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DP/ID/SER.B/617
13 June 1988
ENGLISH

ASSISTANCE TO THE FURNITURE AND JOINERY INDUSTRY

SI/TON/86/873

THE KINGDOM OF TONGA

Terminal Report*

Prepared for the Government of the Kingdom of Tonga
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Horatio P. Brion,
Consultant in Furniture Production

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Vienna

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EXPLANATORY NOTES

The monetary unit of the Kingdom of Tonga is the Pa'anga or Tongan Dollar. The official rate of exchange for the Tongan Dollar was T\$ 1.42 = US\$1.00, at the time of this Mission.

The following acronyms are used in this Report :

CTA	-	Chief Technical Adviser
ITC	-	International Trade Center
UNDP	-	United Nations Development Programme
UNIDO	-	United Nations Industrial Development Organization

A hyphen between numbers (e.g., 1-5) indicates the full range involved, including the beginning and end points.

A full stop (.) is used to indicate decimals.

A comma (,) is used to indicate thousands, millions, billions.

The following symbols and/or abbreviations are used in this Report :

"	-	inch
'	-	foot (or feet)
%	-	"per centum", meaning 1/100
BF	-	Board Feet, unit measure of lumber volume in the United States System
BTU	-	British Thermal Unit, unit of heat energy in the British System
cu.m.	-	cubic meter
EMC	-	Equilibrium Moisture Content
etc.	-	"et cetera", meaning "and so forth"
Ltd.	-	"Limited", a term denoting limited nature of ownership of a business firm
RPM	-	revolutions per minute
TCT	-	Tungsten-Carbide-Tipped

vs. - "versus", meaning "as compared to" or "against"

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ASSISTANCE TO THE FURNITURE AND JOINERY INDUSTRY
OF THE KINGDOM OF TONGA

I. INTRODUCTION

1.1 PROJECT BACKGROUND

Upon request by the government of the Kingdom of Tonga, the UNIDO assigned Experts on the design and manufacture of furniture and joinery products during the first quarter of 1987. One Expert was assigned for a period of three months to help improve the manufacturing techniques of the furniture and joinery industry of the country. The other Expert, assigned for two months, provided technical assistance in the design of furniture products being produced in the country. The present mission, scheduled for one month is a follow-up on the previous two missions.

1.2 PROJECT OBJECTIVES

The present mission has for its objectives the same general objectives of the missions sent by UNIDO under SI/TON/86/873 during the previous year. However, this mission placed emphasis on the following aspects of manufacturing operations:

- plant lay-out
- selection, maintenance and repair of machinery and cutting tools
- production planning and control
- costing.

Based on preliminary findings on the status of the furniture and joinery industry of the Kingdom, the Expert conducted a short seminar at the end of the mission for key personnel of the industry to compliment the technical know-how transferred to the industry during the previous missions and the "On-the-Spot Consultancy Services" provided under this mission.

Secondary objectives of this Project include:

- study on the possibilities of establishing aluminium joinery
- study on the possibilities of establishing rattan furniture manufacturing industries
- study on the processing and utilization of coconut wood.

Annex I is a copy of the Job Description covering the present mission.

1.3 PROGRAM OF ACTIVITIES

After the usual initial rounds of courtesy calls to pertinent government officials, the Expert, in cooperation with Executives of the Ministry of Labour, Commerce and Industries, and with the assistance of Mr. Desh B. Sahae, UNIDO Chief Technical Adviser to the Ministry, formulated the following program of activities:

January 21-22, 1988 - Short visits to Furniture and Joinery Shops in Nuku'alofa, Tongatapu and vicinity.

(Note: These visits were deemed necessary in order to give the Expert a first-hand knowledge on the current status and common problems of the furniture and joinery industry in the country, since all furniture and joinery manufacturing activities, except for two workshops located in the outlying islands, are concentrated in the capital city of Nuku'alofa and environs. The initial findings during these short visits to the furniture and joinery workshops also served as the basis for allocating time to each shop for "On-the-Spot Consultancy Services".)

Jan. 25 - Feb. 12 (a.m.) - Provide "On-the-Spot Consultancy Services" to the furniture and joinery shops in the country.

Feb. 12(p.m.) - Feb. 14 - Preparations for the Seminar/Workshop to be held on the following Monday and Tuesday, were completed.

February 15 and 16 - UNIDO Seminar on Furniture and Joinery Production, conducted in cooperation with the Ministry of Labour, Commerce and Industries, Kingdom of Tonga.

February 17 - Evaluation of the mission and discussions on follow-up activities with key Officers of the Ministry of Labour, Commerce and Industries and the UNIDO Chief Technical Adviser.

February 17 (p.m.) - Departure for Suva, Fiji

II. THE FURNITURE AND JOINERY INDUSTRY OF TONGA

2.1 CURRENT STATUS

Based on observations made during the various plant visits conducted by the Expert covering all (except two) of the manufacturing establishments in the furniture and joinery industry of the Kingdom of Tonga, the following characteristics best describe the current status of the industry:

- Although a majority of the furniture and joinery manufacturing shops showed some degree of mechanization, the production techniques still are dominated by artisan and crafts production practices. Whatever industrial machines are available are mostly used as tools rather than industrial machines.
- Machining precision is still at a low level. Use of production jigs and fixtures is minimal. The few shops that could engage in limited serial production when the volume of current orders allow doing so produce furniture of low quality (compared to Southeast Asian furniture products) at low output levels.
- Basic concept of material quality control is not practiced for the main reason that all the materials available to the industry are or have been imported for the construction and building industry, and more often than not, have quality and specifications not ideally desirable for the production of furniture and joinery products. It appears that the market is forced to accept the poor quality of locally manufactured furniture products.
- The principal labour source for the industry is still the "furniture carpenter", who usually is a carpenter drawn from the construction industry and made to work in the production of furniture and joinery items.
- The industry is still in the primitive stage as far as finishing operations is concerned and majority of the

furniture manufacturers still use long drying finishing materials, such as natural varnish and shellac.

- On the average, techniques of maintaining machines and cutting tools in good operating condition is below the standard used in similar industries in more advanced developing countries like Thailand, Malaysia, Indonesia and the Philippines.

2.2 INDUSTRY SURVEY

To obtain a more detailed understanding of the current status of the furniture and joinery industry of the country, a small industry survey was conducted during the first two weeks of the mission. A survey form (see Annex II) was used as the survey vehicle. Out of a total of 15 sets of survey forms given out to all known or registered furniture and joinery manufacturer in the country, only three firms responded and returned the survey form with the desired complete data, while another two firms responded with incomplete answers to the survey questionnaire.

The response is considered too small to allow the Expert to draw a fair and reliable representative picture for the industry.

Some significant changes in the composition of the industry took place since the end of the first two missions sent by UNIDO during the first quarter of 1987. A number of establishments have stopped operations:

- The Pacific Construction, Ltd., located in Tongatapu, producers of household furniture as a support activity to its building construction business, stopped operations for unknown reasons.
- the Matheus Associates, located at the Small Industry Centre in Nuku'alofa, producer of wooden toys for export, stopped operations allegedly because of marketing problems.
- the Joinery Division of Fua and Lawton, Ltd., building contractors, stopped operations temporarily due to change in management.

On the other hand, a number of new furniture shops started operations during the same period:

- T.N.T. Builders has developed its furniture production unit in support of its building construction activities.
- Lolohea Enterprises, has changed its name to Esiaola Enterprises and has expanded to a level which employs four people and the addition of two machines, the jointer/surfacers and the 1/4-inch bandsaw.
- Manava'ofa Enterprise, in Pangai, Ha'apai group, started producing furniture and joinery products with the help of the Industrial Promotions Office, to meet the needs of the area.

2.3 MAJOR INDUSTRY PROBLEMS NEEDING IMMEDIATE SOLUTIONS

Based on the observations made by the Expert during the first two days of short visits to about ten furniture and joinery manufacturing shops in Nuku'alofa and vicinity, the following problems appear to be a common handicap to the desired development of the furniture and joinery industry in Tonga :

2.31 Use of Inadequately Seasoned Lumber

Inadequately seasoned lumber is the principal material input of the industry. According to complaints of some firms which imported kiln-dried lumber, the shipment was received in Nuku'alofa as wet sawn timber. A visit to the construction materials and supplies warehouses of Burns Philp, Ltd., and the Commodities Board of Tonga, revealed the reasons why even kiln-dried lumber shipped from foreign sources will be wet lumber when received in Nuku'alofa: It is due to improper storage and handling practices of the material.

2.32 Improper Maintenance of Production Machines

This problem has greatly contributed to the low output derived from the use of the existing machinery. Furthermore, precision machining could not be attained to the desired degree in view of the faulty components of most of the machinery which were observed in the shops visited by the Expert.

2.33 Inadequate Maintenance of Cutting Tools

Except for the MAFF Coconut Wood Processing Centre, circular saw blades, planer knives and shaper knives are not properly maintained in the shops visited by the Expert. Thus, surfacing and profiling quality is low and usually has to rely on further sanding activities to attain the desired smoothness or profile of the workpiece.

2.34 Lack of Knowledge on Proper Surface Preparation

Surface defects brought about by nicks or flaws on the planer knives are corrected on the stroke sander. Thus, it was a common experience to see stroke sanders with sanding belts of grits as coarse as 100 or 120 when normal woodworking practices would call for 180 grit as the coarsest sanding belt to be used on the stroke sander. This situation also shows that there is a lack of knowledge on the proper use of the sanding machine.

2.35 Lack of Knowledge of Finishing Materials Systems and Techniques of Application

The most common finishing material used in the industry is natural varnish which is a long-drying material. Thus, any output advantage gained during machining is lost at the finishing end where the varnish usually dries more than 36 hours after application.

2.36 Weakness or Absence of Middle Management and/or Floor Supervision

The more common organizational set-up shows the direct supervision from top management level especially in firms where there are very few workers. The problem becomes more acute when the firm embarks on an expansion program. In some cases where there is "Floor Supervision", the "Foreman" acts more like a "Lead Man" and decision on operational matters is left to the owner/manager.

2.37 Inadequate Documentation and Information Systems

Except in three of the shops visited, all furniture and joinery manufacturing shops did not have a reliable or responsive feed-

back system from operations. This prevents the owner/manager from knowing exactly how much the production cost of a particular piece of furniture was. Consequently, costing based on such faulty gathering of cost elements becomes also unreliable.

2.38 Absence of Wood Residue Collecting and Disposal System

In all the factories visited only one shop has a pneumatic type of wood residue collecting and disposal system. This explains why local furniture manufacturers could hardly attain the precision required for higher quality furniture.

III. "ON-THE-SPOT" CONSULTANCY SERVICES

Two days were spent at one of the furniture shops while one day was given to each of the other shops. Because of time pressure there were three shops which were not given "On-the-Spot" Consultancy Services. These are :

- The Public Works Joinery Shop
- Lacy Lil (a shop specializing in upholstered furniture)
- The Oceanic Industrial Enterprise which manufactures tubular type of metal furniture with wooden seats and back rests.

The results of this aspect of the mission are recorded in Annexes III to XII, inclusive.

IV. THE SEMINAR/WORKSHOP ON FURNITURE/JOINERY PRODUCTION

4.1 OBJECTIVES

Complimentary to the "On-the-Spot" Consultancy Services, and the transfer of technical know-how conducted during previous UNIDO missions to upgrade the furniture and joinery industry of Tonga, a short seminar/workshop was conducted with the principal aim of exposing the participants to the basic concepts of good quality and high volume production techniques. The topics presented and subsequently discussed include mostly manufacturing and management concepts which could not be taken up during the "On-the-Spot" Consultancy Services.

Among others, the topics include the following:

- General production management concepts as applied to the furniture and joinery industry
- Documentation and information systems for small-scale furniture and joinery shop
- Basic communications problems
- Costing techniques for small-scale furniture and joinery enterprises
- Coconut wood and other non-traditional wood material input for the industry
- Jigs and fixtures in small-scale furniture and joinery production
- Basic quality control materials and production supply specifications for small-scale furniture and joinery shops
- Selection of machinery, plant and equipment lay-out and low cost automation for small-scale furniture and joinery shops

4.2 PROGRAMME OF ACTIVITIES

The two-day program of activities under the seminar/workshop is given in Annex XIV. Lectures on the selected topics were given by the Expert, as the only resource person and lecturer. Discussions were conducted after each of the topics were presented by the lecturer. Other activities to bring home to the participants' minds the concept and ideas covered during the lecture include the following :

- group dynamic exercises to illustrate the pros-and-cons on multi-level management and supervisory organizational set-up.
- plant visits to three selected furniture and joinery workshops namely: Commodities Board Joinery Workshop Tonga Wood Products, Ltd., and T.N.T. Builders Enterprise, all of which are located in Nuku'alofa and vicinity.

The Commodities Board Joinery Workshop provided illustrations of:

- (a) faulty machinery lay-out
- (b) safety in machining operations as brought about by an incident when a shaper knife flew out of the cutterhead and punched a hole on the factory wall opposite the machine about ten feet above the factory floor. Apparently, the shaper knife was not properly set on the shaper cutterhead.

Tonga Wood Products provided two specialized types of woodworking machines, namely:

- (a) a portable tenoner saw arrangement, and
- (b) a locally-built lathe mounted with a set of compound lathe knives.

T.N.T. Builders Enterprise provided the participants with the demonstration of a combination woodworking machine capable of performing five different operations, namely: jointing/surfacing, thickness planing, edge shaping, cross or rip-sawing and mortising.

The lecture on coconut wood and other non-traditional wood materials was complemented by an audio-visual presentation on the processing and utilization of coconut wood in house construction and furniture and joinery production. The colored slides were taken during the conduct of a UNIDO-sponsored project (SI/PHI/83/801), in cooperation with the Southern Philippines Development Authority, in the city of Davao in the year 1984, where a low cost house made of 90-95% coconut wood was constructed using existing wood processing facilities in the area.

Workshop project assignments were given during the first day of the seminar when the seminar participants were divided into five groups. The idea is to provide an opportunity for the participants to apply the knowledge that they have gained during the two days seminar to the solution of problems encountered in actual situations. Solutions to the workshop assignments were presented during the afternoon of the last day of the seminar.

The seminar/workshop was given ample publicity over the radio and the press. Annex XIV is a news item published by the Tonga Chronicle in its issue of Friday, 12 February, announcing the conduct of the seminar/workshop and inviting persons or entities who are interested in the Development of the industry to attend. Similar announcements were made twice a day over the local radio during the period 12-14 February 1988.

4.3 THE CONDUCT OF THE SEMINAR/WORKSHOP

The seminar/workshop was given official importance by the presence of the Acting Secretary, Ministry of Labour, Commerce and Industries, Mr. Robert Foliaki, who gave the keynote address on the opening day. In the same manner, the Administrative Officer of the Ministry, Ms. Saane, gave the closing remarks.

Annex XVI gives pictorial record (see Figures 57 to 67) of the seminar/workshop proceedings, including the coconut wood products put on display by the MAFF Coconut Wood Processing Centre. Annex XVI is a list of participants in the seminar/workshop, together with the firms they represented. The seminar/workshop course assignments provided a very good measure on the degree to which the participants were able to absorb or assimilate the ideas and concepts presented during the lecture and discussions. Annex XVII gives the course problem and the five different Game Plans, one of which was assigned to each of the five groups of seminar participants. A realistic

air was provided for the presentation of the course assignments by the presence of Ms. Emiline Tuita, Senior Economist of the Tonga Development Bank, who was named the Chairperson of the Committee on Evaluation of Workshop Project Assignment Presentation, with Messrs. Falekava T. Kupu, Assistant Secretary of the Ministry of Labour, Commerce and Industries, Desh B. Sahae, UNIDO Chief Technical Adviser and Horatio P. Brion, UNIDO Consultant on Furniture and Joinery Production as members of the Committee. During the deliberation of the Committee it was pointed out by the Chairperson that the inherent weakness of the industry in Tonga was highlighted by a similar weaknesses in the presentation of the solutions to the problem on Personnel Table of Organization and the problem on quality control procedures for the products of the mythical furniture and joinery production firm, the Tonga Woodworks, Ltd. The members of the Committee agreed that this was a point well taken and should be given due consideration in any follow-up activity by the Ministry. The Committee's final decision was to recommend approval of the loan.

Hand-outs were also given each of the participants to serve as reference materials during and after the seminar/workshop. These hand-outs include:

- an illustration of the design of a machining jig, i.e., a jig for box-planing the taper on several table legs simultaneously (see Annex XVIII); and
- excerpts from source documents, mainly UNIDO publications, covering selected aspects of the furniture and joinery industries. (See Annex XIX for a list of the source documents.)

V. ALUMINUM JOINERY PRODUCTION

5.1 CURRENT STATUS

Aluminum joinery products, particularly doors and windows, are currently being manufactured by the Jones Industries, Ltd. The firm enjoys more or less a monopoly of this particular sub-sector of the joinery industry. Considering the small population of the country, and the small number of families in the high-income bracket, it appears that there is a limit to the volume of business that can be generated for aluminum joinery products. According to executives of the Jones Industries, Ltd., about 80% of the shop output of aluminum doors and windows are installed in residences while 20% of the output are installed in institutions and other public buildings. Only residences belonging to the upper income bracket of the Tongan population can afford the high prices of the aluminum doors and windows. Another point to be considered is that the population of Tonga has been almost at a stand still during the last two years at around 100,000 people with about 20% of the population concentrated in the capital city of Nuku'alofa.

5.2 COMPARATIVE COSTS: WOODEN vs. ALUMINUM JOINERY PRODUCTS

Executives of the Jones Industries, Ltd., indicated that aluminum doors and windows cost roughly 1.75 times their corresponding sizes in wooden doors and windows. However, they claim that there are three major characteristics of aluminum joinery products that overcome the higher cost of the product, namely :

- aluminum windows and doors have better water-tight properties than wooden doors and windows
- aluminum doors and windows are expected to last at least 5 times as long as their wooden counterparts under similar weather conditions and manner of use
- aluminum doors and windows help upgrade the image of the building or the house, and of course, the social prestige of their owners.

5.3 RECOMMENDATIONS

In view of the foregoing points, the Expert thinks that further promotion of the manufacture of aluminum joinery products should take into consideration the size of the market and the small portion of the Tongan society which could well afford the cost of aluminum joinery products. A formal study of the Tongan market for aluminum joinery products is indicated.

VI. RATTAN FURNITURE MANUFACTURING

6.1 CURRENT STATUS

There is no known rattan furniture manufacturing activity any place in the Kingdom of Tonga. Existing rattan furniture in private homes have been imported from other countries. There is also no known source of rattan poles good for rattan furniture manufacture in the existing forests of Tonga. Thus, the major ingredient for the development of the rattan furniture manufacturing industry in the country has to be imported.

6.2 SOUTH PACIFIC REGIONAL TRADE AND ECONOMIC COOPERATION AGREEMENT (SPARTECA)

SPARTECA, with Australia and New Zealand as the principal partners, together with a number of South Pacific countries as members, allow duty free importation of certain manufactured products into Australia and New Zealand, provided such products conform to certain conditions of manufacture as specified in the agreement. Certain sectors of the Tongan manufacturing industry, particularly those who have been exposed or had experience in the booming rattan furniture manufacturing industry of Southeast Asia, think that SPARTECA offers ample profit opportunity for Tongan entrepreneurs to import rattan poles, convert them into rattan furniture in Tonga and then export the finished furniture products to New Zealand or Australia.

6.3 RECOMMENDATIONS

Any decision to encourage or promote the development of a rattan furniture manufacturing industry in Tonga should consider the labour-intensive nature of the industry. Current wage levels in Tonga are relatively higher (based on equivalent US Dollar exchange rate) than corresponding wage levels in the rattan-rich countries of the Philippines, Indonesia, Malaysia and Thailand. In this manner, it appears that a very thorough and serious study of the advantages offered by SPARTECA as compared to the resources of Tonga should be made before a decision to promote and encourage rattan furniture manufacturing in the country is officially launched.

VII. UTILIZATION OF COCONUT WOOD IN FURNITURE AND JOINERY PRODUCTION

7.1 CURRENT STATUS

The manufacture of coconut wood into furniture and joinery items in Tonga is still a very dormant activity. Tonga has gained initiative in the production of construction items like roofing tiles, weather boards and framing components out of coconut wood. Further development of the industry to produce furniture or more advanced forms of joinery products (doors, windows, etc.) is handicapped by lack of kiln-drying facilities.

7.2 MAJOR PROBLEMS

In addition to the unavailability of kiln-drying facilities, the small size of the Tongan market presents a challenge to the promotion of the manufacture coconut wood into furniture and joinery products. Coconut terms of "import substitution" to the currently imported timber species.

7.3 DEVELOPMENT NEEDS AND RECOMMENDATIONS

It appears that a pre-requisite to full-scale activities to develop the coconut wood utilization for furniture and joinery purposes should start with an educational and promotional campaign to win the confidence of the Tongan population in coconut wood furniture and joinery products. Exploratory talks with local furniture manufacturers indicate that incentives provided by the Government to firms converting coconut wood into secondary wood products may help initiate industry moves in the desired direction. Furthermore, the industry wishes to be assured of a reliable and continuous supply of coconut lumber, since additional investments (in terms of TCT cutting tools and the corresponding tool maintenance equipment) will have to be made. This can be attained through a more intensive support of the current coconut replanting programme.

It appears that the MAFF Coconut Wood Processing Centre's Joinery Workshop could be used as the nucleus of any promotional and development programme for the use of coconut wood as a material in the production of furniture

and joinery products, provided its facilities are up-graded to meet the needs of such promotional/development activities.

Considering that the Kingdom of Tonga is a timber deficit country, the use of coconut wood for the production of furniture and joinery products deserves vigorous support from the Government sector.

VIII. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

The previous chapters of this Report indicate that the furniture and joinery industry of the Kingdom of Tonga is in state of critical transition. It is now at that point of the industry's development where it is beginning to rise out of the artisan and craftsman type of production activities into one which is beginning to be more mechanized, in the industry's effort to improve both its quality and output. The other side of the picture presents a handicap to the further mechanization of the industry: the small size of the domestic market for furniture and joinery products and the lack of appreciable timber resources. Thus, it is believed that the Tongan furniture and joinery industry greatly needs technical assistance at present in order for it to develop along desirable patterns so that the industry could best serve the interests of the people of Tonga.

8.2 RECOMMENDED FOLLOW-UP ACTIVITIES

"On-the-Spot" Consultancy Services, as provided under this mission to the furniture and joinery manufacturing shops of Tonga, was well received by the owner/managers and leaders of the industry in the country. They have expressed their desire to have a repetition of the consultancy technique together with a seminar/workshop which aim to develop the ability of key personnel of the industry to apply the ideas and concepts brought up during both the consultancy services and the seminar/workshop undertaken during this mission to the daily activities in their respective factories.

It is therefore, recommended that an immediate follow-up activity be considered by the UNIDO, should it be requested by the Government of the Kingdom of Tonga, to provide the furniture and joinery industry of the country with consultancy services in the following aspects:

- serial production techniques;
- proper maintenance and repair of woodworking machines equipment and cutting tools ;
- the design, fabrication and use of production jigs and fixtures;
- proper choice and application techniques of production adhesives ;
- proper selection and use of production abrasives ;
- such other basic industrial practices that will help assure the continued, correct and effective use of the technical know-how transferred to the Tongan industry by means of "On-the-Spot" Consultancy Services and the conduct of seminar/workshop on selected topics of the industry.

It is recommended that the immediate follow-up activity be composed of missions involving the recruitment of one Expert in furniture and joinery production and one Expert in woodworking plant maintenance and repair activities. The Experts are expected to render services to the Tongan industry for a total of three man-months each. Annex XX and Annex XXI, give the respective job description for the two posts recommended as the follow-up activities. This proposed mission will also be expected to recommend the contents and manner of delivery of further technical assistance needed by the industry.

ANNEX I

JOB DESCRIPTION

(SI/TON/86/P73/11-51)

- POST TITLE** : Consultant in Furniture Production
- DURATION** : One (1) month
- DATE REQUIRED** : As soon as possible
- DUTY STATION** : Nuku'alofa, with possible travel in the country.
- PURPOSE OF PROJECT** : To upgrade the furniture and joinery industries through the use of improved designs and production facilities and to investigate the possibilities of establishing aluminium joinery and rattan furniture manufacturing industries, processing and use of coconut wood.
- DUTIES** : The expert will be assigned to the Industry Division of the Ministry of Labour, Commerce and Industries. The expert will, in close cooperation with the counterpart staff, agencies, institutions and other bodies, provide assistance to the twelve units engaged in the manufacture of furniture and joinery as determined by the Ministry. Specifically, he will be expected to:
- complement the assistance provided to the Tongan Furniture industry by the two Experts already fielded, namely in the fields of plant lay-out, selection of equipment, production planning and control and costing.
 - conduct a short seminar for the managers at the end of his stay and prepare a report covering his activities and complementing the existing three reports prepared by the project.
- QUALIFICATIONS** : Wood technologist or engineer with long experience in operating small to medium scale furniture and joinery manufacturing at the production (shop floor) level.
- Experience in developing countries and in production of rattan furniture and in the processing of coconut wood desirable.
- LANGUAGE** : English

BACKGROUND
INFORMATION

There are about twelve furniture and joinery making units in Tonga. These include an export oriented wooden toy industry and the timber joinery factory of the Commodity Board. Except for two mills which are located in Vava'u, the others are all located at Tongatapu - the main island of Tonga. Most of the existing industries are labour-intensive and engaged in the manufacture of simple type of furniture for domestic use, schools and churches. The designs and quality of the products are poor and need improvement, especially for furniture for household use. The Tongan furniture and joinery industry has not been doing well for some time. In spite of a number of industries engaged in those lines, Tonga still spends a substantial amount on imported furniture and joinery as the designs, quality and finish of the locally made furniture are not up to the mark in comparison to imported items.

The timber joinery factory of the Commodity Board was set up in the 1960's and needs improvement in production facilities if it were to manufacture furniture with export potential. Many of the existing industries badly need assistance in design improvement, better method of production, guidance for more suitable technology and equipment and training on the spot, in order to increase the domestic market share of the locally made furniture.

Moreover, the Tonga government wishes to diversify the production of their furniture and joinery industry by introducing aluminium joinery, exploring the possibility of manufacturing rattan furniture processing and use of coconut wood.

ANNEX II

UNIDO Project SI/TCN/86/873
in cooperation with the Government of
Kingdom of Tonga
Ministry of Labour, Commerce and Industries

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SURVEY ON KILN-DRYING NEEDS AND DEVELOPMENT PLANS,
SECONDARY WOOD PROCESSING INDUSTRY OF
THE KINGDOM OF TONGA

- 1.0 Name of Firm: _____
- 1.1 Address: _____
- 1.2 Tel.No.: _____ 1.3 Telex No.: _____
- 2.0 Name of Responding Officer: _____
- 2.1 Position/Title : _____
- 3.0 Sawn Timber Input: (Annual Average, last five (5) years)

3.1

Timber Specie (Local Name)	Board Feet Per Year	
	1" Boards or Thinner	Thicker than 1" but less or equal to 2" thick
_____	BF	BF
_____	BF	BF
_____	BF	BF
_____	BF	BF
_____	BF	BF

- 3.2 Type/Quantity of Products Manufactured: (Annual Average, last five years, if possible, if not, 1987 output)

<u>Product Type</u>	<u>Quantity</u>	<u>Wood Specie</u>	<u>Sawn Timber Used</u>
Household Furniture	_____	_____	_____
Office Furniture	_____	_____	_____
Joinery Products (Doors, Jambs, etc.)	_____	_____	_____
Mouldings and Moulded Items	_____	_____	_____
Others (Specify):	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

6.0 Current Labour Force

6.1 Managerial and Supervisory

<u>No. of Men</u>	<u>Title/Brief Description of Position</u>
_____	_____
_____	_____
_____	_____
_____	_____

6.1 Work Force

<u>No. of Men</u>	<u>Labour Grade</u>
_____	Highly Skilled
_____	Skilled
_____	Semi-Skilled
_____	Unskilled

7.0 Please submit a SKETCH showing your existing factory and machinery lay-out.

Kindly RETURN the filled Survey Form to:

Mr. DESH SAHAE, UNIDO Chief Technical Adviser
Ministry of Labour, Commerce and Industries
Nuku'alofa, Tongatapu, Tonga

ANNEX III

ON-THE-SPOT CONSULTATION SERVICES

O.G. SANFT ENTERPRISES, Furniture Division
(25 - 26 January 1988)

A. GENERAL

- (1) In view of plans to move the factory to a bigger lot, the following were discussed:
 - (a) Guidelines for selection of machinery and equipment ;
 - (b) Guidelines for machinery lay-out ;
 - (c) More applicable Table of Organization, echelons of command ;
 - (d) Costing system, related to realistic and timely data feed-back ; and
 - (e) Choice of export (foreign) partner - do's and don'ts.
- (2) Desirability of division of labour and work specialization.
- (3) Functions of basic organizational components, duties and responsibilities of middle management and floor supervisory staff.
- (4) Raw materials problems - availability and quality assurance (moisture content, etc.)

B. TECHNICAL (See Figures 1 to 12)

Suggestions/recommendations were given on the following :

- (1) Solutions to sanding belt splicing problem.
- (2) Ideas on design of sand-belt skiving machine (using router table of multi-purpose jointer/planer/router machine together with existing portable disc-sanding machine to be mounted over router table).
- (3) Problems on Combination Jointer/Planer/Router (See Figures 1 and 2)
 - (a) "Heeling" on long work pieces: adjustment of infeed - outfeed rolls and fabrication fo "WORK HORSES" to support long work pieces at the same height as each end of machine bed.
 - (b) Proper use of knife-setting gauge.
 - (c) The need to check the set of each knife out of the cutter-head by means of simple "pointed wire" accessory for leveling the planer knives.

- (d) Feeding technique to use whole length of knives (when either jointing or thickness planing) and attain uniform thickness on planing jobs.
- (e) Necessity of regularly checking and cleaning "infeed - outfeed" rollers - how to do it without damaging surfaces of rollers.
- (f) Need for regular grinding and honing of knives - use of proper size spanner to remove knives from cutterhead.
- (g) Desirability of a wood residue collecting and disposal system.
- (h) Adjustment of set-screws to tighten sliding shims to prevent lateral movement of routing table.
- (i) Discussed installing/mounting a knife grinding fixture which is available but not being used - apparently due to need for more knowledge of grinding stones and grinding techniques.
- (j) Use of "BOX PLANING" jig to put taper on a number of table legs simultaneously. (See Annex XVIII).

(4) Combination Table Saw and Vertical Spindle Moulder (VSM or Shaper) (See Figure 3)

- (a) Showed them how to check "correct" grinding of TCT sawblade
 - use of "wire-pointer" fixture to determine "trueness" of side grinding of sawblade; and
 - use of straight-edge to check "levelling" of circular sawblade.
- (b) Need for, and showed them how to check, squareness of extension fixtures with saw kerf line.
- (c) Fabricated work piece "pusher" stick using off-cut piece of lumber for better safety during rip sawing operations.
- (d) Suggested use of safety collar and knives set (serrated type) or solid cutterhead for VSM to attain higher safety level of operations.
- (e) Suggested use of DADO and SCORING saws for wide grooving work.

(5) Stroke Sander, Single Belt (see Figure 5)

- (a) Suggested revival or reactivation of stroking pad attachment to attain better workmanship after changing felt on stroking pad.

- (b) Suggested use of stroke sander as a surface preparation machine with fine grit sanding belt (180 as the coarsest) and not as a machine to correct the planing defects due to badly maintained planer knives.

(6) Band Saw (1" to 2" Blade Width) (See Figure 6)

- (a) Discussed the problem of frequent breaking of saw blade: due to use of wrong width (3/8") blade which also resulted to damage to the crown of the bandsaw pulley.
- (b) Suggested not to alter machine pulleys to fit 3/8" saw blade without consulting machine manufacture; better to buy narrower (thinner) set of pulleys to fit 3/8" saw blade.

(7) Others

- (a) Desirability of using wooden fillets instead of nailing cabinet sides to cabinet top.
- (b) Disadvantages of using particle board (as is) for drawer sides, front and back and nailing them together to form drawer.
- (c) The technique of properly driving woodscrews and the need for "pilot holes" - gave rule of thumb for size and depth of pilot holes for each woodscrew size.
- (d) Suggested the fabrication of a "RUMBLING MACHINE" to smoothen surfaces of drawer knobs imported from New Zealand.
- (e) The need for the services of an experienced woodworking Millwright.
- (f) Fabrication and use of GO/NO GO gauges for specific frequently repeated machining operations.
- (g) Fabrication of planer knife storage rack.
- (h) Fabrication of gauge for setting infeed and outfeed rolls of planer.
- (i) Recommended isolation of painting room from the rest of building by erecting a fire wall around the painting room.

O.G. SANFT ENTERPRISES, Ltd.
(Furniture Division)
Nuku'alofa, Tongatapu
Kingdom of Tonga



Figure 1

Combination planer/
thicknesser, jointer/
surfacer and mortiser.

(Note that workpiece
feed is from right
to left, i.e., from
inside going outside
of the building.)

Figure 2

Serious damage to
planer knives and
cutterhead was
inflicted on two
points by nails
which were not
removed from
"used" lumber
ran through
the planer.

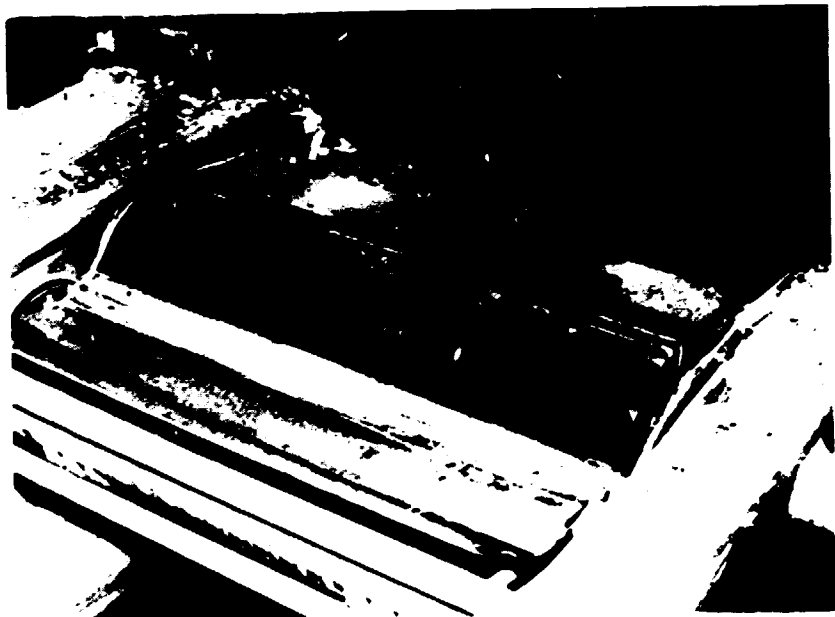




Figure 3

Tilting arbor saw with cross-cutting extension accessory. Shaper head (for vertical spindle moulder) was removed for unknown reason. Again, workpiece feed is from right to left, i.e., from inside going outside of the shop building.

Figure 4

Spraying shelf with a portable grinder installed as a fixed grinder on the far end of the shelf. Definitely a FIRE HAZARD arrangement!!



Figure 5

Locally fabricated stroke sander. Note auto wheel hubs used as sanding belt pulleys. Stroking lever and pad is not being used.



Figure 6

Bandsaw (designed for 1" to 2" sawblade) fitted with 3/8" wide sawblade. Serious damage to the hard rubber crown on the pulleys may be noted - the crown is almost gone.

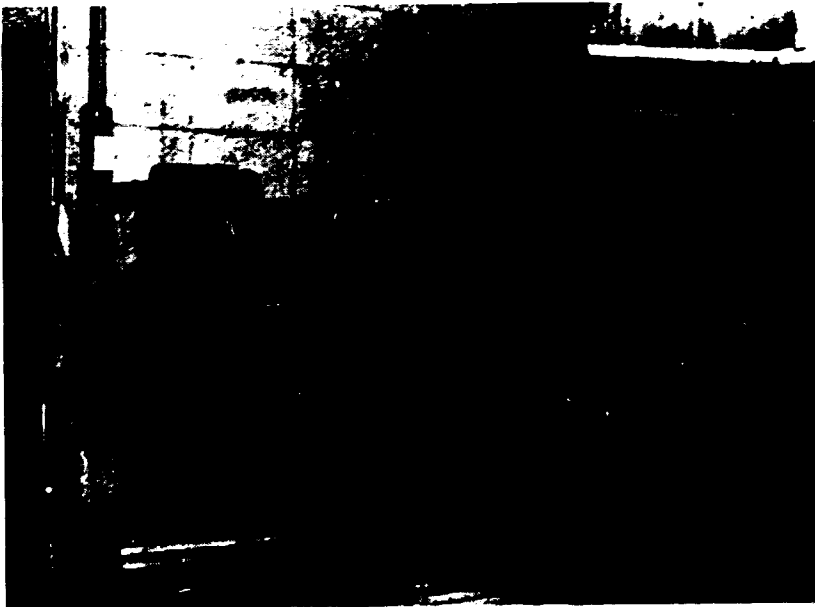


Figure 7

Metalworking lathe converted to turn wooden furniture components.



Figure 8

Welding metal components of bed headboard right next to the woodworking shop.



Figure 9

The upholstery section of O.G. Sanft Enterprises, Ltd., furniture division.

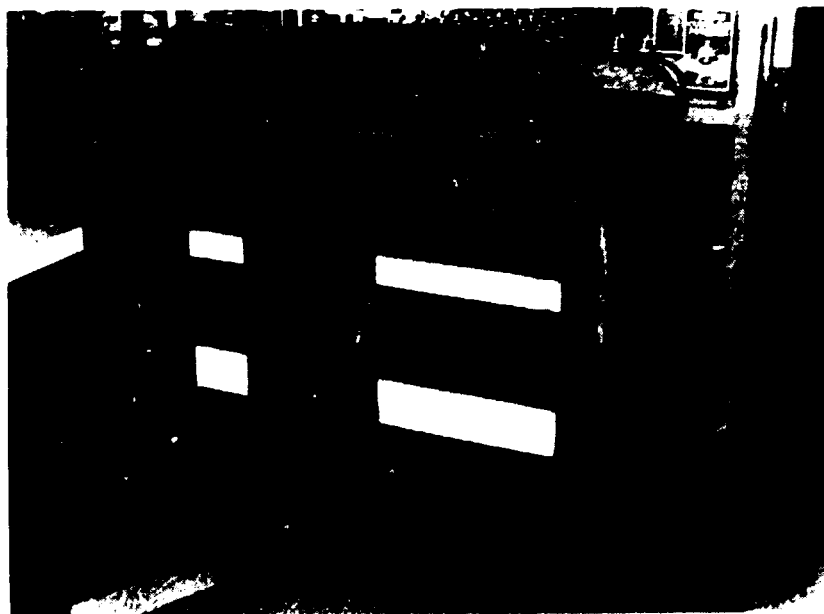


Figure 10

"End Cabinet" made of plyboard laminated with mahogany veneer on both sides. The table top and sides are nailed together. Note that no effort was exerted to color match components of left drawer and top piece of left door to other parts of furniture.

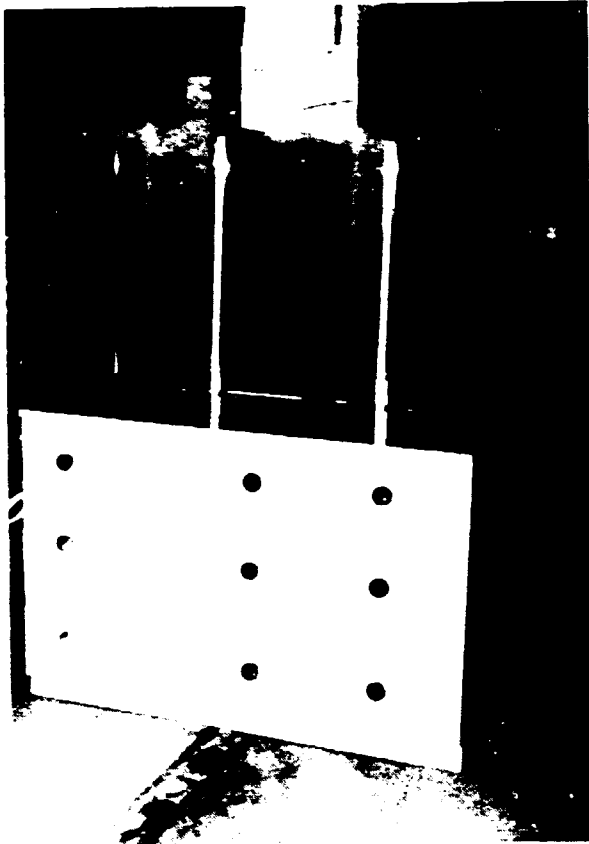


Figure 11

A ladies' dresser made of particle-board laminated with Formica material on the visible surfaces. The inner surfaces are left bare particleboard faces. Note the retail price of T\$414.75 (US\$296.25) including tax.



Figure 12

Chinaware cabinet for the dining room sells at T\$514.50 (US\$367.50) including tax. The utility space between the two cabinet is lined with Formica, same as the outer faces of the sideboards. Wooden surfaces are varnished.

ANNEX IV

ON-THE-SPOT CONSULTATION SERVICES

ESIAOLA (LOLOHEA) FURNITURE SHOP
(27 January 1988)

I. TECHNICAL (See Figures 13 to 19)

A. Problems with the Jointer/Surfacer Machine (See Figure 14)

- (1) Machine (bought 8 months ago) was not provided with knife setting gauge. The owner was advised to write the machine supplier and ask for the gauge as this is a standard accessory of any jointer/surfacer.
- (2) A simple technique of checking whether each knife was properly set was demonstrated using the "wire-pointer" method.
- (3) Taper and "heeling" were noted at both ends of door lippings which were machined on the jointer/surfacer. The use of "work horses" was suggested to hold long work pieces level with the machine bed during planing operations.
- (4) Recommended regular cleaning of machine and work area around it. Since the workshop is only 50 meters (approximately) from the sea, it was also recommended to apply a slight film of oil on the jointer/surfacer bed and the cutterhead and knives at the end of each work-day, to prevent their rusting.
- (5) It was also suggested that a worker should be assigned to be responsible for operating and maintaining the machine. This will help prevent undue damage to the machine.

B. Problems Arising from Faulty Electric Power Supply

Local electric supply voltage is 230 to 240 volts. At times (more frequent lately), it has been noted to drop below 200 volts. This big drop in voltage may damage the electric motors of the machines in the shop. It was recommended that an automatic cut-off switch (magnetic type) should be inserted into the electric circuit supplying power to the machines. This automatic cut-off switch will be activated when the voltage drops to a pre-set level (say 200 volts). It was emphasized that the small investment in the purchase of an automatic cut-off switch is justified (considering the much larger expense needed to rewind a burnt motor, together with the value of lost production).

C. Problems with the Table Saw (Circular) (See Figure 15)

- (1) More than 6 teeth have been damaged or lost, as a result of faulty use of the saw, i.e., cutting "used" lumber which

still had nails in it. It was pointed out that only about 80% (26 out of 32 teeth) are really cutting and further loss of more saw teeth is to be expected. Loss of more teeth will cause overloading the motor, which may burn the motor. It was recommended that the sawblade be sent to the repair shop as soon as possible.

- (2) Another type of sawblade (spring set, rip sawblade) was examined and it was found to be dull and the set was not evenly done. According to Mr. Lolohea, the set on this particular sawblade was done by placing the saw teeth on the edge of a metal table (such as the saw table) and hitting them with a hammer. Mr. Lolohea was advised to stop this practice as it will damage the saw beyond repair.
- (3) Another TCT sawblade was examined. It was found to have lost several teeth and many more have chipped cutting corners. It was recommended that this sawblade should not be used until it has been properly re-tipped and sharpened.
- (4) All the sawblades examined were found to be dirty. Regular cleaning of the sawblades was recommended.
- (5) Again, it was recommended that a worker be assigned to be responsible for operating and maintaining the machine.
- (6) The saw fence was then installed and checked for squareness with the saw kerf. The checking job could not be done satisfactorily as the "try square" used was out of square. Other "try-squares" were tested and also found to be out of square. The shop owner was advised to buy new try-squares and tell his workers to take better care of them.

D. Problems with the 1/4-inch Bandsaw (See Figure 16)

- (1) The hard-rubber crown of the pulleys are beginning to show signs of wear-and-tear although the saw is relatively new (6 months old). It was recommended that the sawblade be set loose on the pulleys at the end of each work day.
- (2) The aluminium backing for the sawblade slot on the bandsaw table has been unduly worn out by excessive pressure on the blade forcing it to cut into the aluminium backing. The workers' attention was called to stop this bad practice and push the workpiece gently against the blade when cutting sharp curves or rounded corners on the bandsaw.
- (3) It was noted that the bandsaw blade was still new. However, the workers were advised to take good care of the blade and not wait for severe damage on the blade before sending it for sharpening or repair.
- (4) Again, Mr. Lolohea was advised to assign a worker to be responsible for operating and maintaining the machine.

E. Machine Fixture and Accessories

While walking away from the bandsaw, this Expert almost stepped on the bandsaw fence attachment which was left lying on the shop floor. The workers were advised to stop this practice of leaving machine accessories on the shop floor. Mr. Lolohea was advised that it is necessary to install racks or shelves to store machine accessories or spare parts when they are not in use. The worker assigned responsible for each machine should also be made responsible for properly storing its accessories when not in use.

F. Portable Hand Router

A 22,000 RPM portable hand router is available. However, it is seldom used. The shop personnel was advised on the advantages of using routing fixtures to obtain the maximum use of the router. Rough sketches were made of routing jigs and fixtures for special purposes such as: dovetailing drawer sides, front and back, routing table cut-outs, etc. A special table for routing operations was recommended to be fabricated. Again, proper care of the router bits was emphasized.

G. Improving Quality of Furniture Products

- (1) The use of dovetailed joints was recommended for the fabrication of drawers, considering the availability of the portable hand router and the appropriate routing bits. This can be achieved by the fabrication and use of a dovetailing fixture. A sketch of the fixture was made for M. Lolohea.
- (2) Bed headboards, dresser table crowns, etc., are currently being fabricated with straight edges. The use of the portable hand router, equipped with the proper router bit, can give a nice profile to these edges and increase the quality level of the product. A sketch of the routing template required for this job was made for Mr. Lolohea.
- (3) Visible defects on the surfaces of the bed frames (ready for delivery) were not corrected, thus giving a lower quality image for the product. It was recommended that these open defects be puttied, smoothly sanded and appropriately stained before final finishing coats are applied on the bed surfaces.
- (4) Although the top surfaces of the drawer knobs (on the wardrobe and dresser) were smooth, the lower surfaces (which touch the fingers when the drawers or cabinet doors are pulled open) were still rough. These surfaces are hardly accessible to sanding paper and thus, can not be made smooth by ordinary sanding techniques. A small "rumbling" box was recommended to do the job. The box is filled with sawdust to 1/3 its capacity and

another 1/3 is filled with the wooden knobs. The "rumbling" box is then rotated slowly continuously, by hand or with the use of an electric motor, until the knob surfaces are smooth.

- (5) Other quality improving practices were illustrated to the workers and to Mr. Lolohea.

II. MANAGEMENT ASPECTS

A. Expansion Goals

Mr. Lolohea expressed his plan to expand his operations in view of the brisk business he made during the previous 12 months. He would like to at least double his present output in two years time, and perhaps double it again in five years time. After some discussions on his needs, it was agreed that the following additional pieces of machinery are needed for the expansion plan, given in the order of their priority for acquisition.

- (1) Planer/Thickneser, 20-inch work width capacity
- (2) Chisel/Drill Mortiser, 1/2-inch maximum width and 1-1/2- inch maximum depth
- (3) Cross-cut Saw (in the meanwhile two cross-cut saw blades will be purchased and one will be mounted on the existing rip-saw when cross-cutting operations are required)
- (4) Stroke Sander, single belt

Note: More detailed machine specifications can only be formulated when the types and designs of the furniture products to be produced in the future are available.

B. Personnel Training

Mr. Lolohea was appraised of the need to up-date the skills of workers, in preparation for the proposed expansion. Since his firm is too small to send its workers abroad for training or hire expatriates to train the workers while at work, it was suggested that he approach the government for possible assistance in this matter.

C. Management Control Techniques

In view of his plans to expand operations, Mr. Lolohea was advised that his present system of running the business will not be effective anymore. He was advised to prepare for the expansion by installing simple systems of material and labour usage control,

quality control and production control. Simple illustrations of these aspects of management control of operations were explained to Mr. Lolohea. He was invited to attend the 15 - 16 February seminar/workshop to be conducted by the Ministry of Labour, Commerce and Industries in cooperation with the UNIDO and UNDP, where such systems of control will be discussed in more detail.

**ESIAOLA FURNITURE ENTERPRISE
Hala Taufu'ahau Haveluloto
Tongatapu, Kingdom of Tonga**

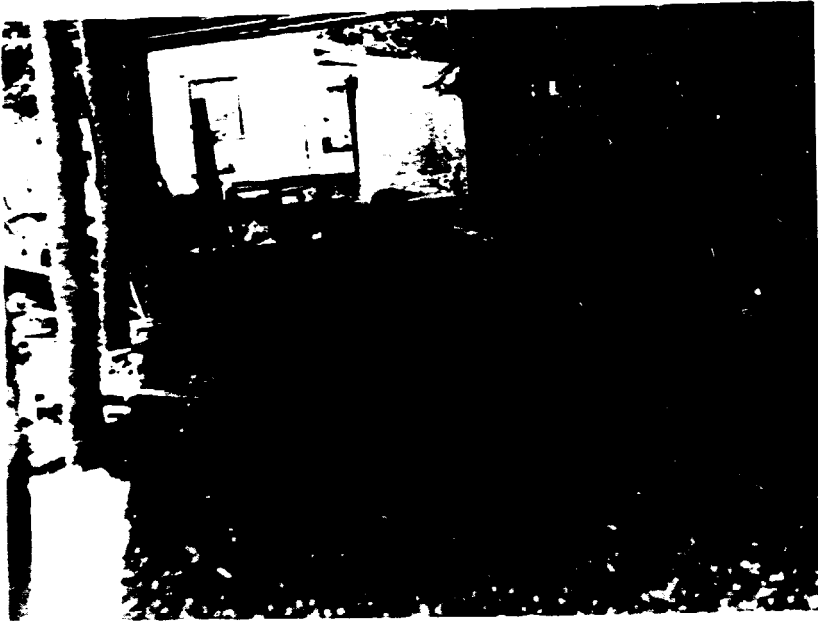


Figure 13

A view of the machining section of the ESIAOLA Furniture Enterprise.

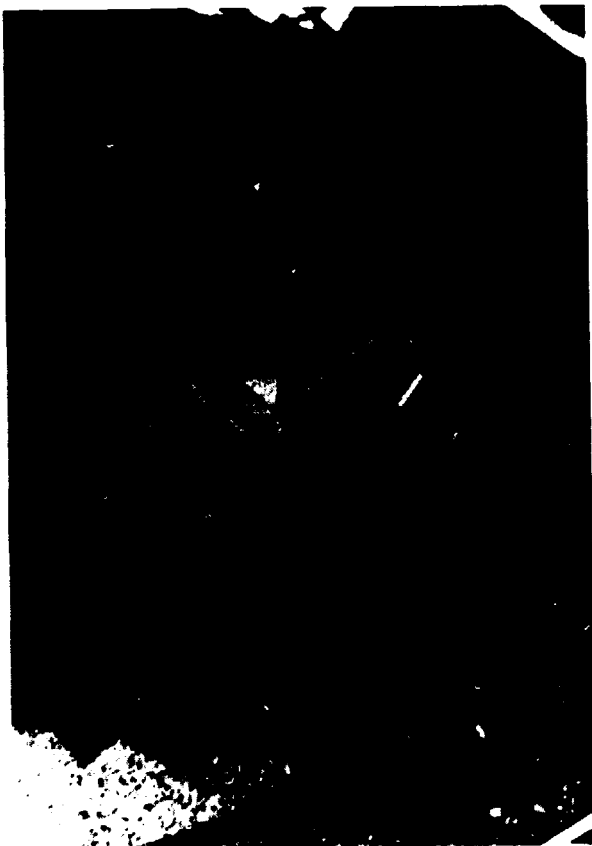


Figure 14

A 6-inch wide jointer/surfacer is the main surfacing machine in the shop.



Figure 15

A table saw does all major ripping and cross-cutting operations. The saw-blade is equipped with TCT blades.



Figure 16

A 1/4-inch bandsaw is used to cut shapes on planed lumber pieces.



Figure 17

Punching nail heads into the door lip surface, preparatory to finishing operations.

Figure 18

Bed frames and wardrobes are among the firm's regular products.

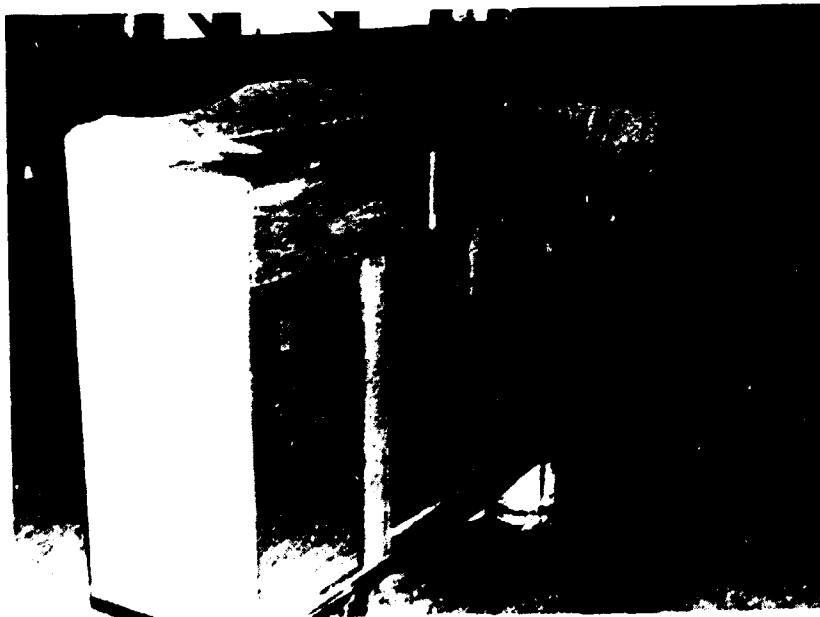
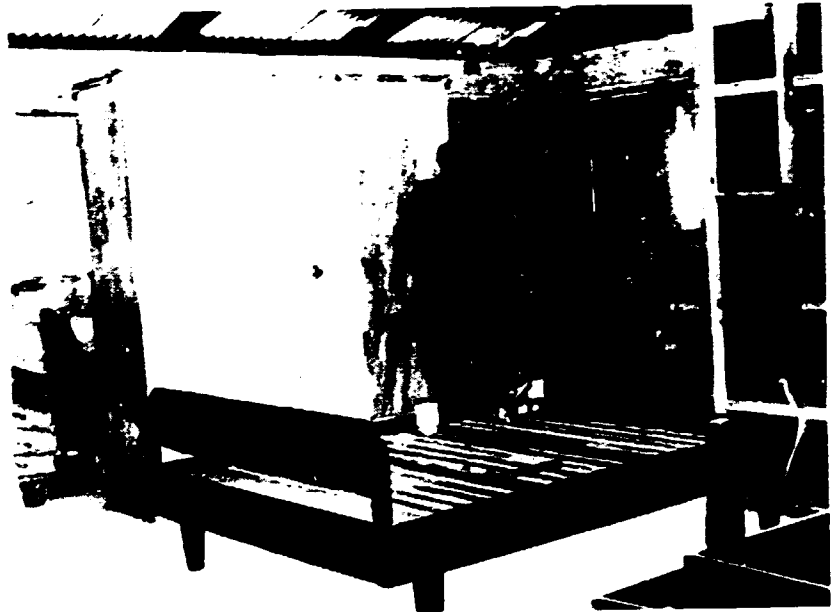


Figure 19

Two of the three units of "end cabinets" being produced upon order.

ANNEX V

ON-THE-SPOT CONSULTATION SERVICES

SOUTH SEAS YACHTING PTY., Ltd.
(28 January 1988)

I. PROJECT HIGHLIGHTS

The Expert's advice was sought in connection with the firm's plans to establish a 5,000 BF Solar Drier for sawn timber. The firm's managing partners, Mr. Brian Russell and Ms. Dianne Manson, maintained the following expectations on the proposed drier:

- (1) It is hoped to dry, hopefully to the EMC level under local conditions, approximately 169,000 BF (400 cu.m.) of hard wood, composed of five timber species, with individual annual volume requirements ranging from 8,480 BF (20 cu.m.) of Fijian "YAKA" to 84,800 BF (200 cu.m.) of "DAKUA SALU-SALU". These are expected timber requirements of their expanded boat-building operations.
- (2) Any excess drying capacity will be offered to the local furniture and joinery industry to dry a portion of their seasoned wood requirements.
- (3) Mr. Russell explained that he would like to keep the as low as possible. He plans to use a forklift to load and unload the drier.
- (4) A copy of the architect's plans of the proposed solar drier prepared by a New Zealand firm was furnished comments. It was explained that the drier design was based on a similar type of solar drier which was presented and discussed in some detail by a technical publication in the U.K.
- (5) Mr. Russell claimed that such type of solar drier can reduce timber moisture content down to 8-10% in two weeks time from an input MC level of 25-30%.

II. EXPERT'S COMMENTS AND ADVICE

- (1) On the basis of Mr. Russell's claim of a 2-week drying period, it could be possible to dry a maximum of 25 loads, setting aside a total of 2 weeks for servicing the drying chamber and its accessories, per year. However, the Expert considers the 2-week drying period as highly optimistic. It was suggested that a small solar drier, using polyethylene sheets as roofing and wall material, of the type developed in Southeast Asian countries such as the Philippines, Thailand and Malaysia, be set up to conduct experimental drying runs before a sizable amount of money is invested in the proposed solar drier offered by the New Zealand firm. In this manner, the drying

characteristics of the target wood species under Tongan weather conditions as determined during the experimental runs can be used as the basis for a larger-capacity solar drier having characteristics suitable to local conditions.

- (2) As presented in the architect's drawings, the proposed solar drier needs further study and possible re-design on the following points :
- (a) Using 1-inch boards as the basic load, the "plenum" balance inside the drying chamber is not defined, thus, there is no basis for checking the feasibility of 2-week drying period per load.
 - (b) Location of the access door to the drying chamber will not allow the use of a forklift to load and unload the drier.
 - (c) There is no specification for the fans, hence, air movement inside the drier could not be calculated. It was suggested that an air speed between 300 to 350 feet-per-minute would be desirable.
 - (d) The amount of heat transmission through the roof (barely any through the sides) of the building could not be calculated as the heat conductivity characteristics of the "corrugated translucent sheet" roofing was not given. An ideal situation would allow heat energy transmission at roughly 50,000 BTU per hour, but not less than 25,000 BTU per hour, for every 1000 BF of sawn timber being dried.
 - (e) As shown in the drawings, a desirable air-flow inside the chamber needed to assure uniform drying of the load could not be attained as the fans are shown to draw air (or exhaust air?) from the outside atmosphere only.
 - (f) "Dead Spots" (i.e., areas with stagnant air) are evident in at least two strategic locations inside the drier. The sharp wall angles in these spots should somehow be eased off (or arched) so as not to impede air flow and become storage areas for stagnant air.
 - (g) The structural design of the drier housing appears to be massive and very expensive. The client's attention was called to the availability of solar drier designs using lower-cost materials.

ANNEX VI

ON-THE-SPOT CONSULTATION SERVICES

TONGA WOOD PRODUCTS, Ltd.
(28 January 1988)

The Plant Manager, Mr. Hopoi Vaivevea, was not available. Thus, the company Chief Executive, Mr. Siotame Tsutome Nakao, decided to discuss his expansion plans for the furniture manufacturing operations on the morning of the visit. However, he requested for another appointment for his plant manager to discuss plant operations.

Mr. Siotame based his current on-going talks with an Italian (Australia-based) group which is interested in forming a joint-venture partnership with Tonga Wood Products.

Various aspects of the proposed joint-venture arrangement were discussed. The expert shared with Mr. Siotame his experiences and knowledge on such arrangements. He was reminded that the UN and its agencies (UNDP, UNIDO and ITC) may be of service to advise him on this venture should proper representations be made through the official channels.

ANNEX VII

ON-THE-SPOT CONSULTATION SERVICES

TNT BUILDERS ENTERPRISE
(1 February 1988)

I. PROJECT BACKGROUND

Mr. Teuli Taukeiaho is a construction contractor operating under the firm name TNT Builders Enterprise. The furniture and joinery production operations was started about a year ago as a support activity to the buildings construction operations. The furniture production shop has a complement of two pieces of good small scale production machines, namely:

- (1) One unit combination Jointer/Planer-Thicknesser/Table Saw/ Vertical Spindle Moulder (Shaper)/Horizontal Router (Mortiser); and
- (2) One unit Radial Arm Saw, 20" width x 4" thick workpiece capacity.

(See Figures 20 to 22.)

These machines are complemented by a number of electrically driven hand tools, e.g., portable hand router, portable disc sander and portable electric drill. Saw blades and knives are sent out for servicing at the Mataliku Shops of the coconut wood production firm operated by the Ministry of Agriculture, Forestry and Fisheries.

Current production operations are on an intermittent basis, as required by contracts for buildings/homes construction. Four of the carpenters working in the construction division of the firm are re-assigned to the furniture shop whenever there are orders for furniture or joinery products. One of these men is assigned (and allegedly sufficiently-trained) to operate the combination machine and the radial arm saw. The portable hand router, however, is seldom used. This apparently is due to their lack of knowledge on routing jigs and fixtures, which are normally needed to obtain satisfactory work out of the hand router.

There was a Foreman for the furniture shop who spent 100% of his time in furniture/joinery products production. However, the man has left the firm, so that the owner/manager himself has to supervise production operations.

Particle board is extensively used. However, plywood has recently been used and found to give better use in furniture making.

Production operations are conducted on a Job Order basis. Costing practice is very rudimentary and tied up to the cost picture for construction operations.

II. EXPERT'S OBSERVATIONS AND RECOMMENDATIONS

A. Management Aspects

(1) Organizational

In view of the Manager's predominant involvement in his construction operations, it was recommended that the position of Shop Foreman be filled immediately. The desirable qualifications for such position were discussed.

(2) Documentation and Information Aspects

Setting up a simple information and data gathering system will soon become a necessity in view of the firm's plans to expand operations. The Manager's wife, Takavaha, is currently the firm's bookkeeper, so that she was asked to join the discussions covering documentation and information systems relative to product costing. The general principles of labour and materials usage controls were discussed. In addition, the basic cost elements involved in the "overhead" expenses title were listed and methods of accumulating them were defined.

Both husband and wife were invited to attend the seminar/workshop on 15 - 16 February, as this was deemed potentially useful to their respective responsibilities in managing their firm.

(3) Personnel Training

The need for up-dating the worker's skills was emphasized, in anticipation of the needs that will arise as a result of the expanded production operations.

After discussing several sources and methods of key personnel training, it was agreed that the firm will not be in a financial position to pay for expatriate training services, but will have to rely on industry-wide training programme which may be provided by the government from time to time.

B. Technical Aspects (See Figures 20-24)

(1) Maintenance and Care of Machinery and Equipment

The clients were advised to assign one worker responsible for each of the machines in the shop. This responsibility covers both operating and maintaining the machine in good operating condition. The owners expressed their opinion that this is a good idea and affirmed their intention to implement the idea immediately.

A check on the sawblades (TCT) revealed defects on at least 6 of the 40 teeth. The Manager was advised to send the sawblades to be sharpened as soon as possible. A simple method of checking the "kerf" of the sawblade, using a pointed instrument (e.g., wire or ball-point pen) was illustrated. This method revealed that at least three of the teeth cut more than the other teeth on the right side of the kerf, while two of the teeth cut more on the left side of the kerf. Thus, it was pointed out to the Manager that only 5 of the 40 teeth are really cutting the kerf and that this will further lead to defects on the teeth that are still sound and eventually burnt-out motor due to overload.

A similar simple test of the planer-knives revealed that only one of the knives is really doing the planing job since it was set furthest out of the cutterhead. The Manager promised to replace the knives immediately in as much as two of them have deep nicks and are ruining the surfacing job.

A check of the radial arm saw showed satisfactory machine and sawblade care and maintenance.

A wooden holder for the spare planer knives was fabricated out of lumber residue found in the shop (see Figure 24).

(2) Production Jigs and Fixtures

The benefits to be derived from the use of production jigs and fixtures were explained to the Manager. A wooden "pusher" was fabricated for pushing the work during sawing operations on the table saw - thus providing more safety to the worker (see Figure 23).

A set of wooden "horses" were suggested to help avoid "heeling" during planing operations on long workpieces.

The use of box-planing jigs to increase the output and quality of planing tapered table legs was explained to the Manager. (See Annex VIII.)

The Manager was advised to pay special attention to the discussion of this production aspect during the seminar, where other labour and materials saving techniques will be discussed.

(3) Furniture Materials

The client was informed of the specific methods and limitations in using particle board as a material for drawers and cabinet components.

Better techniques for laminating "Formica" on particle board were also discussed.

The advantages of using adequately seasoned timber were discussed with the Manager, particularly in connection with his plans to manufacture furniture items based on "DO-IT-YOURSELF" drawings which are easily available in the American market.

The client was invited to join the seminar/workshop on 15 - 16 February, where more discussions on this subject were conducted.

TNT BUILDERS ENTERPRISE
Nuku'alofa, Tongatapu
Kingdom of Tonga



Figure 20

A combination planer/
thicknesser; jointer/
surfacer; table saw;
vertical spindle
moulder; and mortiser
provides the major
machining facilities
in the shop.



Figure 21

Another view of
the combination
machine.



Figure 22

A radial arm saw is used to do the major cutting-to-length job.



Figure 23

The use of the wooden workpiece "pusher", as demonstrated by the owner/manager, provides more safety during sawing operations.



Figure 24

A simple gadget for storing planer knives is shown by the owner/manager.

ANNEX VIII

ON-THE-SPOT CONSULTATION SERVICES

MANAVA'OFA ENTERPRISE
PANGAI, LIFUKA IS., HA'APAI GROUP
(3 February 1988)

I. THE MANAVA'OFA ENTERPRISE

The firm is a small joinery and furniture manufacturing shop in the village of Pangai, Ha'apai Group of Islands, immediately north of Tongatapu. The production operations is managed by the owner, Mr. Pelenato Falemaka, assisted by his daughter, Ofa, in the administrative aspects of the operations. The shop produces various types of furniture items, chests, window frames and jambs, door and door jambs. It is the only furniture and joinery shop in Ha'apai, whose current population stands at approximately 12,000 people. All production materials are supplied by the Commodities Board branch store in Pangai. Production supplies nails, hardware and woodscrews are bought at the Burns Philip Construction supply center in Nuku'alofa Tongatapu.

II. MANAGEMENT ASPECTS

The owner/manager himself performs all the major functions of management. Hardly is there any monitoring or control system for labour and materials usage. Costs are based on over-all inputs, which usually covers the manufacture of various wood products. Thus, management has no idea of how much a furniture item really cost. Joinery products are produced on order, while a few furniture items (such as dressers, chairs, beds, etc.) are sold from a modest inventory of finished goods. No efforts are exerted to monitor the productivity of the workers. There is no "Middle Management" nor "Floor Supervisory" personnel. The owner/manager does all the functions of these industrial positions, there being only 5 workers in the shop (excluding Ofa, the bookkeeper daughter of the owner).

III. TECHNICAL ASPECTS (See Figures 25 to 33)

The production machinery complement includes: combination table saw jointer/surfacers, a portable table saw, a mitre saw, a 1/2-inch blade band saw and a number of portable electric powered hand tools (22,000 RPM hand router, 1/4-inch capacity drill and hand sander). The standard assembly tools found in small joinery shops are also found in this shop: C-clamps, bar clamps, glue brushes, chisels, hammers, screwdrivers, etc.

Maintenance of machinery and tools is at a very low level so that the production machines have never been properly cleaned since they were purchased.

There are five workers: two of them could operate the production machinery. However, none of them could be considered skilled or highly skilled.

The artisan/craftsman production techniques still predominate. The machines are being used as tools rather than industrial equipment. Adjustment of the dimensions of components during the assembling process is a necessity in view of the lack of machining precision. There is a minimal use of production jigs and fixtures. The resulting product quality, although somewhat better than some of those produced in other furniture shops in the country, is still below the quality level of furniture and joinery items produced in some of the more advanced developing countries like Thailand, Singapore and the Philippines.

IV. SUGGESTIONS/RECOMMENDATIONS

Mr. Pelenato has expressed his desire to expand his production operations based on the volume of business he did during the previous year. The following machines are deemed vital to improvement of quality and increase in productivity of the operations: planer/thicknesser, mortiser, and a vertical spindle moulder (shaper). It was recommended that a machine performing the combined operations, as listed above, would be more suitable to the small production volume than individual machines. The owner/manager was given advice on how to lay-out the new machines, together with the existing equipment and to buy at least two sets of saws or knives for each machine. Proper care of machinery and cutting tools was demonstrated to all the shop workers, after all the shop equipment and cutting tools were cleaned, with the help of the expert and the owner/manager.

Safety gadgets such as a wooden workpiece pusher were fabricated under the guidance of the expert.

The limitations on the use of particle board in manufacturing furniture were explained to the owner/manager.

The fabrication of a routing fixture for "dovetailing" drawer components was discussed, using the router manual as a source material. A similar fixture was borrowed from the local school workshop to give the owner/manager a better idea of the fixture. Some parts of the fixture were suggested to be fabricated from materials already available in the shop.

The use of "pilot holes" for wood screws was also explained to all the shop workers and the owner/manager.

The following suggestions were given to improve control and monitoring of shop activities:

- (a) Assignments of definite responsibilities to each worker (specialization and division of labour);
- (b) Operating and cleaning responsibilities for each machine assigned to qualified workers;
- (c) Use of reports to monitor the daily output of each worker;
- (d) Setting up a system to monitor the withdrawal of raw materials and their use in production; and

MANAVA'OFA ENTERPRISE
Pangai, Lifuka Island, Ha'apai Group
Kingdom of Tonga

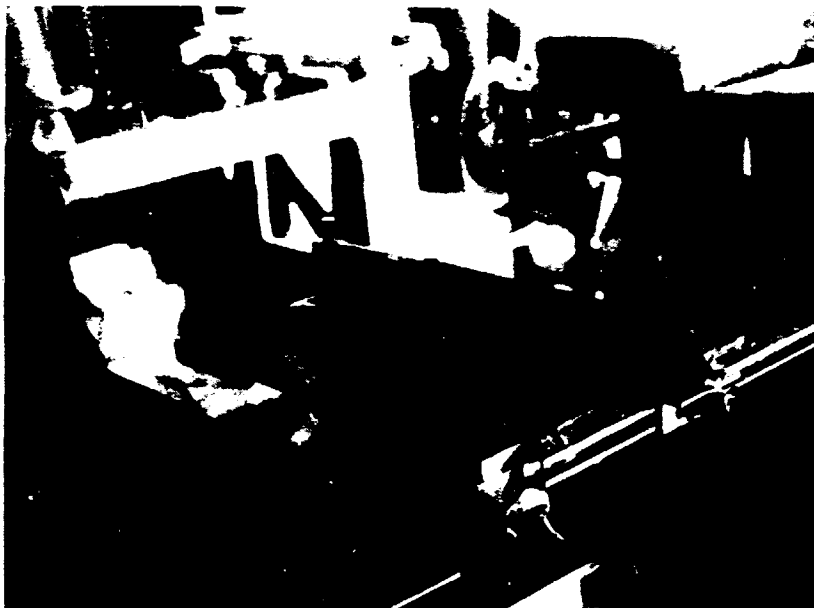


Figure 25

A combination table saw and jointer/surfacer is the principal machine in the shop. The jointer/surfacer, however, is not operating for want of a V-belt.

Figure 26

A portable table saw on a metal frame and table, is being used as a rip-saw when not in use on job sites.





Figure 27

Portable electric drills and disc sanders complement the industrial machines.



Figure 28

Cleaning the circular sawblades under the direction of the UNIDO Expert.

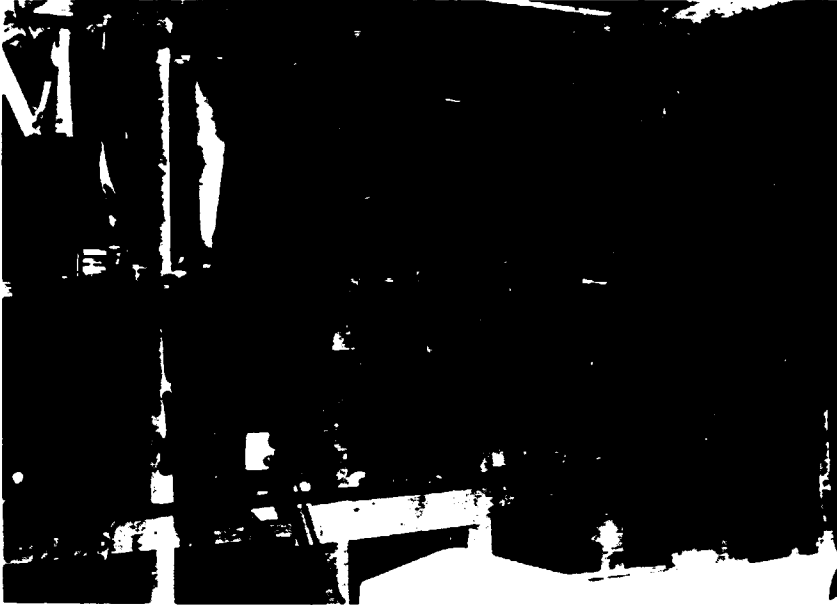


Figure 29

Carpenters' hand tools
on the storage rack
provide complementary
facilities to the
industrial machines.



Figure 30

An "end cabinet", one of the
standard products of Manava'ofa.
Note puttied nail holes which were
not stained to match the wooden
frame of the cabinet.



Figure 31

A utility/clerical desk, another standard product of Manava'ofa. The drawers are made of particle board laminated with Formica on the drawer front. The drawers are not interchangeable.



Figure 32

The framework of the standard Manava'ofa chair. The seat and back of the chair is made of thick canvass.



Figure 33

A "gentleman's dresser", made of particle board laminated with Formica, another standard product of Manava'ofa.

ANNEX IX

ON-THE-SPOT CONSULTATION SERVICES

V.J.N. & SONS JOINERY ENTERPRISE
NEIAFU, VAVA'U ISLAND
(4 - 5 February 1988)

I. THE ENTERPRISE

The firm is principally a furniture and joinery production establishment, serving the needs of the approximately 32,000 people living in the Vava'u Group of Islands, north of the Ha'apai Group. The principal material input is about 65% New Zealand pine and 33% Canadian Douglas fir. The rest is made up of ASAU (Western Samoa) timber. There are only 2 regular workers in the shop. More workers are hired (on a temporary basis) when the volume of work requires doing so. The previous year's output includes: 20 sets living room furniture, 30 sets bedroom furniture, 40 sets kitchen furniture and furnishings, and about 20 sets office furniture. It is planned to produce some institutional (accommodation) furniture items during this year. It is hoped to produce during this year twice the volume of products produced last year. Ultimately, it is desired to export some household furniture items to Pagopago, in American Samoa.

Particle board is also extensively used in the manufacture of chairs, tables and shelvings. Plywood has found some use in a few of the furniture products.

II. MANAGEMENT ASPECTS

There is not much to say about the organizational set-up of the enterprise since the owner/manager also supervises the shop operations and sells the products, himself. More recently, however,

devote more of his time to shop operations. The new staff member has developed into a production control and materials management assistant to the owner/manager.

A brief study of their costing accounts showed the use of a Job Order system. However, distinct overhead cost items have been assigned per cent participation in pricing activities. These per cent figures are based on empirical data, accumulated during the previous year of operation. Materials issued to the shop and furniture (and other products) produced are entered in separate accounts. (Note: This provides a good starting point to develop and install a costing, and therefore pricing technique which will be able to handle serial production of furniture components.)

III. TECHNICAL ASPECTS (See Figures 34 to 41)

The shop is relatively better maintained compared to the other shops previously visited. There is also a better organized layout of machines

and assembling benches. (See Figures 34 and 35.) The condition of machines and tools showed comparatively better care and maintenance than those seen in the other shops previously visited. A few more pointers on proper and regular maintenance of machinery and tools, however, are still needed.

A major handicap to the improvement of product quality is the inadequately seasoned timber input of the shop. The need for seasoning (kiln-drying) facilities is being seriously considered by the owner/manager.

Rudimentary forms of assembling fixtures were being used. This, together with better machining of furniture components, has helped maintain a higher level of workmanship as compared to those produced in the shops previously visited.

The use of a slow-drying varnish system of finishing materials, however, has negated some of the good outputs attained in the machining and assembling phases of the operations.

IV. SUGGESTIONS AND RECOMMENDATIONS

A. On Expansion Plan

- (1) A low-cost kiln drier (possibly of the directly-heated flue gas heat source type) should be included in the list of equipment complement, particularly if product quality is to meet export standards.
- (2) Guidelines on machinery and equipment lay-out and plant site lay-out were discussed. Personnel safety and fire fighting and prevention features were also covered during the discussions.
- (3) Proper handling and storage of finishing materials were also discussed.
- (4) The advantages of setting up a store room for raw materials and production supplies were brought up.
- (5) The desirability of including a machinery and cutting tools maintenance and repair shop to support expanded operations were discussed.
- (6) The need for a training programme for new workers hired under the expanded operations activities was also discussed. Possible assistance from external sources were also explored.

B. On Production Operations

- (1) More intensive and extensive use of production jigs and fixtures was illustrated and recommended. Among these are:

- (a) Wooden "horses" at both the infeed and output ends of the planer, jointer/surfacers and the table saw was recommended to be used when working on long workpieces.
 - (b) Box-planing jigs were recommended to help attain higher output and more uniform size of tapered legs for tables and chairs. (See Annex XVIII.)
 - (c) The use of eccentric clamping devices in the fabrication of assembling jigs and fixtures.
 - (d) The advantages of using LCA concepts in both machining and assembling operations were pointed out.
- (2) Division of labour and specialization of skills were discussed for possible adoption in the near future. The advantages of developing workers to be skilled in two or more operations were pointed out to the owner/manager.
 - (3) Setting up Operations Sequence Lists for each furniture component was discussed and the desirability of its use in the manufacture of standard product lines was emphasized.
 - (4) The need to adopt a workable and simple system to monitor usage of labour and materials was brought up and its importance to attain reliable and up-to-date product costs was emphasized.
 - (5) Other activities to improve quality and volume output were also discussed, among which is the installation of a wood-residue collecting and disposal system.
 - (6) The owner/manager was invited to participate in the seminar/workshop held in Nuku'alofa on 15 and 16 February, where more discussions on how to improve quality and shop output were discussed.

V.J.N. & SONS JOINERY ENTERPRISE
Neiafu, Vava'u Island
Kingdom of Tonga



Figure 34

A general view of the shop lay-out. Note the small tools mounted on the work-tables.



Figure 35

One of the assembling tables in the shop.

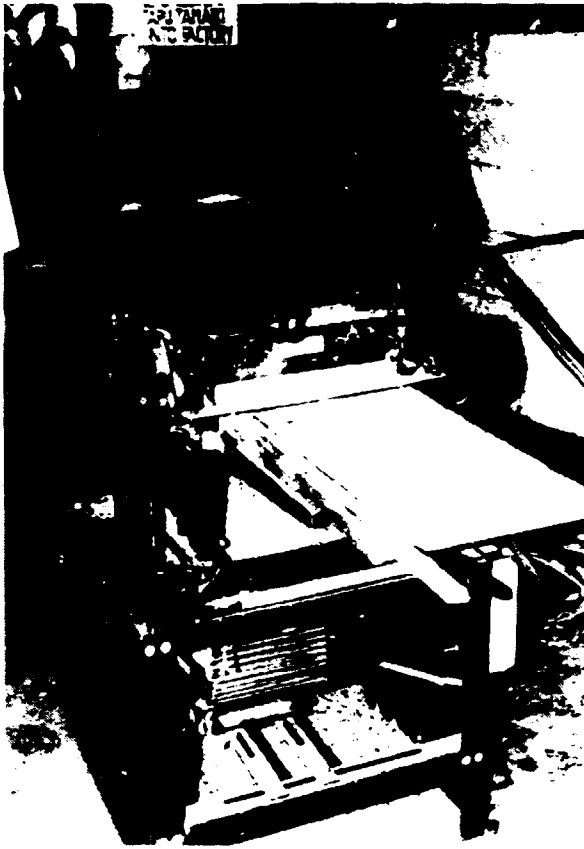


Figure 36

An 18-inch wide surfacer does all the planing work in the shop. Note the improvised feed table made of particle board

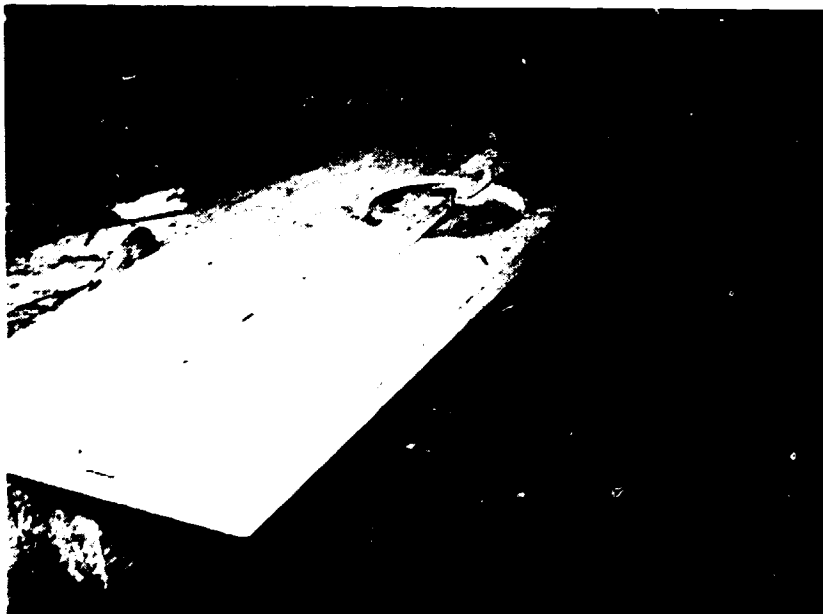


Figure 37

A horizontal disc sander designed and fabricated by the shop owner/manager.



Figure 38

A living room set made out of
pine wood and particle board.



Figure 39

Another living room chairs-cum-table/shelf set
designed by the shop owner and
made out of pine wood and particle board.

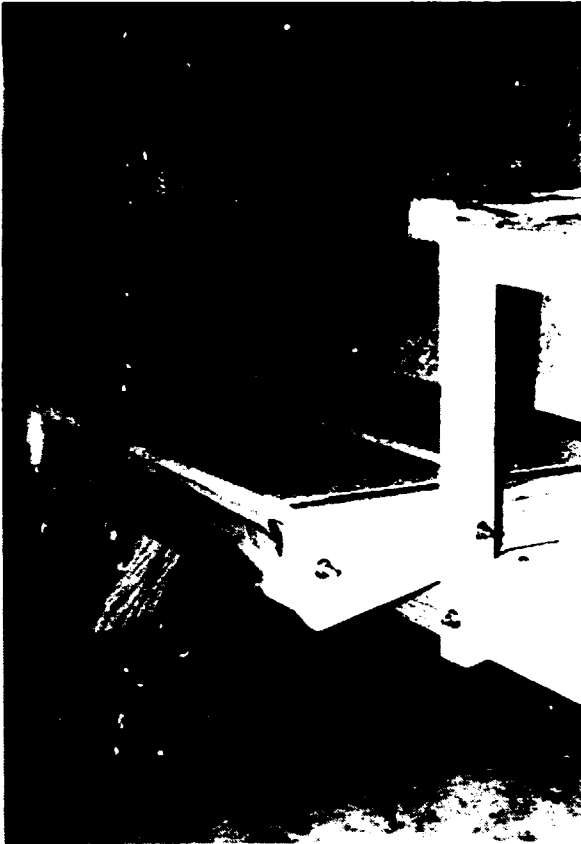


Figure 40

A close-up view of the bolted joints of the furniture item in Figure 39.



Figure 41

The leg and arm-rest assembly of the furniture item in Figure 39. Note the use of "blind dowel" on the chair arm rest.

ANNEX X

ON THE SPOT CONSULTATION SERVICES

COMMODITIES BOARD JOINERY WORKSHOP
NUKU'ALOFA TONGATAPU
(8 February 1988)

I. THE JOINERY WORKSHOP

The joinery workshop is one of the manufacturing units operating under the Construction Division of the Commodities Board of Tonga. Its main function is to fabricate or process sawn timber into construction items (weather boards, flooring, etc.), joinery products (doors and door jambs, window frames and jambs, etc.) and some furniture items (dining tables and chairs, kitchen furniture and furnishings, etc.). These products are generally manufactured as needed by the construction projects of the firm. Currently, the workshop is directly supervised by a Joinery Supervisor (Mr. Fakasii Taniela), who reports to the workshop Manager. Aside from the joinery workshop, there are other workshops (metal, concrete hollow blocks, etc.) which are under the direction and responsibility of the workshop Manager. The joinery workshop Supervisor is assisted by a Foreman and Assistant Foreman. There are eight levels of command between the chief executive officer (the Director) and the workers.

There are currently 18 permanent and 30 casual workers. The number of permanent workers is fixed by the annual budget, while the number of casual workers vary according to the needs of the manufacturing operations.

II. MAJOR WORKSHOP PROBLEMS

Among the principal problems that were observed during the Expert's short visit to the workshop were:

- (1) Jointing, gluing and finishing problems brought about by the use of inadequately seasoned timber.
- (2) Lack of machining precision due to:
 - (a) inadequate maintenance of machine fixtures and cutting tools;
 - (b) minimal use of jigs and fixtures (see Figure 42); and
 - (c) improper use of machine.
- (3) Low output due to artisan/craftsman style of production operations; machines are mainly used as tools rather than as industrial equipment (see Figures 42 and 43).
- (4) Insufficient knowledge of the capabilities of existing machinery and equipment.

Other problems contributing to the low quality of the end products are:

- (1) The use of generally low grade timber which are normally suitable for construction purposes only.
- (2) The wrong use of particle board for cabinet works.
- (3) The use of long drying finishing materials.
- (4) Faulty gluing techniques when laminating particle board components with Formica.
- (5) Quality standards, if there are any, are ignored or are not sufficiently known to the workers and even foreman and supervisor.

III. SUGGESTIONS AND RECOMMENDATIONS

In view of the time constraint on the visit, most of the Expert's attention was concentrated on the machining section of the workshop. The following were some actions suggested and/or illustrated to help improve the quality and volume of the shop's output:

- (1) More extensive use of jigs and fixtures in the machining operations; such as using wooden "horses" at the infeed and outfeed ends of the planer, rip-saw or vertical spindle moulder (shaper) when working on long pieces of timber; the installation of guides and spring-loaded hold-downs to hold the workpiece firmly against the cutterhead during shaping operations; etc.
- (2) The proper setting of knives on the planer/thicknesser and the jointer/surfacer cutterheads, using gauges, and the use of simple gadgets to check if the knives were properly set.
- (3) Proper cleaning and setting (1.4 mm above planer table) of the infeed and outfeed rolls of the planer/thicknesser.
- (4) Proper setting of the bandsaw tension take-up attachment to 1/4-inch (6 mm) above the workpiece.
- (5) Replacement of the cross-cut saw table surface (made of particle board sheets) and make it at the same level as the top of the dead-roll conveyor rollers before and after the saw.
- (6) Design, fabrication and use of GO/NO GO gauges to check on the correctness of the machine setting when machining for critical dimensions of the workpiece.
- (7) Fabrication and use of a wooden pusher to provide better safety during rip-sawing operations.

The workshop Foreman and Supervisor were invited to attend the seminar/workshop on 15 - 16 February, where more details of similar problems and their solutions were discussed.

COMMODITIES BOARD JOINERY WORKSHOP
Nuku'alofa, Tongatapu
Kingdom of Tonga

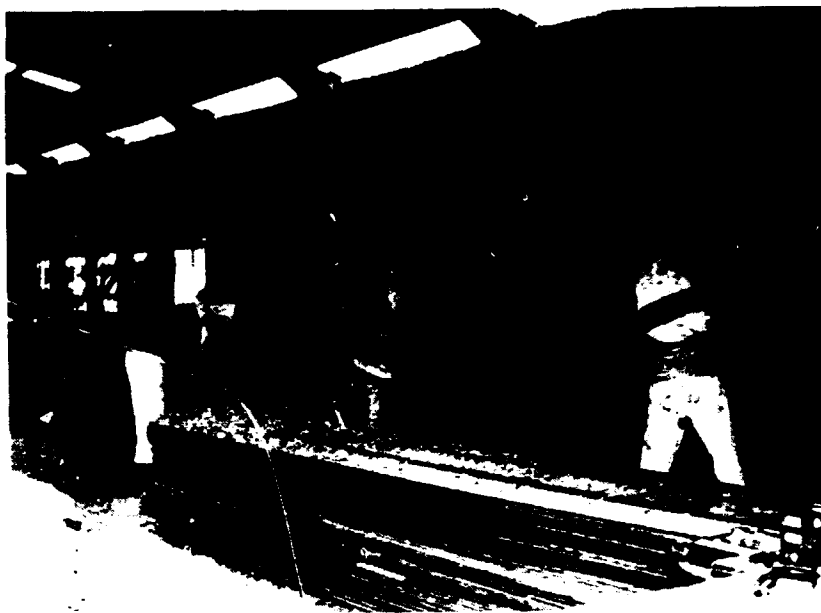


Figure 42

It takes six workers to run these weather boards on the vertical spindle moulder. The same operation can be done by 3 workers with the use of proper jigs and fixtures.

Figure 43

Better workmanship and higher output in this assembling operation could be attained if proper assembling tools and fixtures are made available to the workers.



ANNEX XI

ON-THE-SPOT CONSULTATION SERVICES

JONES INDUSTRIES, LTD. (Wood and Aluminium Joinery Department)
NUKU'ALOFA TONGATAPU
(8 February 1988)

I. THE WOOD JOINERY WORKSHOP

A. Management Aspect

This is one of the manufacturing units of Jones Industries, Ltd. Its main purpose is to supply joinery products required by the building construction activities of the firm. There is a major constraint to the shop engaging in the manufacture of furniture and joinery products. Its sister unit is engaged in the importation and marketing (locally) of furniture and joinery items. Thus, the Wood Joinery Department is relegated to a supporting role of producing joinery items (doors, windows, etc.) and some kitchen furnishings (sink cabinets, cupboards, etc.).

The previous year's output included:

- (a) 4 units - dining tables
- (b) 24 units - dining chairs
- (c) 3 units - coffee tables
- (d) 5 units - coffins
- (e) 3 units - cupboards
- (f) 12 units - sink cabinets
- (g) 6 units - panel doors

There is a centralized costing system so that only total job costs could be obtained from their records. It is not possible to distinguish the unit cost for any furniture or joinery product component.

B. Technical Aspect (See Figures 44 to 47)

There are three units of industrial machinery: a vertical spindle moulder, a tilting arbor saw and a drill press. These are supported by a number of portable electric hand tools (a belt sander, electric drill, etc.), aside from the set of hand tools (hammer, chisel, squares, screwdrivers, hand plane, etc.) normally used in the carpentry trade. There are no regular production runs. The machines are operated only when needed, more as carpenters' tools than as industrial equipment. Level of precision in machining operations is very low. Thus, major adjustments of component dimensions are still required during the assembling operations.

The circular saw and the vertical spindle moulder have been badly used. (See Figures 44 and 45.) The sawblade has lost more than 40% of its TCT. The main collar nut of the VSM has lost its square edges so that it could only be tightened (or unscrewed) by the use

of a 24-inch adjustable wrench. Unless repaired immediately (to restore the square edges) and use of the proper spanner size, the nut edges will be worn out too thin to give adequate hold on the knife collars. This could possibly cause the knives to fly out of the cutterhead or the collars and injure the worker/s.

C. Suggestions and Recommendations

The following actions were suggested or recommended for immediate implementation:

- (1) Replace the circular sawblade and send it immediately for repair. The replacement sawblade is not exactly in the best condition, but it has less damaged TCT than the one being replaced. The Foreman was advised to install and use the newly repaired sawblade as soon as it is received from the saw doctoring shop, and then send the second sawblade for immediate repair also.
- (2) A wooden "pusher" was fabricated to help assure better safety to the saw operator (see Figure 45).
- (3) The main collar nut of the VSM should be repaired to restore the square edges. However, the required grinding work should be done equally on both sides of the spindle axes to obtain a total width of 40 mm across the nut. Only the proper size spanner (40 mm) width should be used to tighten or unscrew the main nut.
- (4) A pair of VSM profiled knives was checked (roughly) for balance and was found to be sadly out of balance. A simple scale to check the knife balance was sketched and recommended to be fabricated immediately. The VSM operator and the Foreman were taught how to obtain a good balance for each pair of knives. Furthermore, they were taught how to install the balancing counterweights (pieces of tinfoil) together with the VSM knives.
- (5) A number of single VSM knives were found in a wooden box containing VSM knives and other irrelevant metal objects. The Foreman was advised to separate the single knives, and NOT to use them until a pair for each knife has been ground and balanced. A storage rack, of simple design, was suggested to be fabricated out of off-cut lumber and scrap plywood, in order to store (safely) the VSM profiled knives in pairs.
- (6) The safe practice for the VSM operator to duck under the shaper table was emphasized to the workers, indicating the reason for locating the electric switch on the lower part of the machine body a few inches above floor level.
- (7) The Foreman was advised to see to it that all the machines are cleaned before the end of the working day and properly lubricated regularly.

- (8) The shop Supervisor and Foreman were invited to attend the seminar/workshop on 15 - 16 February, where more details of similar problems and their solutions

II. THE ALUMINIUM JOINERY WORKSHOP

The aluminium joinery workshop is another unit of the production division of Jones Industries, Ltd. and is administered along the same scheme as the wood joinery workshop. Complete sets of windows (various types) and doors (with joints) are being fabricated from extruded aluminium profiled bars imported from Australia. The shop was started in 1978 with only 1 worker. Now, the department has a Foreman and two workers. The only major piece of equipment is a mitering saw with TCT teeth. Screwdrivers, glass cutters, and other hand tools complete the tool requirements of the shop. 80% of the shop's output are installed in residences while 20% of the output are installed in institutions and other public buildings. The firm enjoys a complete monopoly of the business in Tonga. Plans are being prepared for the establishment of a branch workshop in Vava'u and other island groups in Tonga.

Although aluminium doors and windows cost roughly 1.75 times their corresponding sizes in wood, the following points were brought up to justify the customer's preference for aluminium doors and windows:

- (1) Aluminium products could be made more water-tight than corresponding wooden joinery products. This was confirmed during the last typhoon which visited Tonga in 1982.
- (2) Aluminium doors and windows are expected to last at least five times as long as their wooden counterpart under similar weather conditions and manner of use.
- (3) Aluminium doors and windows help build the prestige or image of the building.

JONES INDUSTRIES, Ltd. (Joinery Division)
Nuku'alofa, Tongatapu
Kingdom of Tonga

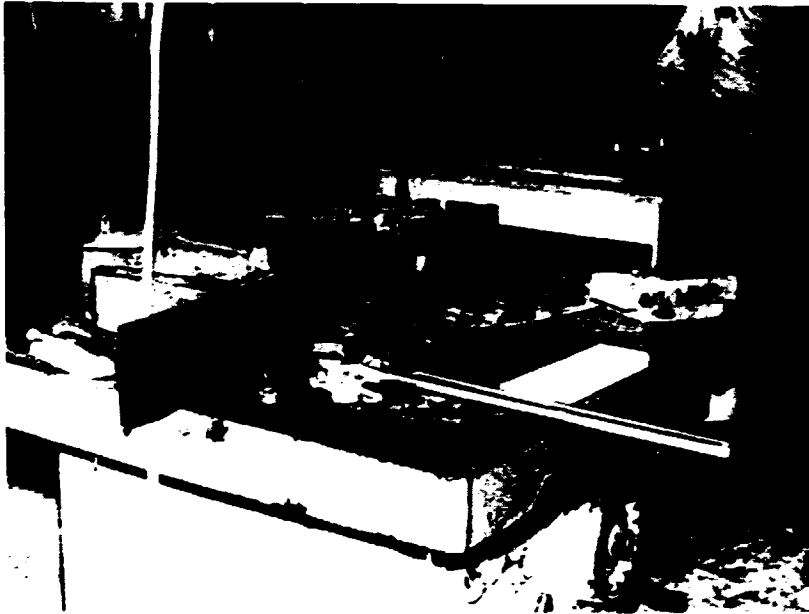


Figure 44

Vertical spindle moulder (shaper) with defective main collar nut (top spindle nut). Note the adjustable wrench with 24-inch handle which is used to tighten top spindle nut.



Figure 45

Workpiece wooden "pusher" provides more safety during operation of tilting arbor saw.



Figure 46

This drill press, with 1" maximum drill diameter capacity, is the 3rd piece of industrial machinery in the shop.



Figure 47

The "sink cabinet" is one of the standard products of the shop. It is made of 1/2-inch plyboard. In some cases particle board laminated with Formica, is used instead of plyboard.

ANNEX XII

ON-THE-SPOT CONSULTATION SERVICES

MAFF COCONUT WOOD PROCESSING CENTRE
MATALIKU, NUKU'ALOFA, TONGATAPU
(11 February 1988)

I. GENERAL

The Coconut Wood Processing Centre is a government wood processing and training institution operating under the Ministry of Agriculture, Forest and Fisheries. It is located in Mataliku, Nuku'alofa, and is composed basically of three units: the coconut wood sawmill, the pressure treatment facilities and the woodworking joinery shop. The Centre is managed by an expatriate, Mr. Brian Miller, who has been the Officer-In-Charge for the last two years with the assistance of a Tongan counterpart. It processes annually an estimated 212,000 BF of 1" boards or thinner and an equal volume of boards thicker than 1" but less or equal to 2" thick.

The principal products are construction components, e.g., mouldings and other moulded items, weather boards, roofing tiles and shingles, timber framing and block flooring. Further processing of coconut wood into furniture and more advanced joinery products is planned. However, the absence of kiln-drying facilities makes it hard to realize this plan in the near future. The machining operations, working on air-dried coconut wood material, is confined to the production of components for the buildings and construction industry.

The Centre is composed of seven principal buildings, namely: the saw-milling shop, the tools and mechanical repair building, the joinery workshop, the saw doctoring shop, the pressure treatment plant, the timber storage and air-drying building, and the office building.

The production operations is managed and supervised by 10 personnel including the Officer-In-Charge and his counterpart Manager, the various Plant Supervisors and Foremen and 13 highly skilled, 15 semi-skilled and 2 unskilled workers.

The Centre also offers courses on coconut wood processing and utilization. It has recently completed one such course with participants from nearby island countries and other Tongan islands.

II. TECHNICAL ASPECTS (See Figures 48 to 56)

A. The sawmilling output includes only the hard and medium-hard portions of the coconut wood stem. Apparently, the soft coconut stem core is not converted into lumber since the Centre has not yet found an end product for soft coconut wood. Thus, it is understandable that the lumber yield rate of the sawmilling operations is approximately 38%, on the average. Since the end products are construction items, almost all of the products are pressure-treated with Copper-Chrome-Arsenate (CCA) solution.

- B. Machinery complement in the sawmill includes: one Edwards 54-inch circular saw; one Edwards 30-inch breast bench saw and one hand-operated cross-cut saw. Log bucking operations are done with the use of two 24-inch chainsaws.
- C. Circular saws and straight knives are maintained and repaired in the saw-doctoring and knife grinding shops of the Centre. The machines in the saw-doctoring shop include one face grinder and one side grinder for circular saws up to 60-inch diameter; one double-end grinder. The woodworking tool maintenance shop has one grinding machine for 20-inch straight knives, a bench grinder and assorted types of hand tools.
- D. Material handling and transport operations are done with the use of the following vehicles: one Hino logging truck; one Ford 550 log loader and one Massey-Ferguson tractor loader.
- E. The woodworking shop machinery complement includes one 20-inch planer/thicknesser; one 6-inch jointer/surfacer; one spindle moulder with 8-inch maximum cutterhead diameter; two rip saws and one single belt stroke sander. The machinery lay-out is more adaptable for the production of roofing tiles and shingles, and weather boards. Surfacing of timber framing items, which composes about 90% of the woodworking shop's output, is also easily done on the same machinery lay-out. The shop is also equipped with a centralized type of wood residue collecting and disposal system.
- F. However, the present lay-out will need major modifications and the machinery complement increased if the Centre decides to go into the production of furniture and more advanced joinery products. The present shop floor area will also be needing expansion. The machines appeared to be reasonably well maintained in good operating condition. The woodworking shop was not in operation during the plant visit, thus no comments could be made on the manufacturing techniques employed by the Centre's woodworking shop.
- G. The matter of faulty side grinding of small diameter TCT saws (10" to 16" TCT) which was observed in all furniture and joinery shops which send their TCT circular sawblades to the Coconut Wood Processing Centre for appropriate maintenance and sharpening services was discussed with the Officer-In-Charge, Mr. Brian Miller. The matter was considered by the expert as serious because even the two saws in the Centre's woodworking shop were found to have sawblades which were not properly side ground.
- H. Another point which was brought up by the expert was the uncovered inlets of the wood residue collecting system in the woodworking shop. These inlets were provided for connection to other machines which will be hooked up to the system in the future. It was suggested that even temporary covers should be installed on these open outlets so that the effectiveness of the wood residue collecting system will not be impaired.
- I. The woodworking shop Supervisor brought to the attention of the Expert the needs of his knife grinding and sawfiling room. The knife

grinding room is equipped with a 20-inch straight knife grinder. However, this grinding machine is not designed with the desired level of precision to allow grinding of TCT knives using standard diamond impregnated grinding wheels. The expert indicated that unless the straight knife grinding machine can be renovated to allow grinding wheel feeds of at least 1/10,000 of an inch then it would be better to purchase a new grinding machine, preferably a universal grinder, with such a required precision.

- J. The matter of fungus infestation on the coconut wood tile roofing on the eaves of the office building which is presently being constructed near the gate to the Centre's compound was brought to the attention of the expert by Mr. Brian Miller. The expert suggested that the fungus infested areas be brushed with a steel wire brush and then brushed or sprayed with CCA solution. The CCA solution for brushing purposes may be obtained from the sump tank which collects seepage out of the pressure treatment cylinder after each treatment run. The brushing and re-treatment operations should be done at least once annually, right after each rainy season.
- K. The matter of expanding operations to produce furniture and joinery items was also discussed with the Officer-in-Charge. It was pointed out that the primary pre-requisite to this proposed expansion should be the establishment of kiln-drying facilities. The volume of coconut wood currently being produced is good enough to justify the erection of at least two units of 5,000 BF charge per kiln unit. Small volume kilns, designed to burn woodwaste as fuel and with flue gas thus generated as the heating medium, have now been found effective in Southeast Asian countries. The same type of kiln-drier is recommended for the MAFF Coconut Wood Processing Centre.
- L. The matter of promoting the Centre as a training institution for coconut wood processing and utilization was also discussed with the Officer-in-Charge. The expert indicated that such a programme can be developed with the co-operation of other coconut-growing Pacific island countries, e.g., the French Polynesian islands, Vanuata, Tuvalu, Raratonga, etc., in the South Pacific area. Assistance from UNIDO on this matter may be sought through official channels.

NAFF COCONUT WOOD PROCESSING CENTER
Nuku'alofa, Tongatapu
Kingdom of Tonga



Figure 48

The main log break-
down saw at the
cocowood sawmill.

Figure 49

Edging and
ripping
operations are
done on this
circular saw.





Figure 50

Boards are cut to desired lengths
on this hand-operated cut-off saw.



Figure 51

A view of the preservative treatment
(pressure type) facilities.

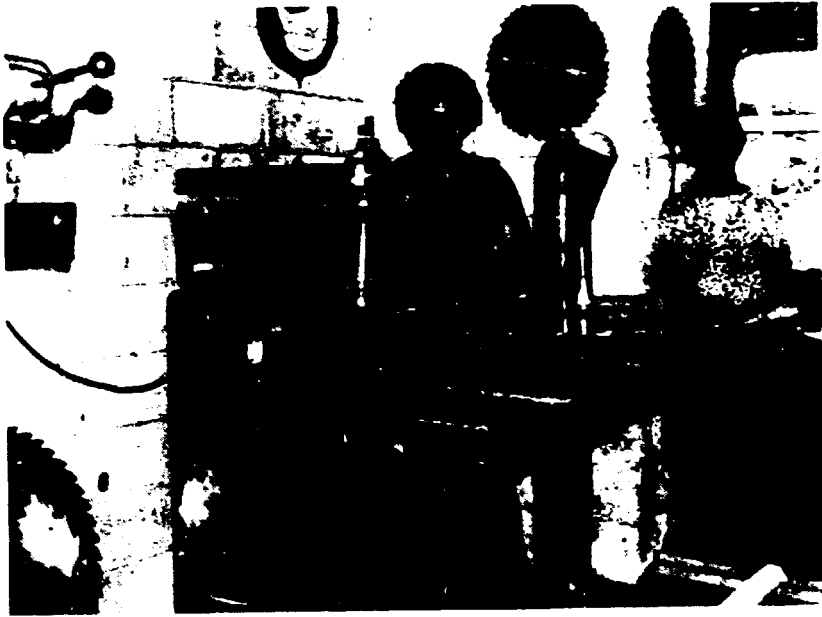


Figure 52

Silica grinding operations on the
main sawblade with TCT.

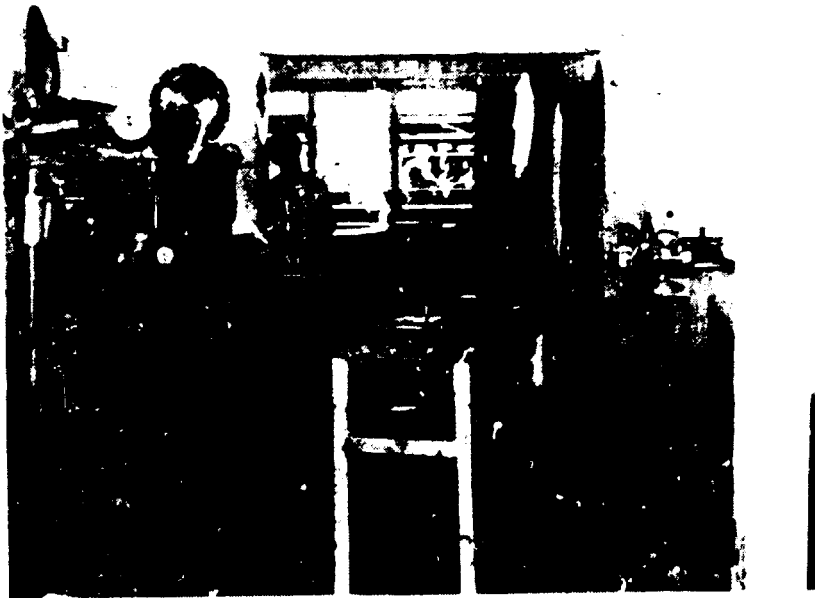


Figure 53

A view of the saw doctoring facilities.



Figure 54

A view of the
woodworking
facilities.

Figure 55

The vertical
spindle moulder
(shaper) on the left
and the stroke sander
on the right.



Figure 56

The planer/
thicknesser on the
right foreground,
with the shaper
behind it and the
stroke sander on
the left.



ANNEX XIII
FURNITURE AND JOINERY INDUSTRY SEMINAR
15 - 16 February 1988
International Dateline Hotel

Organized by the
United Nations Industrial Development Organization
and the
Ministry of Labour, Commerce and Industries
Kingdom of Tonga

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MONDAY, 15 FEBRUARY

- 8:30 a.m. - 9:00 a.m. - Registration
- 9:00 a.m. - Prayer
- 9:05 a.m. - Welcome Address
Mr. Desh B. Sahae, UNIDO Chief Technical Adviser
Ministry of Labour, Commerce and Industries
- 9:15 a.m. - Explanatory Remarks about the Seminar
Mr. Horatio P. Brion, UNIDO Consultant in
Furniture and Joinery Production
Vienna, Austria
- 9:30 a.m. - Government's Role in Promoting Furniture
Joinery Industries
Mr. Falekava T. Kupu, Assistant Secretary,
(Industries), Ministry of Labour, Commerce and
Industries
- 9:40 a.m. - Keynote Address by
Mr. Robert Foliaki, Acting Secretary
Ministry of Labour, Commerce and Industries
- 9:55 a.m. - Vote of Thanks
Mr. Maliepo Toma, Industrial Promotions Officer,
Ministry of Labour, Commerce and Industries
- 10:00 a.m. - Tea Break
- 10:15 a.m. - Organization of Participants and Distribution
of Workshop Assignments
- 10:30 a.m. - "GENERAL PRODUCTION MANAGEMENT CONCEPTS AS
APPLIED TO THE FURNITURE AND JOINERY INDUSTRY"
- 11:15 a.m. - Discussions

- 11:30 a.m. - (a) "DOCUMENTATION AND INFORMATION SYSTEMS FOR SMALL-SCALE FURNITURE AND JOINERY SHOPS" ;
(b) "BASIC COMMUNICATIONS PROBLEMS"
- 12:15 p.m. - Discussions
- 12:30 p.m. - Lunch Break
- 1:30 p.m. - "COSTING TECHNIQUES FOR SMALL-SCALE FURNITURE/ JOINERY ENTERPRISES"
- 2:45 p.m. - Discussions
- 3:00 p.m. - Coffee Break
- 3:15 p.m. - Plant Visit to Selected Furniture/Joinery Workshops:
 - (a) Commodities Board Joinery Workshop
 - (b) Tonga Wood Products, Ltd.
 - (c) TNT Builders Enterprise (Furniture/Joinery) Workshop

TUESDAY, 16 FEBRUARY

- 8:30 a.m. - "COCONUT WOOD AND OTHER NON-TRADITIONAL WOOD MATERIAL INPUTS FOR THE INDUSTRY"
- 9:15 a.m. - Audio-visual Presentation:
"THE PROCESSING AND UTILIZATION OF COCONUT WOOD IN HOUSE CONSTRUCTION AND FURNITURE/ JOINERY PRODUCTION"
- 9:45 a.m. - Discussions
- 10:00 a.m. - 10:15 a.m. - Tea Break
- 10:15 a.m. - "JIGS AND FIXTURES IN SMALL-SCALE FURNITURE AND JOINERY PRODUCTION"
- 10:30 a.m. - Discussions
- 11:15 a.m. - "BASIC QUALITY CONTROL; MATERIALS AND PRODUCTION SUPPLIES SPECIFICATIONS FOR THE SMALL-SCALE FURNITURE/JOINERY SHOP"
- 11:30 a.m. - Discussions
- 11:45 a.m. - "SELECTION OF MACHINERY; PLANT AND EQUIPMENT LAY-OUT AND LOW-COST AUTOMATION FOR SMALL-SCALE FURNITURE AND JOINERY SHOPS"

- 12:30 p.m. - Discussions
- 12:45 p.m. - Lunch Break
- 1:45 p.m. - Presentation of Workshop Project Assignments
- 3:00 p.m. - 3:15 p.m. - Coffee Break
- 3:15 p.m. - Evaluation of Workshop Project Assignment Presentation
- 4:15 p.m. - Closing Remarks
- Ms. Saane, Administrative Officer
Ministry of Labour, Commerce and Industries
- Mr. Isitolo Finau, Class President

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Resource Person and Lecturer:

HORATIO P. BRION
UNIDO Consultant in
Furniture and Joinery Industry

Committee on Evaluation of Workshop Project Assignment Presentation:

- Chairperson : Ms. Emiline Tuita, Senior Economist,
Tonga Development Bank
- Members : Mr. Falekava T. Kupu, Assistant Secretary
(Industries), Ministry of Labour, Commerce
and Industries, Kingdom of Tonga
- Mr. Desh B. Sahae, UNIDO Chief Technical
Adviser, Ministry of Labour, Commerce and
Industries, Kingdom of Tonga
- Mr. Horatio P. Brion, UNIDO Consultant,
Furniture/Joinery Production

The Tonga Chronicle
Where Time Begins
15 Seniti.
Volume XXIV, No. 37. Nuku'alofa, TONGA Friday, February 12, 1988.

Furniture seminar set

Furniture and joinery production, quality control, and management will be among the topics of an industry seminar Feb. 15-16 at the International Dateline Hotel.

Machinery selection, layout, maintenance, production planning, and use of coconut and non-traditional materials will also be discussed. Visits to Tongatapu enterprises will also be on the agenda.

Those interested in attending are invited to contact Mr D.B. Sahae, UNIDO business adviser and programme co-ordinator, at the Ministry of Labour, Commerce, and Industries, or telephone 21-888.

Participation is free. Participants will register at 8:30a.m. on Feb. 15 at the seminar venue.

Organized by UNIDO in association with the Ministry, the seminar will be the final phase of technical assistance provided by UNIDO to the industry.

Under the assistance, Mr H. Brion of the Philippines, who will be a key resource person for the seminar, is currently in the Kingdom, where he has visited some 12 enterprises in the industry.

ANNEX XV

THE SEMINAR/WORKSHOP ON FURNITURE/JOINERY PRODUCTION
International Dateline Hotel
Nuku'alofa, Kingdom of Tonga
15 - 16 February 1988



Figure 57

Acting Secretary,
Ministry of Labour,
Commerce and Industries,
Robert Foliaki, giving
the Keynote Address
on the opening day of
the seminar/workshop.

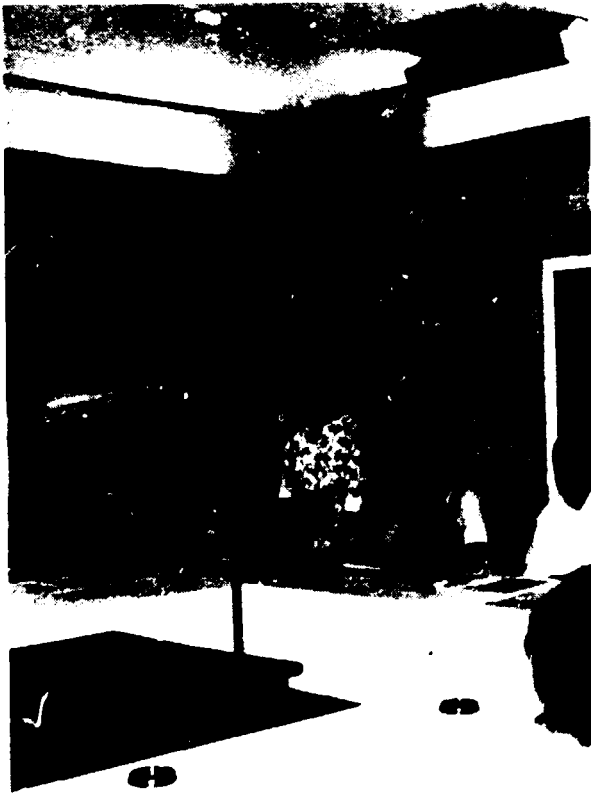


Figure 58

Ms. Saane, Administrative Officer,
Ministry of Labour, Commerce and
Industries, giving the Closing
Remarks at the end of the
seminar/workshop.



Figure 59
Participants in
the seminar/workshop.



Figure 60
Participants in the
seminar/workshop.

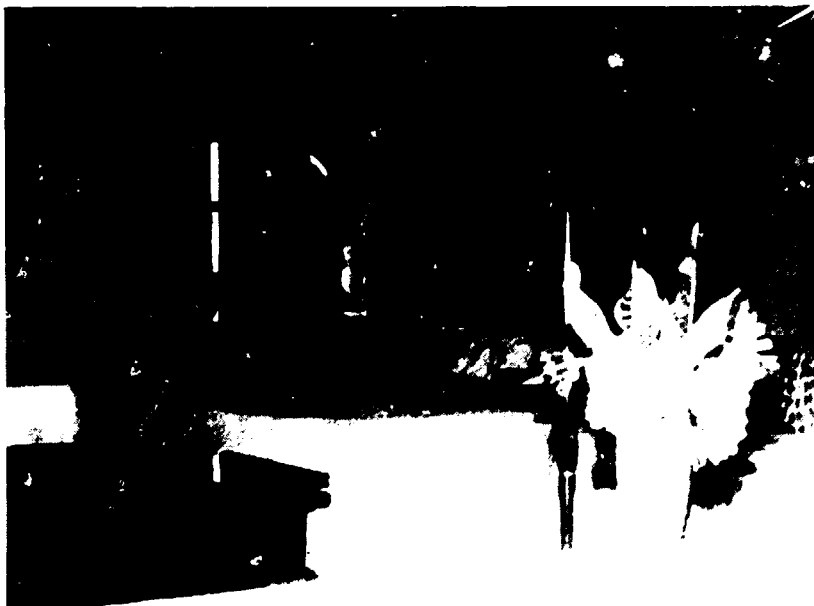


Figure 61
Participants in the
seminar/workshop.



Figure 62

The "BOSS" giving instructions to the worker in an exercise on communications problems.

Figure 63

The "SUE MINATE", executing the Boss' instructions by drawing figure on the blackboard.

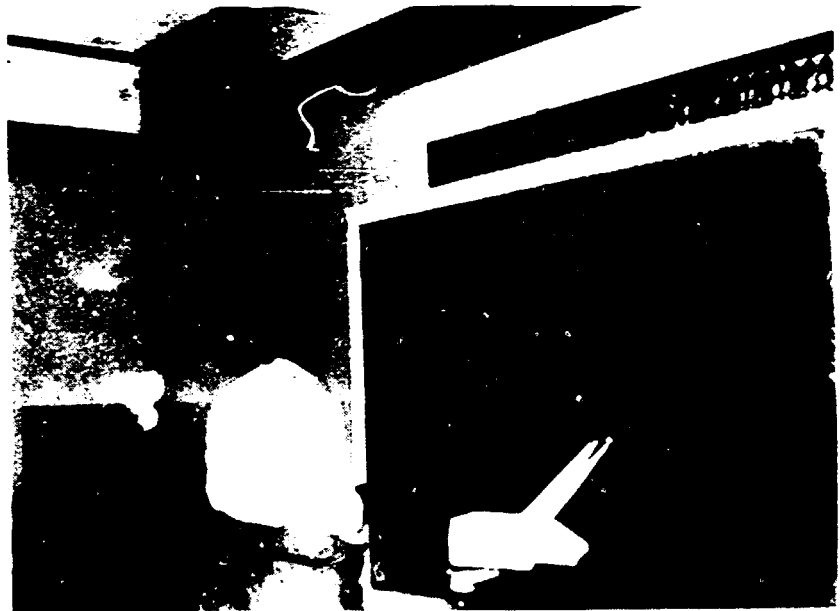


Figure 64

A small display of cocowood furniture items during the seminar/workshop.

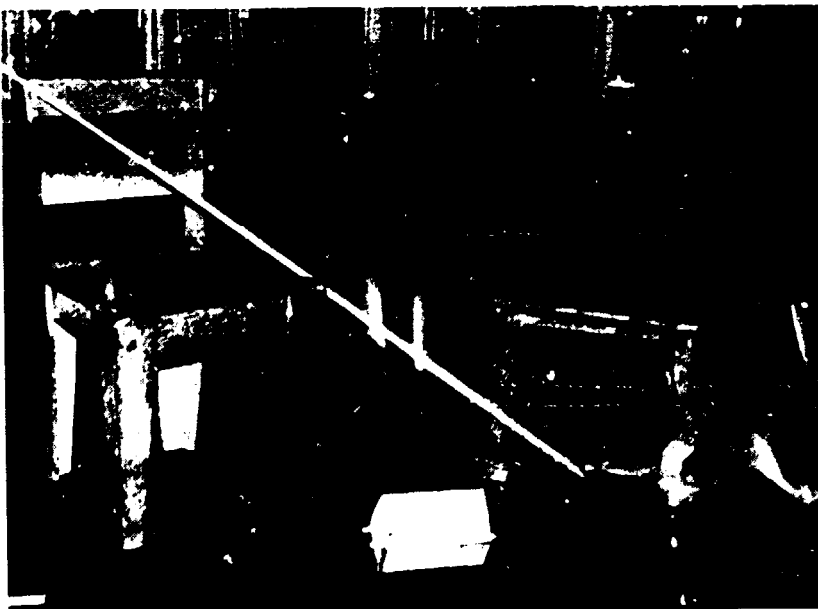




Figure 65

A Tea Table made of cocowood,
on display during the seminar/workshop.

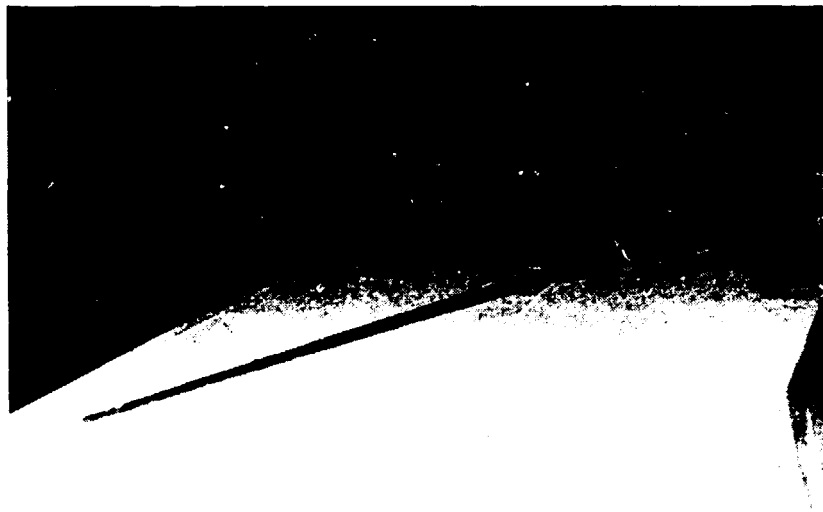


Figure 66

A Billard Cue Stick made of cocowood,
on display during the seminar/workshop.



Figure 67

A chair made of cocowood,
on display during the seminar/workshop.

ANNEX XVI

LIST OF PARTICIPANTS
UNIDO SEMINAR/WORKSHOP ON FURNITURE/JOINERY PRODUCTION

<u>Name</u>	<u>Address</u>
Manava'ofa Falemaka	Manava'ofa Enterprise Pangai, Ha'apai Islands Group
Mo'unga Falemaka	Manava'ofa Enterprise Pangai, Ha'apai Islands Group
Isotolo Finau	Jones Industries, Ltd. P. O. Box 34, Nuku'alofa
Taniela Hoponoa	Ministry of Agriculture, Forestry and Fisheries (Forestry Division)
Tevita Ika	Pangai, Ha'apai Islands Group (Applicant for Registration of Furniture Shop)
Sau Kakala	Jones Industries, Ltd. P. O. Box 34, Nuku'alofa
Viliami L. Blake Kava	Joinery Department, Construction Division, Commodity Board, Nuku'alofa
Taniela Lolohea	Esiaola Furniture Enterprise Haveluloto, Nuku'alofa, Tongatapu
Saiti Maipe'o	Neiafu, Vava'u Islands Group
Sunia Mafileo	Atenisi Institute P. O. Box 90, Nuku'alofa
Brian Miller	MAFF Coconut Food Processing Centre Nuku'alofa, Tongatapu
Tupouto'a Mulikiha'amea	Atenisi Institute, P. O. Box 90, Nuku'alofa
Sione Palometa	Marlboro Construction Co., Ltd. P. O. Box 673, Nuku'alofa
R. E. Raasch	Queen Salote College P. O. Box 116, Nuku'alofa
Carl Sanft	O. G. Sanft & Sons, Ltd. P. O. Box 32, Nuku'alofa
Neamani Sateki	T.N.T. Builders, P. O. Box 1357, Nuku'alofa
Takavaha Taukei'aho	T.N.T. Builders, P. O. Box 1357, Nuku'alofa
Teuili Taukei'aho	T.N.T. Builders, P. O. Box 1357, Nuku'alofa
S. M. Taukolonga	P. O. Box 223, Nuku'alofa

ANNEX XVII
UNIDO SEMINAR/WORKSHOP ON
FURNITURE/JOINERY MANUFACTURING
COURSE ASSIGNMENTS

I. PROJECT BACKGROUND

Your firm, the TONGA WOODWORKS, Ltd., has requested the TONGA DEVELOPMENT BANK for financial assistance in connection with the proposed expanded operations of your firm's Furniture and Joinery Manufacturing Division. Data on current and expanded operations as originally submitted to the Tonga Development Bank are as follows :

<u>Item</u>	<u>Existing Operations</u>	<u>Proposed Operations</u>
Production Output	20 Dining Sets/month	50 Dining Sets/month
Machinery and Equipment	(see attached list)	not submitted
Work Force:		
(a) Production	3 men	4 men
(b) Office	1 man	2 men
(c) Sales	none	1 man
Factory Lay-Out	(see attached sketch)	not submitted

II. PROBLEM

The Tonga Development Bank has deferred approval of your loan request pending submission of certain data and explanatory notes and compliance to some conditions which their Loan Appraisal Committee considers vital to the grant of the loan.

As members of the Technical Staff of Tonga Woodworks, Ltd. , you are assigned to prepare and justify (in person) the following :

GAME PLAN " A "

Prepare a Personnel Table of Organization for the proposed expanded operations, indicating the duties and responsibilities of each worker and officer of the firm. Justify the need for each work position.

GAME PLAN " B "

Submit a list of additional machinery and equipment needed by the expanded operations and present the corresponding plant lay-out. Justify.

GAME PLAN " C "

The Tonga Development Bank Loan Appraisal Committee is not yet convinced that your existing system to monitor and control usages of labour and materials is adequate for the proposed expanded operations. Please explain and illustrate (by means of diagrams) a more adequate system of monitoring the amount of labour and materials used everyday.

GAME PLAN " D "

The Tonga Development Bank Loan Appraisal Committee is concerned that the quality of the furniture products to be produced under the expanded operations may not be good enough to generate sales of 50 sets per month. The Committee has pointed out the present trend in the country for better quality furniture products. Prepare and submit a schedule of activities (Quality Control) to assure acceptability of the proposed products in the Tongan market.

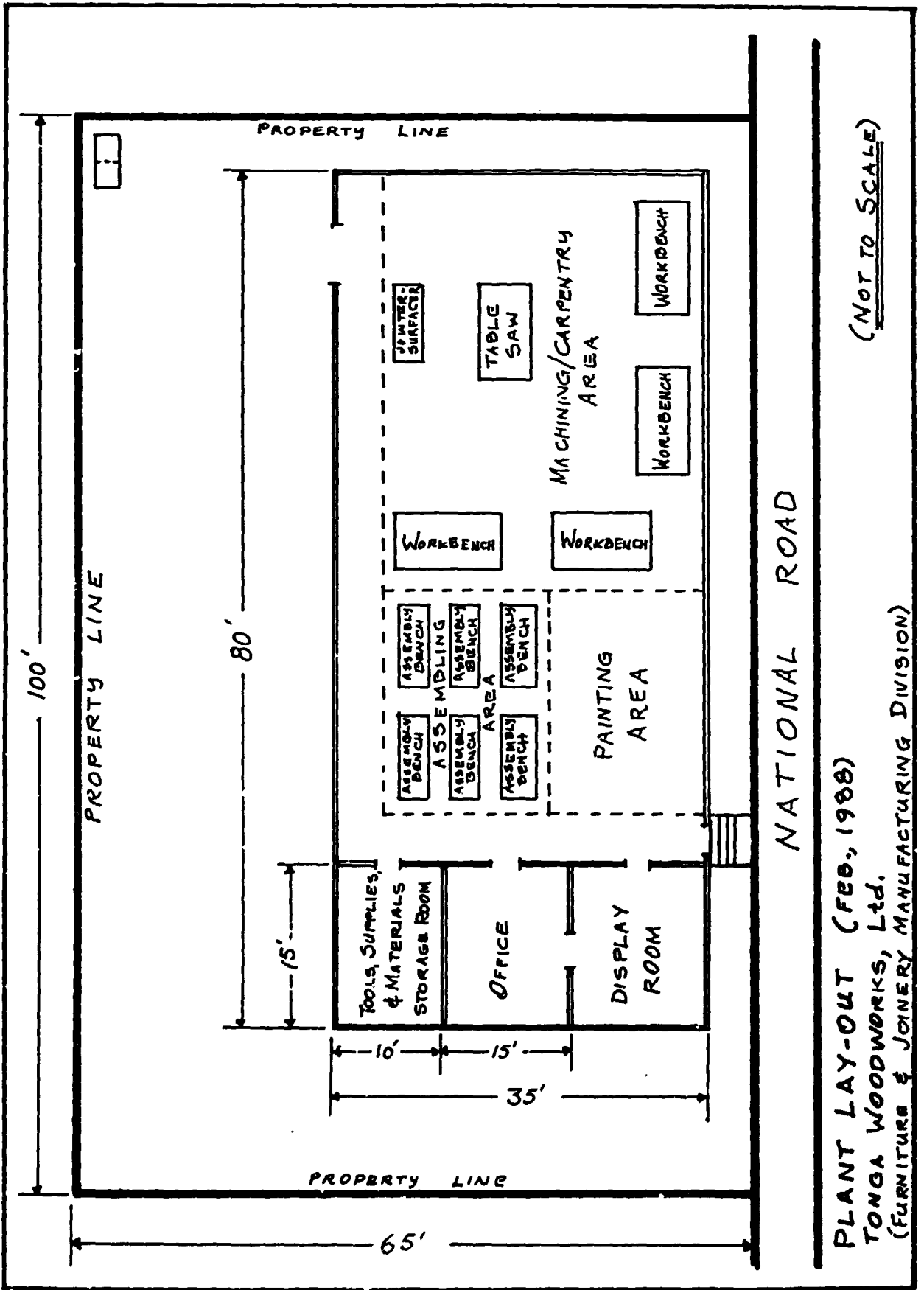
GAME PLAN " E "

The Tonga Development Bank Loan Appraisal Committee is not familiar with the Jigs and Fixtures which you claim will help produce more furniture parts with the use of the proposed machines, but requiring less manpower. Please illustrate by sketches and verbal explanation how the Jigs and Fixtures will increase the productivity of the proposed expanded operations. Use at least two different parts of the Dining Furniture to illustrate the use of Jigs and Fixtures.

TONGA WOODWORKS, Ltd.

LIST OF EXISTING MACHINERY, EQUIPMENT AND HAND-TOOLS,
1988

<u>No. of Units</u>	<u>Description</u>
1 unit	<u>Table Saw</u> : 14-inch sawblade diameter, 3,500 RPM saw spindle speed; 3 Horsepower, 230-250 Volts, 50-Hertz, single-phase electric motor (installed 1983)
1 unit	<u>Jointer-Surfacers</u> : 6-inch wide workpiece capacity, with accessories for 3/4-inch rebate; 4,500 RPM cutterhead speed; 3 Horsepower, 230-250 Volts, 50-Hertz, single-phase electric motor (installed 1983)
1 unit	<u>Portable Hand Router</u> : 22,000 RPM spindle speed; 1 Horsepower, 230-250 Volts, 50-Hertz, single-phase electric motor (purchased 1985)
1 unit	<u>Portable Hand Sander</u> : 4-inch wide sanding belt; 1/2 Horsepower, 230-250 Volts, 50-Hertz, single-phase electric motor (purchased 1985)
Assorted	Carpenter's Hand Tools (chisels, hammers, bar clamps, C-clamps, etc.)



ANNEX XVIII

BOX-PLANING JIGS FOR TAPERED TABLE LEGS

I. WORKPIECE DIMENSIONS (Refer to Figure 1)

<u>Workpiece Aspect</u>	<u>D I M E N S I O N S</u>	
	<u>Rough</u>	<u>Finished</u>
Length	L	L
Width (top end)	(B + 5/32"), minimum	B
Width (bottom end)	(B + 5/32"), maximum	A
Thickness (top end)	(B + 5/32"), minimum	B
Thickness (bottom end)	(B + 5/32"), maximum	A
Length of squared clearance for table frame corner attachment	-----	M

II. GENERAL SCHEME OF OPERATIONS

- A. Two jigs (No.1 and No.2) are required to obtain a full taper on two adjacent faces and a partial taper on the opposite adjacent faces.
- B. Box-planing jig No.1 is first used to obtain a full taper on two adjacent faces of the wooden blank (with a square cross-section, see Figure 3).
- C. Box-planing jig No.2 is used to obtain a full taper on the two adjacent faces opposite the faces tapered in the first two passes through the planer (see Figure 4).
- D. Box-planing jig No.1 is again used to plane two adjacent faces at top ends of legs to form a squared clearance (of length "M") for attaching the legs to the inside corners of the table frames.
- E. The jigs can be constructed to take in as many legs as is allowed by the working width of the planer/thicknesser (see Figure 2).

Note: Appropriate wedge-shaped Filler Blocks (shims) may have to be used to keep the leg blanks steady inside the box-planing jig, see Figures 5 and 6.

III. OPERATIONS SEQUENCE

Opn No.	Operation Name/Description	Machine Used	No. of Workers	Remarks Remarks
1	Cutting to length "L"	Radial Arm Saw	1	Use Gauge No.L-1
2	Ripping to rough width	Table Saw	1	Use Gauge No.W-1
3	Ripping to rough thickness	Table Saw	1	Use Gauge No.W-1
4	Box-Planing 1 Face	Planer/Thickneser	2	Use Box-Planing Jig No.2
5	Box-Planing Adjacent Face	Planer/Thickneser	2	Use Box-Planing Jig No.1
6	Box-Planing Opposite Face	Planer/Thickneser	2	Use Box-Planing Jig No.2
7	Box-Planing Adjacent rough face	Planer/Thickneser	2	Use Box-Planing Jig No.2
6	Box-Planing One face to get corner clearance "M"	Planer/Thickneser	2	Use Box-Planing Jig No.1; Use Gauges TL-1; TL-2; TL-3; and TL-4
9	Box-Planing Adjacent Face to get corner clearance "M"	Planer/Thickneser	2	Use Box-Planing Jig No.1; Use Gauges TL-1; TL-2; TL-3; and TL-4

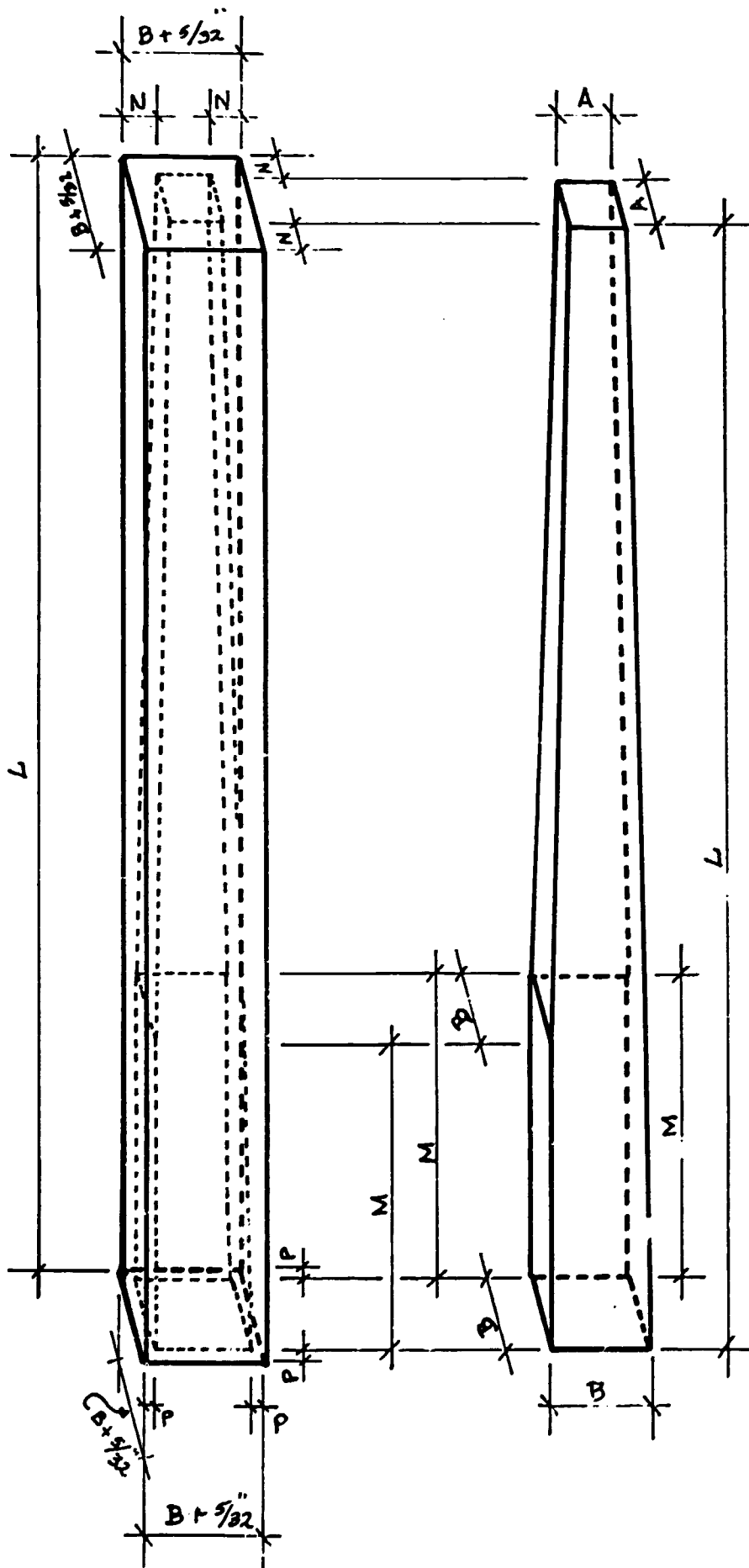


Figure 1 - Development of Tapered Table Leg from Squared Blank

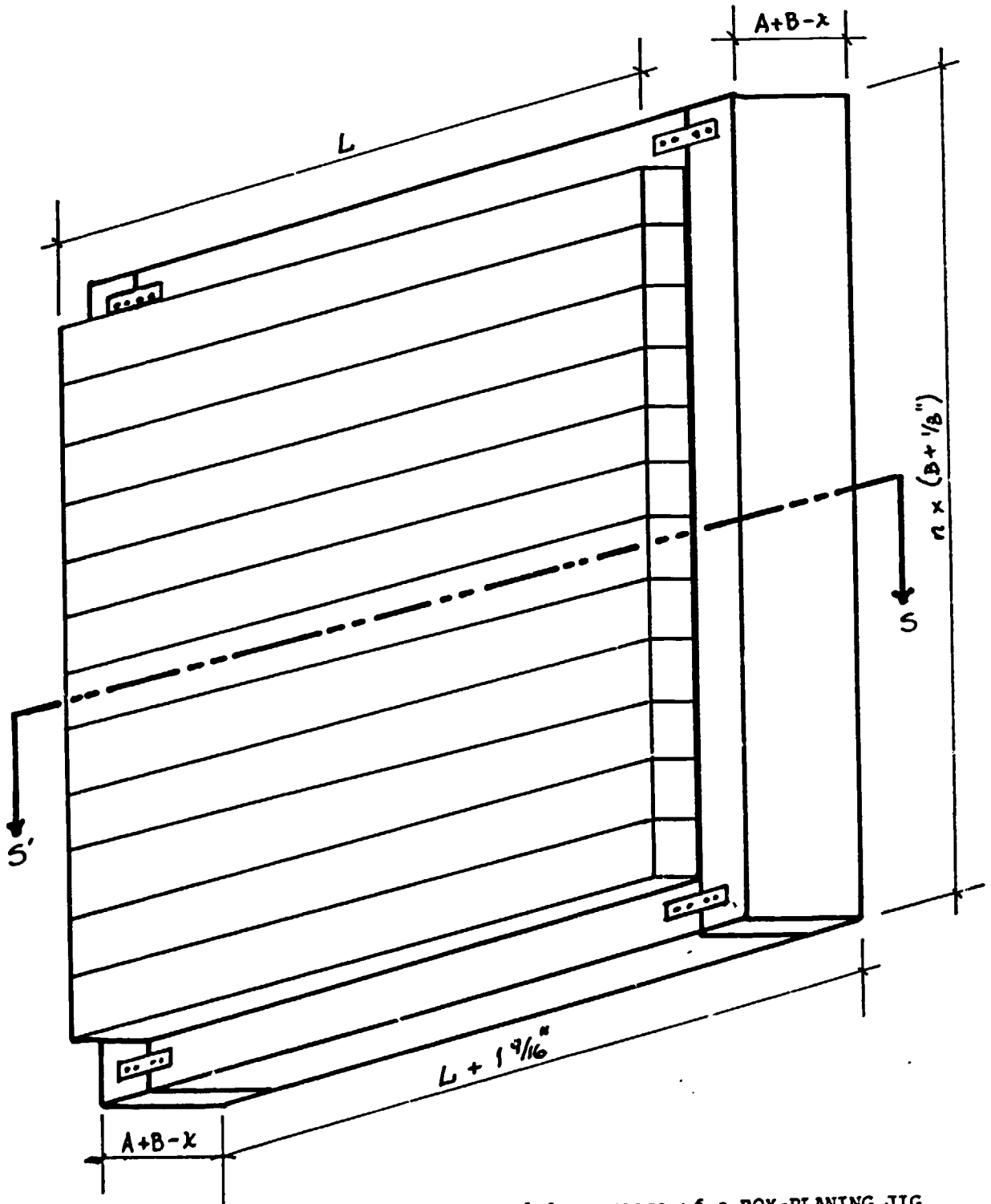


Figure 2 - General Appearance of a BOX-PLANING JIG

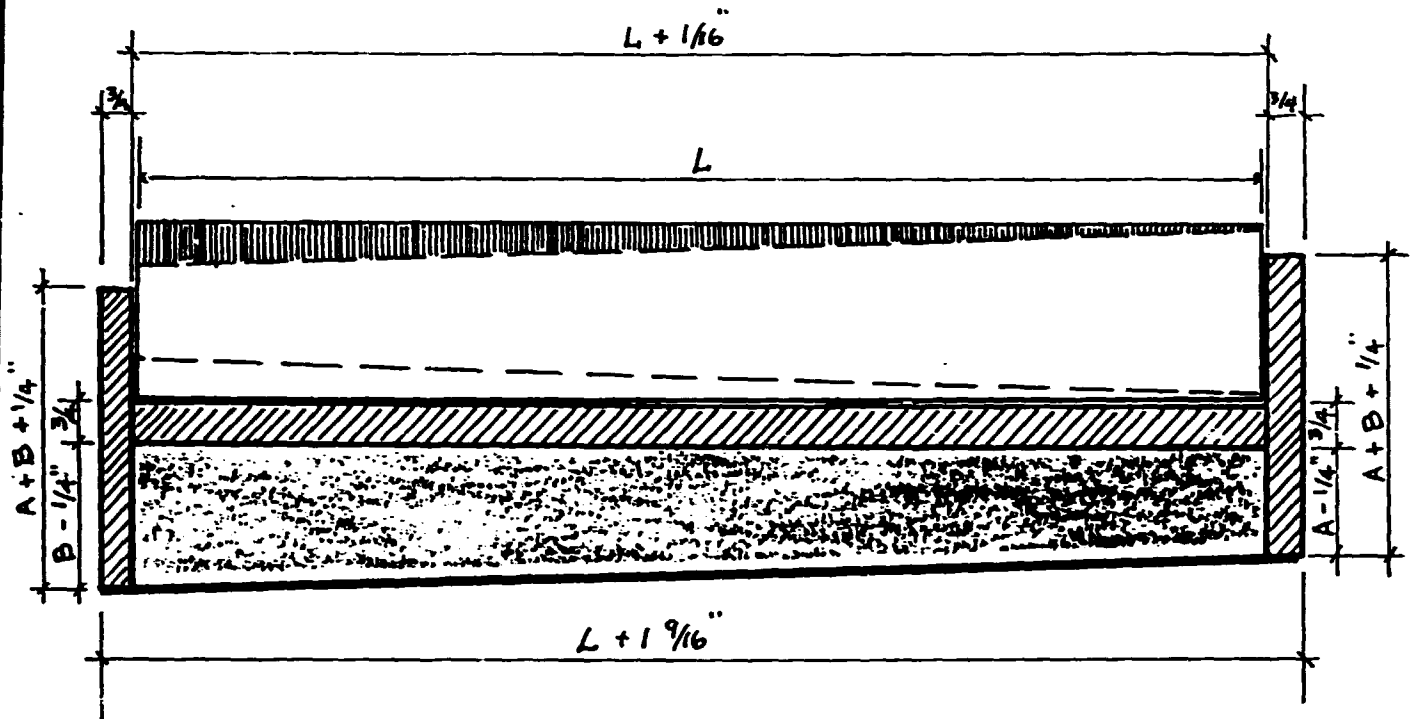


Figure 3 - Cross-section S-S', BOX-PLANING JIG No.1

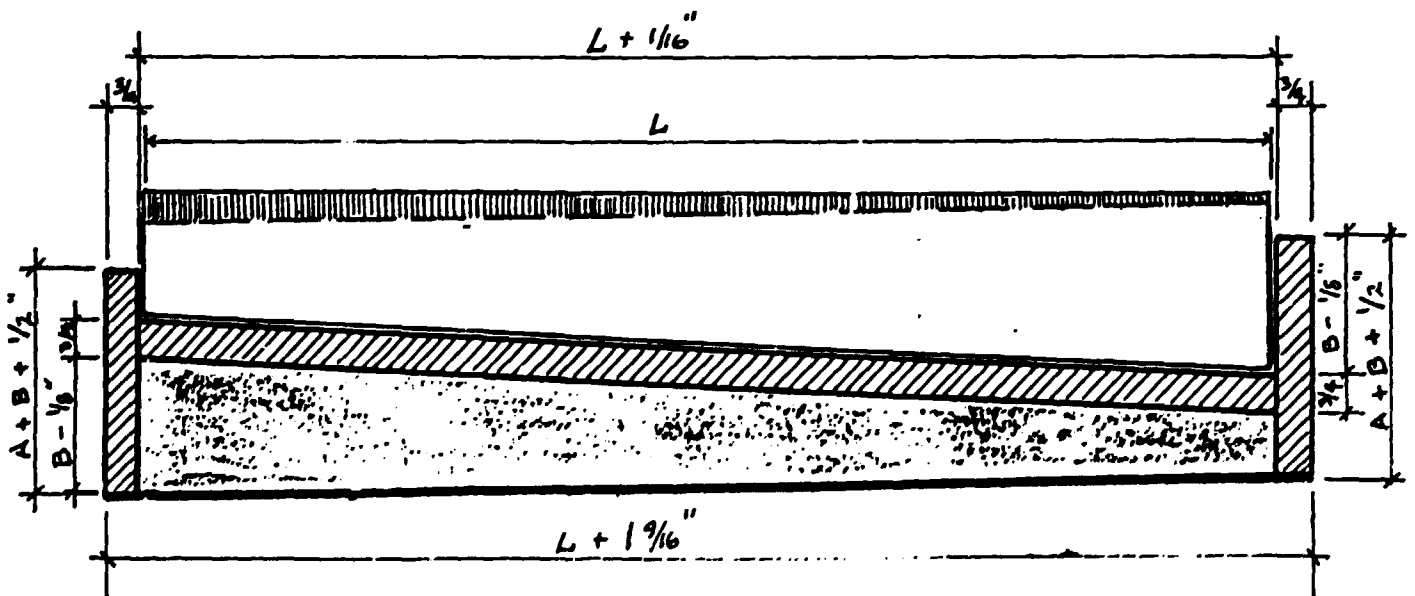


Figure 4 - Cross-section S-S', BOX-PLANING JIG No.2

Figure 5 - Wedge-shaped FILLER BLOCKS
(Shims) used in BOX-PLANING
JIG No.1

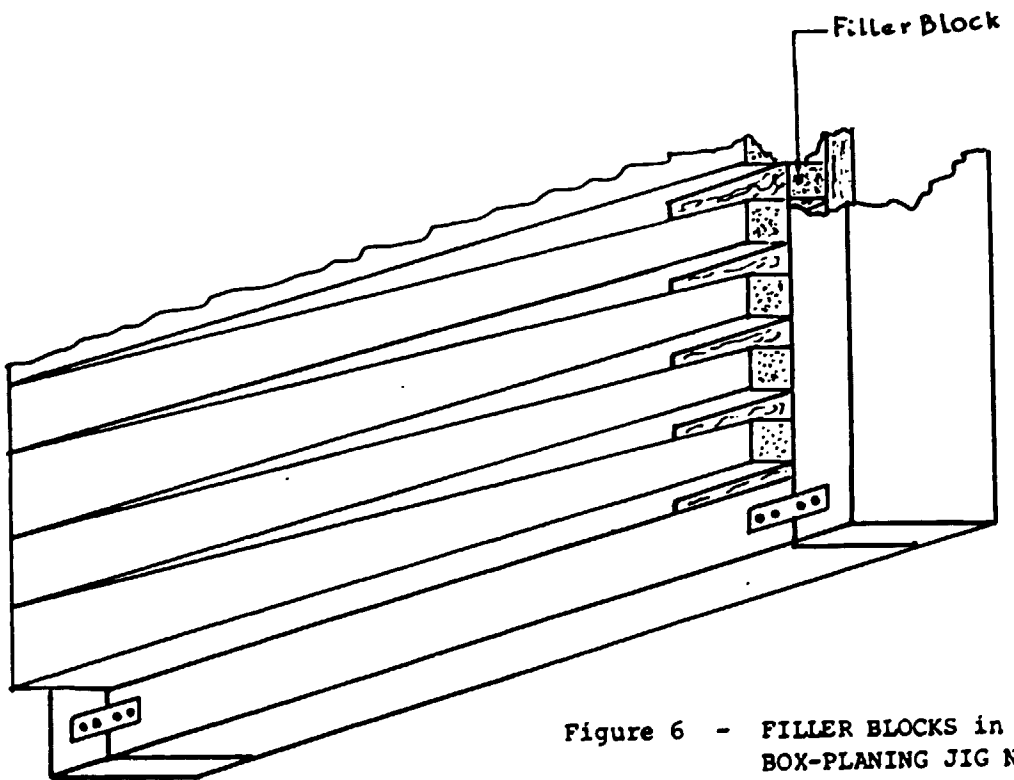
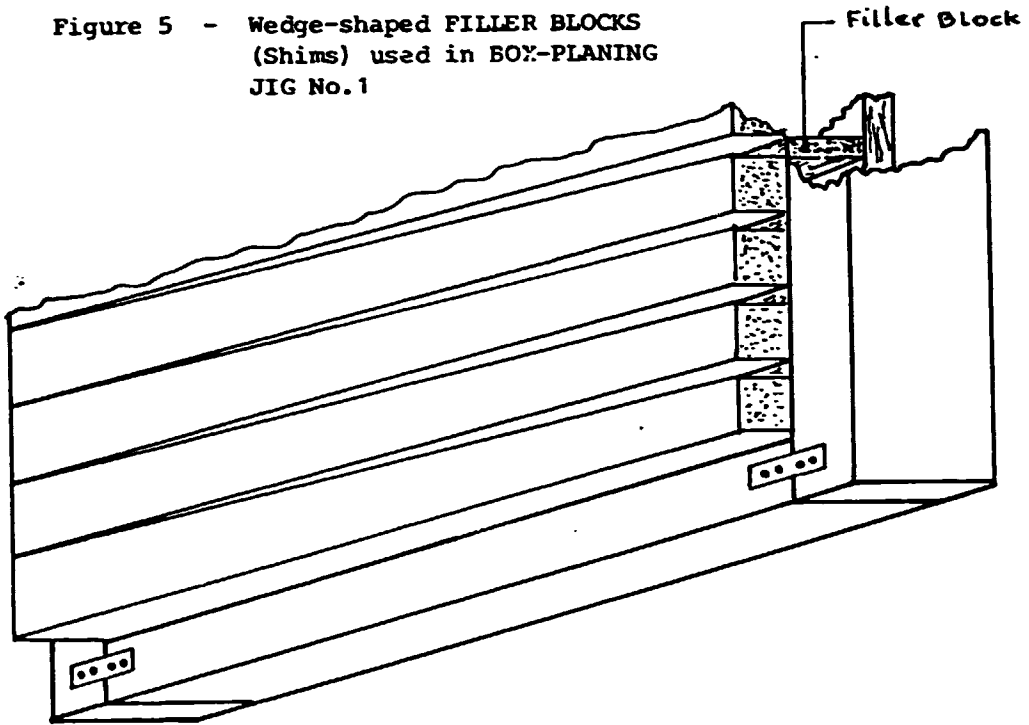


Figure 6 - FILLER BLOCKS in
BOX-PLANING JIG No.2

ANNEX XIX
SOURCE DOCUMENTS FOR
HAND-OUTS DURING SEMINAR/WORKSHOP

-----oOo-----

- Bassili, A. V. METHODOLOGY FOR THE PURCHASE OF WOOD-
WORKING MACHINES, UNIDO, ID/WG.256/26,
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- Brion, H. P. DEMONSTRATION OF COCONUT WOOD UTILIZATION
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484, Vienna, 1984
- Brion, H. P., Cruz, C. C.,
Garza, P. B., & Mariano, L. M. MANUAL ON DOCUMENTATION AND INFORMATION
SYSTEMS FOR FURNITURE AND JOINERY PLANTS
IN DEVELOPING COUNTRIES, UNIDO, ID/315,
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AND JOINERY INDUSTRIES, UNIDO, ID/154/Rev.1,
New York, 1983
- Canela, E. Q. PRODUCTION MANAGEMENT FOR SMALL- AND
MEDIUM-SCALE FURNITURE MANUFACTURING
FIRMS IN DEVELOPING COUNTRIES, UNIDO,
ID/300, New York, 1983
- Cody, D. MANUAL ON UPHOLSTERY TECHNOLOGY, UNIDO,
ID/275, New York, 1983
- Monnett, C. G., Jr. KNIFE GRINDING AND WOODWORKING MANUAL,
Dependable Machine Co., Greensboro, 1954
- Paavola, P., et.al. FURNITURE AND JOINERY INDUSTRIES FOR
DEVELOPING COUNTRIES, UNIDO, ID/108/Rev.1,
New York, 1981
- Paavola, P. J., & Ilonen, K. MANUAL ON JIGS FOR THE FURNITURE
INDUSTRY, UNIDO, ID/265, New York, 1981

ANNEX XX

JOB DESCRIPTION

- POST TITLE : Furniture and Joinery Production Expert
- DURATION : Three (3) months
- DUTY STATION : Nuku'alofa, Tongatapu, with possible travel within the country
- DATE REQUIRED : As soon as possible
- PURPOSE OF PROJECT : To up-grade the furniture and joinery industry of the Kingdom of Tonga through the training of key industry personnel in serial production techniques, proper maintenance and repair of machinery, equipment and cutting tools, the design, fabrication and application of production jigs and fixtures, proper choice and application of adhesives, correct selection and use of production abrasives, and the introduction of basic industrial plant practices that will help assure the continued correct and effective use of the technical know-how thus transferred.
- DUTIES : The Expert will be assigned to the Ministry of Labour, Commerce and Industries. The Expert, in cooperation with the officers and staff of the counterpart agency and some selected industry leaders, will provide "on-the-spot technical consultation" to the firms chosen by the Ministry to be the recipient of technical assistance during this mission. The Expert will:
- conduct seminar/workshop to train key industry personnel in the aspects of furniture and joinery production operations enumerated in the preceding paragraph.
 - demonstrate the techniques and practices presented at the seminar/workshop in each of the furniture and joinery factories which participated in the seminar/workshop.
 - conduct an evaluation of the effectiveness of the mission, and recommend the course of action and industry aspects to be covered in succeeding follow-up activities under the technical assistance programme.
- QUALIFICATIONS : Woodworking Engineer with extensive practical experience in small and medium levels of the furniture and joinery manufacturing industry, as middle and top levels manager. Consultancy experience in furniture and joinery products manufacturing in developing countries desirable.
- LANGUAGE : English
- BACKGROUND INFORMATION :

ANNEX XXI

JOB DESCRIPTION

- POST TITLE : Woodworks Plant Maintenance and Repair Expert
- DURATION : Three (3) months
- DUTY STATION : Nuku'alofa, Tongatapu, with possible travel within the country
- DATE REQUIRED : As soon as possible
- PURPOSE OF PROJECT : To up-grade the furniture and joinery industry of the Kingdom of Tonga through the training of key industry personnel in serial production techniques, proper maintenance and repair of machinery, equipment and cutting tools, the design, fabrication and application of production jigs and fixtures, proper choice and application of adhesives, correct selection and use of production abrasives, and the introduction of basic industrial plant practices that will help assure the continued correct and effective use of the technical know-how thus transferred.
- DUTIES : In cooperation with the Furniture and Joinery Production Expert, and in consultation with counterpart officials of the Ministry of Labour, Commerce and Industries, the Expert will:
- train local counterparts in plant maintenance and repair systems and techniques as applied to furniture and joinery manufacturing shops.
 - provide "on-the-spot consultancy services" to the local furniture and joinery factories.
 - assist in the conduct of training courses for key industry personnel
 - assist the Furniture and Joinery Production Expert in the evaluation of the mission and formulation of follow-up activities.
- QUALIFICATIONS : Mechanical and/or Electrical Engineer, with long experience in maintenance and repair activities in furniture and joinery factories. Experience in personnel training in plant maintenance and repair activities desirable.
- LANGUAGE : English
- BACKGROUND INFORMATION :