with respect to raw material supplies and markets (both present and future);
(b) Cost of land;
(c) Area required;
(d) Transportation;
(e) Availability and cost of fuel, power and water;
(f) Labour market (quantitative and qualitative);
(g) Township facilities.

3. Draw up the technical specifications of the equipment needed, (this should be detailed enough to serve as a basis for a call for tenders) as well as the characteristics of the building.

4. Evaluate the manpower requirements and training needs for key personnel.

5. Estimate the capital requirements (both in Kenyan shillings and foreign currency) for the proposed integrated plant.

6. On the basis of the above, determine the project's profitability and its impact on the local economy.

7. Determine the effects that changes in the main cost factors (cost of equipment, raw materials, labour, interest rates) and selling price would have on the project's profitability - i.e. undertake a "sensitivity analysis."

8. Recommend all measures that will have to be taken by the management of the plant to be erected, the Kenya Industrial Estates Ltd., the Forest Department, and other Government and local bodies, as well as eventually by international organizations to ensure the speedy implementation of the project.

D. Training

Train counterparts which the Industrial Survey and Promotion Centre may wish to send to the Contractor's Head Office in all technical aspects related to the above work.

Phase 2: (Evaluation of offers)

A. Field work in Kenya (tentative duration one man/month)

1. Discuss with the Kenyan authorities and the owners of the proposed complex any modifications that the latter have decided to introduce in the proposal made by the Contractor in his final report for Phase 1.

2. Discuss all details concerning buildings and site infrastructure, and clarify all points with the local civil engineer, architect and contractor retained for the project.

3. Make a preliminary assessment of the offers received and discuss it with the Kenyan authorities and the owners of the complex, indicating to them the methodology proposed to be used and identifying those offers which need clarification and/or completion.

B. Work to be done at the Contractor's Head Office

1. Approach those bidders who have submitted incomplete and/or unclear offers and obtain the complementary information.

2. Make an in-depth study of the offers received for each piece of equipment and/or each production line and/or each turnkey proposal; indicating the advantages and disadvantages of each machine selected, as they relate to conditions prevailing in Kenya, and justify the choice made.

3. Select for each machine the appropriate accessories and/or spare parts which must be purchased with it.

4. Update the feasibility study prepared in Phase 1 to conform with the actual equipment costs and labour requirements of the plant that will be erected and re-calculate the project's profitability.

5. Train the counterparts which the Industrial Survey and Promotion Centre may wish to send to the Contractor's Head Office in all technical aspects related to the above work.

III. PROPOSED IMPLEMENTATION

Phase 1 (Feasibility study)

The Contractor is to delegate a team of qualified specialists to Kenya, within one month of the submission of the contract to him by UNIDO for his signature, to proceed with the field work foreseen for Phase 1 above.

This team will comprise - but not be limited to - specialists in the following fields: forestry, logging, marketing of primary and secondary wooden products, sawmilling, production of furniture, joinery and other wooden products. The team leader (and key members of the team) shall visit UNIDO in Vienna on their way to and from Kenya for briefing and exchange of views.

Five copies in English of the draft report are to be submitted to UNIDO within two months of the return of the team from Kenya.

Thirty copies of the Final Report for Phase 1 (also in English) are to be submitted to UNIDO within one month of receipt of UNIDO's comments on the draft report.

Phase 2 (Evaluation of offers)

The Final Report on Phase 1 will be studied by the Kenyan authorities and the interested investors who shall decide whether to proceed with the project or not.

UNIDO shall notify the Contractor of their decision on whether they wish to implement Phase 2 or not within a maximum of six months from the date of submission of the final report and indicate a tentative date for the start of the field work for Phase 2.

If the Kenyan authorities decide to proceed with the project proposed in the Final Report of Phase 1, they shall issue a call for tenders to supply the equipment for the proposed complex. This shall be either on a turn-key basis for the whole plant (or whole production lines), or through the purchase of individual machines - or a combination of both alternatives - for all or part of the proposals made.

In case Phase 2 will be implemented, the Contractor shall make available a team of specialists in the primary and secondary wood processing industries being established, wood technology, mechanical and electrical engineers and specialists in procurement of equipment to to evaluate the bids received by the Kenyan authorities.

The team leader (and key members of the team) shall visit UNIDO Headquarters in Vienna for briefing, debriefing and exchange of views on their way to and from Kenya.

They shall submit a draft report, in five copies in English, within two months of their return from Kenya, and the Final Report on Phase 2 in ten copies in English within one month of receipt of UNIDO's comments.

IV. BACKGROUND INFORMATION 1/

Kenya has considerable forest resources. Natural forests - comprising mainly hardwoods - cover an area of hectares, and man-made forests - consisting mainly of plantations of cypress and pines - cover hectares. In recent years annual removals from the forests were m3 of hardwoods and m3 of plantation softwoods. It is estimated that the allowable annual cut of plantation softwoods will increase by in the next five years as plantations mature.

Kenya's sawmilling industry consists of about small and medium sized mills producing an average of m3 of sawn wood and employing on the average persons. There are only mills which could be considered large. These produced an average of m3 each. The recovery rate (or yield) from these smaller mills is notoriously low. Most mills use obsolete machines, and little effort is made to utilize the residues rationally. None of the smaller mills sell kiln dried sawn wood, and wood preservation is not common.

On the other hand, Kenya's secondary wood processing industry is fragmented, and many of the smaller firms do not qualify as "industrial plants".

Kenya Industrial Estates Ltd., a Government supported corporation, wishes to promote the establishment of small, yet modern and efficient, integrated woodworking complexes to be established in rural areas.

1/ The uptodate information to be supplied with the request

Assistance is sought from UNDP/UNIDO to prepare a detailed techno-economic feasibility study for such a complex, and to evaluate the offers for the equipment as they are received.

APPENDIX IV

PERSONS MET BY MR. A. V. BASSILI DURING HIS MISSION TO KENYA, 26 NOVEMBER TO 7 DECEMBER 1975

UN, UNDP and specialised agency staff

Mr. K. H. Englund	Resident Representative, UNDP
Mr. W.R. Millager	Senior Industrial Development Field Adviser, UNIDO
Mr. J. E. Collins	Principal Expert, Structures Engineer, UNIDO
Mr. K. Petersen	Associate Woodworking Expert, UNIDO
Mr. E. W. Esperhahn	Team Leader, ISIC Project, UNIDO
Mr. O. Karsegard	Project Manager, Export Promotion Project, UNCTAG/GATT ITC
Mr. H. Bokker	Product Adaptation Expert, Export Promotion Project, UNIDO

Officials of the Kenya Government and affiliated bodies

Miss E. K. Kimweli	Official of the Treasury (liaison with UNDP)
Mr. O. Mburu	Chief Conservator of Forests, Forest Department, Ministry of Natural Resources
Mr. J. Wawiye	Conservator of Forests, Forest Industries Department) Ministry of Natural Resources
Mr. O. Mwangola	Counterpart to UNIDO Experts - Bridge Project
Mr. Mutuku	Counterpart to UNIDO Experts - Bridge Project
Mr. E. C. Kohut	Director, Industrial Survey and Promotion Centre
Mr. A.M. Shikulo	Deputy Director, Kenya Industrial Estates Ltd.

Other persons

Prof. R. Patel,	Dean, Faculty of Engineering, Nairobi University
Prof. P.A. Campbell	Professor of Civil Engineering, Nairobi University
Mr. M. M. Barrat	Plant Manager, Sokoro Fibreboards Ltd.

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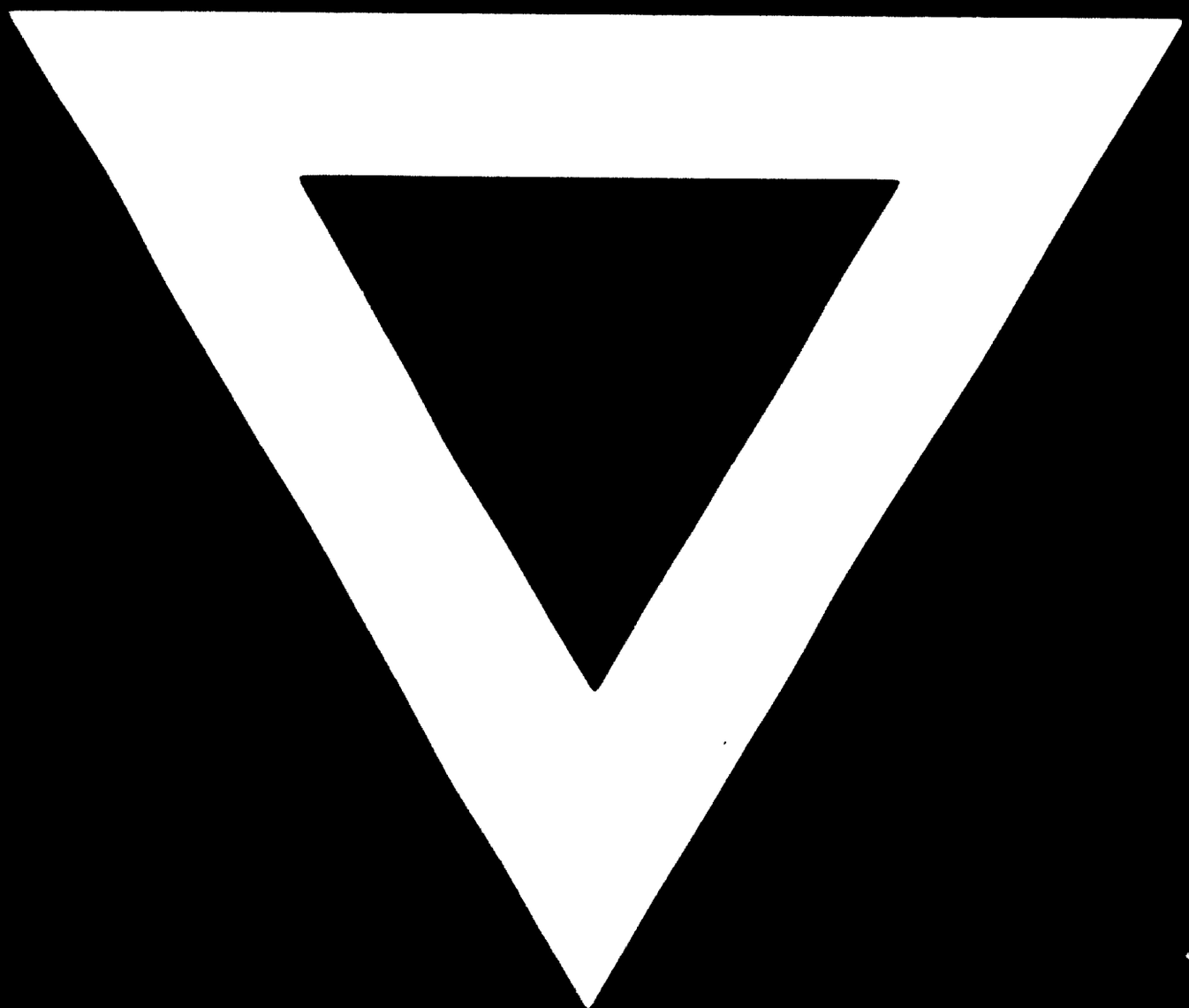

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