



**sINTERNATIONAL NETWORK FOR BAMBOO AND RATTAN
(INBAR)**

**TRANSFER OF TECHNOLOGY MODEL
(TOTEM)**

RATTAN FURNITURE MAKING UNIT

by
Wan Tarmeze Wan Ariffin,
Hamdan Husain,
Abdul Hamid Salleh

**Forest Research Institute Malaysia
Kepong 52109,
Kuala Lumpur,
Malaysia**

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TRANSFER OF TECHNOLOGY MODELS (TOTEMS)

Transfer of Technology Models (TOTEMS) are focussed educational tools providing relevant information and distance training on one specific area of bamboo/rattan management, processing or utilization. They are a means of technology transfer between similar regions throughout the world, with the emphasis on South-South transfer for livelihood development. They enable those involved in the management and use of bamboo and rattan resources to more efficiently and effectively develop and use skills relating to these resources.

TOTEMS are primarily intended as practical information resources and teaching aids for those at the local extension level in their communities, who can utilize them to assist local community development. Each TOTEM consists of a detailed written report of the technology, a PowerPoint presentation, a film, and, where relevant, a set of technical photographs. They also include information on target users, financial analyses of sample set-ups from the partner country preparing the report and information on where to source particular technologies (such as equipment). The TOTEM thus provides all the information required for establishing similar technologies within interested countries and regions.

- The **report** contains all the technical details of the particular processes involved, as well as other relevant information for establishing the technology such as costs of business establishment, running costs and cash flows.
- The **PowerPoint** presentation contains details of the relevant technologies and their applications, and is intended to provide an overview of the potential of the technology for development.
- The **film** provides a visual guide to the processes involved and helps to bring them alive in the minds of the learners.

The different parts of the TOTEM are targeted at slightly different audiences, via the local extension workers. The report and film are intended to be the main means of extension to the individuals and communities who will implement the technology and who will directly benefit from it. The PowerPoint presentation is primarily intended as a tool for the extension worker to sell the technology and its role in development to those who provide the infrastructural, policy and financial support for its implementation, such as government departments, donors and NGOs. There is considerable flexibility, however. Local extension workers will be able to incorporate the TOTEMS in their own work as they wish, and using the bibliography and list of web-sites will be able to adapt and develop the TOTEM to suit their particular requirements and conditions.

This TOTEM on the **Modern Rattan Furniture Manufacturing Unit** has been produced by Wan Tarmeze Wan Ariffin, Hamdan Husain and Abdul Hamid Salleh at the Forest Research Institute Malaysia (FRIM). It may be used alone, or in conjunction with the TOTEM on rattan pole stem bending, which has been produced at the Forest Products Research and Development Institute, Laguna, Philippines and the TOTEM on the rattan oil curing, bleaching and preservation unit, which has been produced at FRIM.



The report part of this TOTEM describes the technology for establishing a rattan furniture manufacturing unit for rural development in regions where rattan is available as a raw material. It is intended to be used in conjunction with the illustrative film included in this TOTEM package

The first part of the report introduces the technology, discusses its history, its development attributes, its benefits and its applicability. The second part of the report provides detailed information on the technical aspects of producing rattan furniture. **Appendix I** gives questionnaire forms used in the survey. **Appendix II** illustrates the locations of factories surveyed. **Appendix III** shows photographs of the process of manufacturing rattan furniture. **Appendix IV** is a list of publications on rattan furniture making.

This TOTEM is one of the first to be produced by INBAR/ FRIM and your feedback is most welcome - kindly contact INBAR or FRIM with your comments or suggestions.

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Note 1: This TOTEM has been edited at INBAR and differs slightly from the form in which it was received from the authors.

RATTAN FURNITURE AT-A-GLANCE

Why rattan furniture?

Rattan furniture has been produced since Roman times. The furniture is elegant, stylish and highly popular in many countries. During the early part of the 20th century most of the rattan furniture was produced in affluent countries that imported raw rattan from producing countries. Nowadays furniture is manufactured in the raw material producing countries and so the benefits of the high value-addition that manufacturing imparts remain in the producing country.

What is the market for rattan furniture?

The market for rattan furniture is very large and it accounts for a significant proportion of the export earnings of countries such as Malaysia and Indonesia. The international markets are particularly lucrative, and much of the rattan furniture produced is sold to more affluent countries in Europe and America. The markets are expected to continue to develop.

What is the role of a rattan furniture making unit in rural development?

A rattan furniture making unit will provide a significant number of jobs to local people, both in the unit itself and in its forward and backward linkages. The unit is non-polluting and can be established in conjunction with a number of other related units, such as the steam bending unit and the rattan oil curing, bleaching and preservation unit as an integrated community project. The unit should only use rattans harvested from sustainably managed forests or plantations, and thus promote environmental protection. Local plantations could be established to supply the unit.

How do I establish a rattan furniture making unit?

A rattan furniture making unit requires considerable start-up capital, land, and reliable supplies of raw materials, labour, electricity and water. The unit described in this model would cost USD \$ 84, 000 to establish and USD \$ 53, 000 to run each month, and would generate pre-tax profits of USD \$10, 000 per month.

PART ONE

INTRODUCTION

DEVELOPMENT ATTRIBUTES, TARGET GROUPS and BENEFITS of a

RATTAN FURNITURE MANUFACTURING UNIT

1. Introduction to the rattan furniture manufacturing unit

Rattan furniture manufacturing is the process of converting rattan poles and other rattan materials into furniture. The process can be as simple as a backyard enterprise and as complicated as the medium- to large-sized industry. In this TOTEM, a model of a furniture manufacturing company is proposed with appropriate information on financial viability and technical requirements. The model was developed based on the data and information collected during a recent survey of some medium-sized rattan furniture factories in the western states of Peninsular Malaysia. The questionnaire used in the survey is shown in **Appendix I** and locations of the factories visited are depicted in **Appendix II**.

2. Development of the rattan furniture industry in Malaysia

Looking back at history, it can be said that the rattan furniture manufacturing industry in Malaysia has grown significantly only in the last decade. Before that, the Malaysian rattan industry was dominated by the exportation of raw and semi processed rattan materials to other furniture manufacturing countries such as Hong Kong and Singapore that have no natural rattan resources of their own. In 1986 these countries exported USD 19.6 million and USD 8.5 million worth of rattan furniture respectively. Malaysia, in the same year, exported a mere USD 2.6 million.

Realizing these discrepancies, the Malaysian government took a drastic measure by banning the export of rattan commencing December 1989. The ban was aimed at encouraging the development of rattan products manufacturing especially of furniture by ensuring a consistent and affordable supply of raw materials. The value of rattan furniture exported from Malaysia has increased since then to about USD 24.0 million per year now.

3. General development attributes and advantages

The main development attributes of the technology are as follows:

- Creates a large number of income generation opportunities
- Increases community welfare
- It is gender sensitive
- Promotes rattan furniture as a substitute for timber-wood furniture

The main advantages of the technology are:

- The furniture is durable, light and popular
- The unit can easily be adapted to the production of a wide range of different designs
- The same sub-assemblies can be used for a number of different products

4. Suitable agro-ecological regions

All regions in which rattans grow naturally are suitable, such as the Philippines, Malaysia, Indonesia, Laos, and Vietnam in Asia and Ghana, Cameroon and other West African nations. Many other tropical regions where they do not presently grow would also be suitable, such as many of the countries of Latin America.

5. Target groups

There are two main target groups. The first are those who will be employed in the unit. The unit will require unskilled, semi-skilled, technically trained and management personnel and many of these people can be recruited from the local villages. Staff with skills in marketing and design will also be required and there will be many opportunities for training and skills upgradation of existing staff. Most of the activities involved in making rattan furniture are gender sensitive and suitable for men or women. The female workers may be allowed to dominate the least arduous tasks like sanding, scrapping and packaging, leaving other laborious jobs to the male workers. The second group are those who cultivate and harvest the rattan raw materials for the unit who will benefit from the increased demand for poles.

6. Benefits

The unit will create employment and income generating opportunities for a wide range of people and will improve the economies of the rural communities in which is established. The income generating potential of the unit is considerable because of the high level of value addition the processing imparts, and indeed if established as a community cooperative venture and well run, the community should benefit considerably. Increasing the area of rattan plantations and improving management practices will benefit the local environment and those involved with their cultivation.

7. Requirement for success

Rattan furniture manufacturing can be considered as skill dependent. The technologies and skills needed could be learned from craftsmen in Malaysia as well as from the neighbouring countries, especially the Philippines.

The **financial aspects** required to operate rattan furniture manufacturing business may differ from one country to another. For countries like Vietnam and Laos, the labor costs may be far cheaper than those of Malaysia. The cost of purchasing machinery may also vary depending on the rate of import taxation imposed by the respective governments.

The rattan furniture manufacturing business can be best run as **small and medium scale industry** (sole proprietorship). It is also suitable as a community cooperative business since the villagers can become the workforce. In Malaysia, rattan furniture manufacturing has been taught to the aborigines as a way to upgrade their standard of living.

In whatever type of existence, to be successful, the rattan furniture manufacturing business needs a substantial amount of

- Funding,
- Consistent supply of raw material and
- Secured skilled workforce.

8. Potential improvements and research needs

The rattan furniture manufacturing industry still needs a lot of **research and development** efforts in order to maintain its relevancy to other industries in the world. While the world has seen a growing concern on the **environment**, rattan furniture manufacturers should strive more in adapting and developing better and systematic method to select and use rattan materials to **minimize wastage** and to **ensure the highest quality furniture**, both in terms of appearance and the in-service strength. Better techniques could be developed to **lessen the damage** on rattan materials during the manufacturing processes. **Mechanization** of certain processes would help in reducing dependency on skilled labor while maintaining the uniformity of the products. Inevitably, **new designs** of rattan furniture would be required to suit the changing life styles in the next millennium.

Concluding remarks

The rattan furniture unit is a medium or large scale venture requiring considerable start-up inputs and a number of experienced personnel. The unit is equally suited to men and women and opportunities for career enhancement and development in this large unit will encourage and empower the staff. The unit can easily be established at community level, preferably as a cooperative venture. But due to the high level of initial investment required it may be appropriate to establish the unit with the assistance of state agencies or NGOs to ensure the venture is successful and the community are the true beneficiaries.

PART TWO

THE RATTAN FURNITURE MANUFACTURING UNIT

1. Introduction to rattan furniture

Rattan furniture is produced by the following basic steps

- Selection and classification of poles
- Straightening of poles
- Measuring poles and cutting to length
- Bending and moulding poles
- Drilling, grooving and end-coping components
- Assembling components
- Binding and weaving components together
- Scraping and sanding
- Finishing

2. The model rattan furniture factory

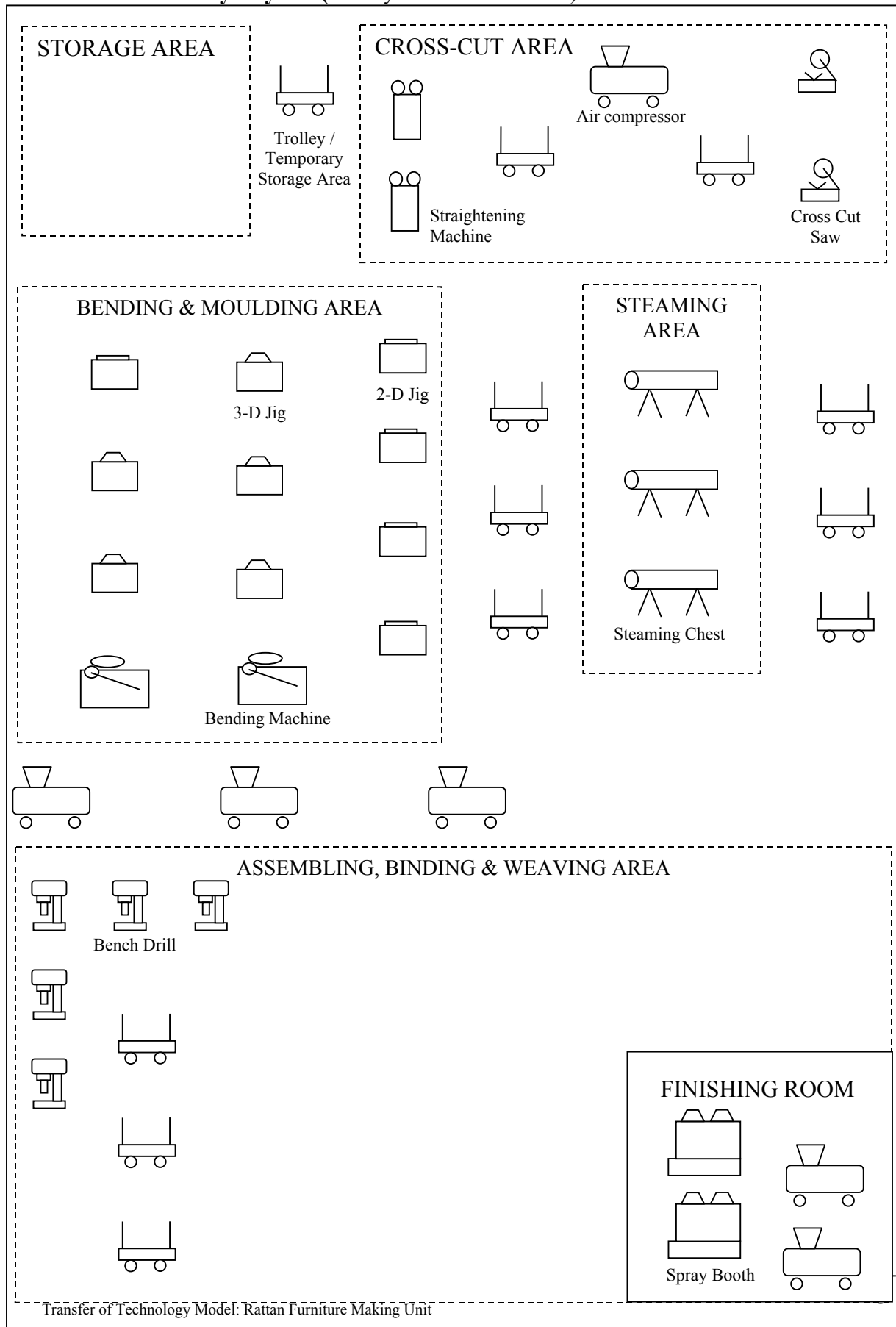
2.1 Characteristics of the Model Company

From the survey conducted, it is highly recommended that rattan furniture manufacturing be run by an individual or with a partner who oversees the overall operation of the company. The details of the proposed company set up are shown below.

Table 1. Detailed Set-up of the Model Company

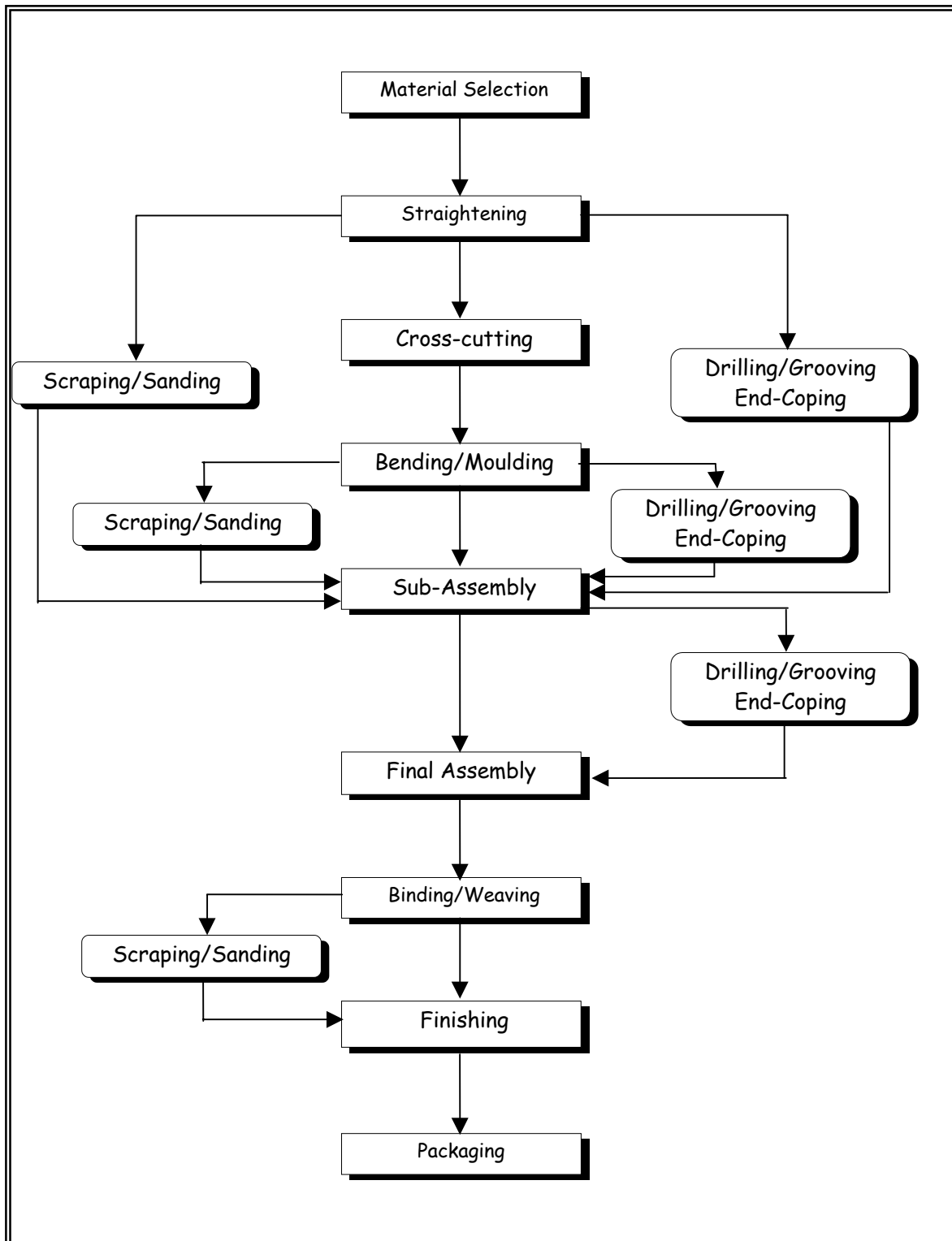
Item	Description
1. Type of Company	Sole Proprietorship
2. Workforce	45 person (including 7 managerial workers)
3. Factory Size	1 hectare land area 1800 m ² factory floor area
4. Major Products	2 + 1 Living Room Set Basic frame = 100 % from peeled manau Medium end quality
5. Market	United Kingdom
6. Capacity	4 containers (40 footer) per month 100 sets per container
7. FOB Values	USD16,000 per container
8. Total Sales per month	USD64,000

2.2 Model Factory Layout (Factory Plan = 30 m x 60 m)



3. Manufacturing methods

Generally, rattan furniture manufacturing involves processes as described in the flow chart below. Descriptive photos of the processes are shown in **Appendix III**.



3.1 Rattan selection

Rattan poles are selected according to grades and the quality of furniture they are intended for. The criteria for rattan grading and classification are as shown in Table 3 and Table 4 below.

Table 2. Grades of Rattan Poles by Surface Quality

	Grade	Criteria
Natural	1/1	No black or brownish spots
	1/3	Little spots
	4/5	Many spots
Peeled	A	Uniform whitish color
	B	Some discoloration

Table 3. Classification of Rattan Poles by Diameter

Size	Diameter
1	40 mm and above
2	35 – 39 mm
3	30 – 34 mm
4	25 – 29 mm
5	24 mm and below

Grade 1/1 refers to the highest quality rattan poles with smooth and clear skins. These poles are normally used as main frame components such as backrests and legs. Grade 1/3 poles are used for the shorter and hidden components such as bracers. The outer skin layers of grade 4/5 poles are normally removed to produce even, off-white, uniform, peeled rattan poles. The peeled rattan poles are then further sorted into grades A and B.

Grade A rattan poles with diameters of 30 to 34 mm (the most popular for furniture making) are used in this proposed rattan furniture manufacturing factory model,.

The species of rattan commonly used by the furniture industry are shown in Table 4 below.

Table 4. Rattan Species and their Uses

Botanical Names	Local Names	Remarks/Uses
<i>Calamus manan</i>	Rotan manau	Considered as the best quality rattan species. Highly pliable. Used as furniture frame.
<i>Plectocomia spp.</i>	Rotan mantang	Less expensive substitute to manau. Used as furniture frame.
<i>Calamus caesius</i>	Rotan sega	Processed into high quality skins (binding materials), splits and cores (for weavings)
<i>Calamus trachycoleus</i>	Rotan irit	High quality skins, splits and cores

3.2 Straightening rattan poles

Rattan poles are normally bent out of shapes a little bit due to their inherent properties and because they are stored vertically. The bent rattan poles are straightened either manually or using pneumatic straightening machines (Photo 1). Straightened rattan poles ease the processes of making higher quality rattan furniture.

3.3 Measuring and crosscutting

The straightened rattan poles are measured and cut to the desired lengths. Measurements can be made using a 1:1 scaled plan. It is better to use pencil for marking the length so it can be easily erased. Measuring and cross cutting could also be done simultaneously using a radial arm-saw with adjustable stoppers (Photo 2).

3.4 Bending and moulding

Before bending into the desired shapes, rattan poles are heated so that they become soft and pliable. Heating of rattan poles is normally done in steaming chests (Photo 4) for 20 to 30 minutes. Sometimes, blowtorches are also used to pre-heat the rattan parts that need to be bent.

Two dimensional furniture components are produced using jigs made from wooden blocks and plywood board. The rattan poles are manually bent by pressing them against the wooden block stoppers arranged on the plywood surface of the jig (Photo 5). Clamps of mechanical or pneumatics types are added to the jig to secure the rattan poles inside.

The jigs for moulding 3-D components are more complicated with wooden block stoppers (of various shapes) arranged on several plywood boards unparallelled to each other (Photo 6). Bending and moulding, especially for simple 2-D components could also be done using machines (Photo 7).

The setting time of simple bends and moulds is about four hours and the time is longer for more complicated shapes.

3.5 Drilling, grooving and end-coping

Many rattan furniture components, especially the seat and backrest, are drilled with a series of holes for inserting slates (smaller rattan poles or cores) or grooved for inserting rattan webbing.

Depending on the shape of the furniture components, the drilling and grooving are done either prior to or during the assembly process. For the straight components, drilling and grooving are achieved using bench-drill units (Photo 3). For the moulded components, drilling and grooving are done manually using a hand drill when the basic frame is assembled.

Some ends of the components are cut into a half-moon shape using a special drill bit. Half-moon ends ease the jointing of the components together during the assembling process. Furthermore this method which is also known as ‘coping’, strengthens the joints.

3.6 Assembly

The furniture components are assembled together to form frame structures. Screws and nails are commonly used to join the components.

Assembly is done in two stages: a) sub-assembly to form basic frame structures and b) final assembly to attach additional components. A basic frame structure is made of components such as legs, arm supports, backrest and seats. The additional components include leg bracers, seat slates and back slates.

The assembly work is best done on a workbench equipped with various jigs and fixtures (either made of wood or steel) to ease in clamping, stopping and arranging the furniture components before fastening takes place (Photo 9).

3.7 Binding and weaving

Various types of materials have been used in the industry for binding and weaving works. The popular materials are rattan skins, splits and cores. Sometimes, leather and plastic strips are also used. While leather bindings are normally chosen for the high-end rattan furniture, plastic bindings are gaining popularity, especially in rattan chair sets used in western pavement cafes.

In this model 6 mm wide rattan splits (without skins) are used as the binding materials.

Some workers prefer to sit on a low stool or even on the floor to do this work (Photos 10 and 11), while others like to work at a low bench on which the frame is placed. Either sitting down or standing up, it is important to ensure comfortable working conditions and that the materials needed are readily available so that the binding time is reduced to a minimum.

3.8 Scraping and sanding

Scraping and sanding are used to smooth the surfaces of the components. The work is done at various times during the workflow and can be done after cross cutting, after bending and moulding, after assembly and during the finishing process.

After bending, sanding is required to polish the rough rattan surface due to the steaming process or to remove burn marks caused by the blowtorch. Scraping is done using a hand scraper to remove excessive putty (the paste applied on to fill holes and gaps in rattan frames). A pneumatic hand scraper is used to level the protruding rattan cores that have been plugged in to hide the screw or nail heads (Photo 13).

The sand paper grit sizes are selected based on when the sanding processes are done. A grit size of 220 is used for sanding before the finishing process. During the finishing processes, grit sizes of 280, 320 and 360 are used.

Sanding can be done manually or by using machines (Photo 15 and 16).

3.9 Finishing

Finishing is another important stage to ensure the final quality of furniture. Spray guns powered by compressed air are used for spraying the furniture.

The best finishing quality can be achieved in enclosed spraying rooms equipped with spray booths (Photo 18) and a proper exhaust system.

The workers must wear proper personal protective equipment (PPE) that conforms to the standards imposed by the government.

4. Comprehensive input requirements

4.1 Workforce

In the proposed set-up, a medium-sized factory with a workforce of about forty-seven employees, the presence of skilled and experienced workers plays an integral part in the daily operation. The detailed distribution work force and the wages are shown below.

Table 5. Work Force Distribution in the Model factory

Department	Position/Skill level	Number of workers	Wage (USD)	Total (USD)
A. Managerial, clerical, design, marketing	a. Manager	1	700	700
	b. Clerk	2	150	300
	c. Designer	1	250	250
	d. Supervisors	3	500	1,500
B. Cross cutting, drilling, bending and assembling	a. Skilled	7	400	2,800
	b. Semi-skilled	3	200	600
C. Scraping, sanding and filling	a. Semi-skilled	2	130	260
	b. Unskilled	10	100	1,000
D. Binding and weaving	a. Skilled	7	400	2,800
	b. Semi-skilled	3	200	600
E. Finishing	a. Skilled	3	270	810
F. Packaging	a. Unskilled	3	100	300
			Total	11,920

Notes: **Skilled** = Normally craftsmen with more than 10 years experience (Malaysian or Philippines); **Semi-skilled** = Younger generation with potential skill and work as apprentices under supervision of the master craftsmen; **Unskilled** = Apprentice for less skill required task

4.2 Raw material acquisition

The major raw materials and the cost to produce the proposed capacity of rattan furniture are shown in Table 6 below. Peeled manau and peeled mantang poles are used for making basic frame components and additional components, respectively. Rattan splits (without skin - grade C) are bought in bundles to be used as the binding materials.

Table 6. Major Raw Material Requirements for the Model Factory

Material	Quantity per month	Price (USD)	Total (USD)
Peeled manau poles (grade A) 3 m length 30-34 mm diameter	12,000 poles	2.00 per pole	24,000
Peeled mantang poles (grade 1/3) 3 m length 25-29 mm diameter	5,000 poles	0.80 per pole	4,000
Rattan split (grade C) 6 mm	350 kg	2.00 per kilo	700
Lacquer	400 liter	3.00 per liter	1,200
Thinner	600 liter	0.50 per liter	300
Screws	20,000	0.10 per piece	2,000
Total			32,200

4.3 Tools and machines

The tools and machines can either be imported from Taiwan and Japan or fabricated locally whenever practical and economical. Due to their lower prices, the Taiwanese machines are selected to perform less critical jobs such as cross cutting and drillings. Meanwhile, for assembly, binding, weaving and spraying, it is recommended that the Japanese pneumatic hand tools be used. The Japanese tools that have a good reputation in terms of longer service life and fewer breakdowns and will ensure the manufacturing processes are done smoothly without frequent disturbances caused by jammed parts of the tools.

The quantity and price of the tools and machines required to set up the factory are shown in Table 7 below.

Table 7. Tools and Machines for Rattan Furniture Manufacturing

Item (Country of origin)	Quantity	Price per unit (USD)	Total (USD)
Cross cut saw (Taiwan)	5	200	1,000
Straightening machine (Local)	2	1,500	3,000
Bending machine (Taiwan)	2	1,300	2,600
Bench drill (Taiwan)	5	150	750
Air compressor (Japan)	6	1,000	6,000
Spray gun (Japan)	6	100	600
Staple gun (Japan)	10	120	240
2-D mould bench (Local)	5	130	450
3-D mould bench (Local)	5	160	800
Pneumatic screw driver (Japan)	10	90	900
Pneumatic nail driver (Japan)	10	100	1,000
Spray booth (Local)	2	1,300	2,600
Steaming chest (Local)	3	300	900
Blowtorch (Taiwan)	6	100	600
Total			21,400

4.4 Maintenance of machines and tools

Requirements for the maintenance of machines and tools used in rattan furniture manufacturing are not absolutely vital. However, since most of the machines and tools are powered by compressed air, the compressed air generation and distribution systems must be carefully designed and maintained to ensure that the air produced is clean and free from moisture and debris.

Many factories have neglected these requirements. As a result, the moving parts in the machines and tools go rusty faster than they are supposed to. Consequently, these will degrade the performance and shorten the service life of the machines and tools.

4.5 Facilities and institutional supports

4.5.1 Facilities required

While it is ideal for the industry to operate within an industrial zone, it is however often not so. Basic infrastructure facilities (as shown in Table 8) must be made available, without which production output will be hampered. In cases where the facilities are not provided or not in operation, contingency plans are proposed. For instance, water pumps with adequate filtration system could provide the water needed by the factory from sources such as rivers and wells. In the case of electrical blackout, generator sets should be made available as the stand-by.

Table 8. Basic Facilities for Rattan Furniture Manufacturing Factory

Facilities	Institution	Contingency Plan
1. Water	Local Department of Water Supply	Water pumps
2. Electricity (3 phase)	Tenaga Nasional (National Power)	Generator set
3. Communication	Telekom Malaysia (Telecommunication service company)	Hand phone
4. Road and easy access for 40 footer containers	Local Authority / Jabatan Kerja Raya (Public Works Dept)	-

4.5.2 Institutional support

While the above deals with the factory set-up, the following Table 9 illustrates the relevance for human resource development. Where the industry is concerned, training of workers is mainly in-house through apprenticeships. Realizing this, the government agencies mentioned below supports the demand by providing these training programs.

Table 9. Training Aspects Supported by Government Agencies

Training Aspects	Institution	Follow-up Activities
Skill Development	Kraftangan Malaysia	In-house training
Marketing	MTIB	Showroom
Research & Development	FRIM	In-house RND unit

Notes: Kraftangan = Malaysian Handicraft Development Corporation; MTIB = Malaysian Timber Industrial Board; FRIM = Forest Research Institute Malaysia

5. Financial aspects of running the unit

The viability of rattan furniture manufacturing as a business is determined through cost and profit analyses and this is discussed in this chapter.

5.1 Initial and operational costs

Initial and operational costs are shown in Tables 10 and 11 respectively. The initial investment is the cost of acquiring fixed assets such as land, building, vehicles, tools and machines. The operational cost is the monthly expenditure on raw materials, utility bills, salaries and so forth.

Table 10. Fixed Asset as the Initial Investment Costs

Fixed Asset	Cost (USD)
1. Land area (1 hectare)	20,000
2. Building	25,000
3. Tools and machines	21,400
4. Electrical wiring, water and telephone installation	5,000
5. One ton lorry	10,000
6. Miscellaneous (office equipment)	3,000
Total	84,400

Table 11. Operational Costs per month

Item	Cost (USD)
1. Raw materials (rattan)	28,700
2. Hardware (Finishing, nails, screw and stapler)	3,500
3. Salaries	11,920
4. Electricity & water	750
5. Telephone	100
6. Containers rental @ USD2,000 per container	8,000
7. Miscellaneous	500
Total	53,470

5.2 Profit projection analysis (Excluding the Initial Investment Costs)

The monthly profit is calculated by subtracting the operational cost from the monthly sales where,

Monthly Profit = Sales – Cost

$$\begin{aligned}
 &= (\text{FOB values} \times \text{Number of containers}) - \text{Operational Cost} \\
 &= (\text{USD } 16,000 \times 4) - \text{USD } 53,470 \\
 &= \text{USD } 64,000 - \text{USD } 53,470 \\
 &= \text{USD } 10,530 \#
 \end{aligned}$$

$$\begin{aligned}
 \text{Ratio of Profit to Product Sales} &= \frac{\text{Monthly Profit}}{\text{Products Sale}} \\
 &= \frac{\text{USD } 10,530}{\text{USD } 64,000} \\
 &= 0.16 \#
 \end{aligned}$$

Yearly profit is determined by the following methods,

$$\begin{aligned}
 \text{Year 1 Profit} &= [(\text{Monthly Profit} \times 12) - (\text{Fixed Asset Loan Repayment})] \times 45 \% \text{ Govt. Tax} \\
 &= [(\text{USD } 10,530 \times 12) - 1/3 (\text{USD } 84,400)] \times 45 \% \\
 &= [(\text{USD } 126,360) - (\text{USD } 28,133)] \times 45 \% \\
 &= [\text{USD } 98, 227] \times 45 \% \\
 &= \text{USD } 54,025 \#
 \end{aligned}$$

$$\begin{aligned}
 \text{Year 2 Profit} &= [(\text{Monthly Profit} \times 12) - (\text{Fixed Asset Loan Repayment}) - (\text{Fixed Asset Value Depreciation})] \times 45 \% \text{ Govt. Tax} \\
 &= [(\text{USD } 10,530 \times 12) - 1/3 (\text{USD } 84,400) - 0.05 (\text{USD } 84,400)] \times 45 \% \\
 &= [(\text{USD } 126,360) - (\text{USD } 28,133) - (\text{USD } 1,070)] \times 45 \% \\
 &= [\text{USD } 97, 157] \times 45 \% \\
 &= \text{USD } 53,436 \#
 \end{aligned}$$

6. Additional notes on implementation

6.1 Marketing

Rattan furniture manufacturers should have no problem when it comes to marketing their products as there are always markets for quality rattan furniture, locally or abroad. There are various ways of hunting for potential buyers. Having a showroom to display the products is one method and is a good initial step.

With advances in information technology, the showroom could be produced in virtual form, i.e., as an Internet web site. In the present situation, the cost of developing a web site is very low, but the impact it might have on market potential is limitless. Many international rattan furniture companies have their own web sites and are selling their products through the e-commerce mechanism.

Another effective way of marketing is by participating in furniture fairs held by various organizations in the world. Malaysia has been holding her own International Furniture Fair (MIFF) annually since early this decade and the effectiveness of the event is manifested in sharp rises of the furniture export values in the last few years.

6.2 Environmental

Rattan furniture manufacturing does not impose threats to the environment as significant as wooden furniture manufacturing. Nevertheless, one major problem that needs to be solved is the high wastage of rattan raw material, especially rattan poles, which often become a burden to the environment through open burning and illegal dumping.

Rattan poles have been wasted even before the furniture manufacturing process takes place because both ends of the poles supplied are normally rendered unusable by fungal attacks and their inherent non-uniform diameter. In some cases, 6 inches of each end must be cut off and thrown away. At this stage, the wastage rate could be as high as 10 percent. In financial terms, as much as USD 0.20 is wasted from each pole (10 % of USD 2.00 – average price of rattan pole).

A productive way of managing the waste is by using them as fuel for the steaming chest. By doing this, the cost saving is doubled, i.e., on other fuel such as kerosene and on the waste dumping.

6.3 Occupational safety and health

Occupational safety and health problems (hazardous working conditions) would come from the usage of hand tools such as nail guns, staplers and spray guns. Carelessness in operating the tools might cause serious injuries to the worker and others as accidentally shot nails or staples pierce the skin and eyes.

Prolonged inhalation of finishing chemicals from the spraying gun could cause long term health problems (especially the respiratory system) to the worker. Therefore, the workers must be made to wear proper personal protective equipment (PPE) while working with the tools.

6.4 Potential transferability constraints

Among the constraints identified to the transfer of technology are capital financing, supply of raw materials and availability of a skilled workforce.

To set up a medium-sized furniture manufacturing factory requires a large amount of capital investment that requires financial support either from the government, in term of soft loans, or from banking institutions.

Like any other resource based industry, a consistent supply of raw material is important to ensure the existence of the industry. While it may not be possible to control the price of the commodity, the manufacturers may off set the situation by producing high quality products. Over the years, the industry has observed a certain change in rattan supply. Raw materials are becoming scarce in quantity and quality where the nominal length of rattan poles has been reduced by one foot but the price has increased significantly.

Skilled workers such as master craftsmen are not easy to find and keep. The Philippines has been a well-known source of such workers. Their availability and their hiring costs would depend much on the foreigners employment policies imposed by the government in the country that requires them. A more sensible solution, however, would be to ask them to run training courses for technology transfer that people from the target country could attend. However, it is also interesting to note that while semi-mechanization (through pneumatic technology) is slowly making its presence felt, skilled workers are still a sought after commodity in this industry.

APPENDICES



APPENDIX I:

QUESTIONNAIRE FORMS

QUESTIONNAIRE ON RATTAN FURNITURE MANUFACTURING INDUSTRY Peninsular Malaysia. Sept-Oct 1999

FORM A: GENERAL INFORMATION

Company Name: _____		Questionnaire No: _____																																																													
Address: _____		Year Established: _____																																																													
Telephone: _____ Fax: _____ E-mail: _____																																																															
Person interviewed : _____ Position: _____																																																															
Organizational Structure Number of Workers : _____ a. Management : _____ b. Skilled : _____ c. Semi-skilled : _____ d. Unskilled : _____ Highest Position: _____ No. of Working Days: _____ Number of Shift: _____	PRODUCTS <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 10%;"></th> <th style="text-align: left; width: 30%;"><u>Type+</u></th> <th style="text-align: left; width: 20%;"><u>Market#</u></th> <th style="text-align: left; width: 20%;"><u>Quantity*</u></th> <th style="text-align: left; width: 20%;"><u>Price^</u></th> </tr> </thead> <tbody> <tr><td>a.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>b.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>c.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>d.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>e.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>f.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>g.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>h.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table> + Living Room Set, Dining Set, Bedroom Set, etc # Export or Local * Per Month ^ Per Set or Per item				<u>Type+</u>	<u>Market#</u>	<u>Quantity*</u>	<u>Price^</u>	a.	_____	_____	_____	_____	b.	_____	_____	_____	_____	c.	_____	_____	_____	_____	d.	_____	_____	_____	_____	e.	_____	_____	_____	_____	f.	_____	_____	_____	_____	g.	_____	_____	_____	_____	h.	_____	_____	_____	_____															
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FOR FRIM USE Examples of Rattan Materials a. Rattan Poles b. Rattan Skins c. Cores Examples of Other Materials a. Lacquer b. Thinner c. Nails or Screw d. Plywood	Rattan Raw Materials <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 10%;"></th> <th style="text-align: left; width: 30%;"><u>Species</u></th> <th style="text-align: left; width: 20%;"><u>Quantity*</u></th> <th style="text-align: left; width: 20%;"><u>Source</u></th> <th style="text-align: left; width: 20%;"><u>Price</u></th> </tr> </thead> <tbody> <tr><td>a.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>b.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>c.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>d.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>e.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>f.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table> Other Raw Materials <table style="width: 100%; border-collapse: collapse;"> <tbody> <tr><td>a.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>b.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>c.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>d.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>e.</td><td>_____</td><td>_____</td><td>_____</td><td>_____</td></tr> </tbody> </table> * Per Month				<u>Species</u>	<u>Quantity*</u>	<u>Source</u>	<u>Price</u>	a.	_____	_____	_____	_____	b.	_____	_____	_____	_____	c.	_____	_____	_____	_____	d.	_____	_____	_____	_____	e.	_____	_____	_____	_____	f.	_____	_____	_____	_____	a.	_____	_____	_____	_____	b.	_____	_____	_____	_____	c.	_____	_____	_____	_____	d.	_____	_____	_____	_____	e.	_____	_____	_____	_____
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FORM B: DETAIL WORKFORCES

Process	Machines/Tools	No. of Worker	Salary	Race	Education	Gender
Cross Cutting	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Bending/ Moulding	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Assembly	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Binding/ Weaving	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Scraping/ Sanding	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Finishing	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Packaging	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____
Others (Please State)	• • •	• Skilled: ____ • S-Skilled : ____ • Unskilled: ____	____ ____ ____	Malay: ____ Chinese: ____ Indian: ____ Foreign: ____	• Std 6: ____ • LCE: ____ • MCE: ____ • None: ____	M: ____ F: ____

FORM C: TECHNICAL ASPECTS

Machines, Tools and Maintenance:

Type	Origin	Price	Spare parts	Service	Cost	Frequency
Machines	_____	_____	_____	_____	_____	_____
Hand Tools	_____	_____	_____	_____	_____	_____
Compressor	_____	_____	_____	_____	_____	_____
Finishing	_____	_____	_____	_____	_____	_____

Origin: Country Imported? Spare Parts: Sources?
 Service: Where? By Who? Local? Overseas? In-house? Frequency: When Broke-down? Periodically?

Training Programs for the Workers:

Type of Training	Place/Organizer	Time Length	Cost
a. _____	_____	_____	_____
b. _____	_____	_____	_____
c. _____	_____	_____	_____
d. _____	_____	_____	_____
e. _____	_____	_____	_____
f. _____	_____	_____	_____
g. _____	_____	_____	_____

Type of Training: Binding? Bending? Machine Operation? Furniture Manufacturing? Design? QC? Safety?
 Place/Organizer? : In-house, Kraftangan, MTIB? Master Craftsmen?
 Time Taken to Master: 2 months? 3 months? ½ year?
 Cost: None (on-job training)? Subsidized?

Design Aspects:

Type of Furniture	Market	Who Design?
a. _____	_____	_____
b. _____	_____	_____
c. _____	_____	_____
d. _____	_____	_____
e. _____	_____	_____
f. _____	_____	_____

Type: Dining Set? Living Room Set? Bedroom Set? All Types?
 Market: Personal Order? Furniture Shop? Export?
 Who Design: Individual Customer? Furniture Shop? Oversea Buyer? In-house Designer? Copied from magazines?

Waste Management:

Rattan Type		% Wastage		% Recycled	
% Dumped	Dumping Cost				
a.	_____	_____	_____	_____	_____
b.	_____	_____	_____	_____	_____
c.	_____	_____	_____	_____	_____
d.	_____	_____	_____	_____	_____
e.	_____	_____	_____	_____	_____
f.	_____	_____	_____	_____	_____

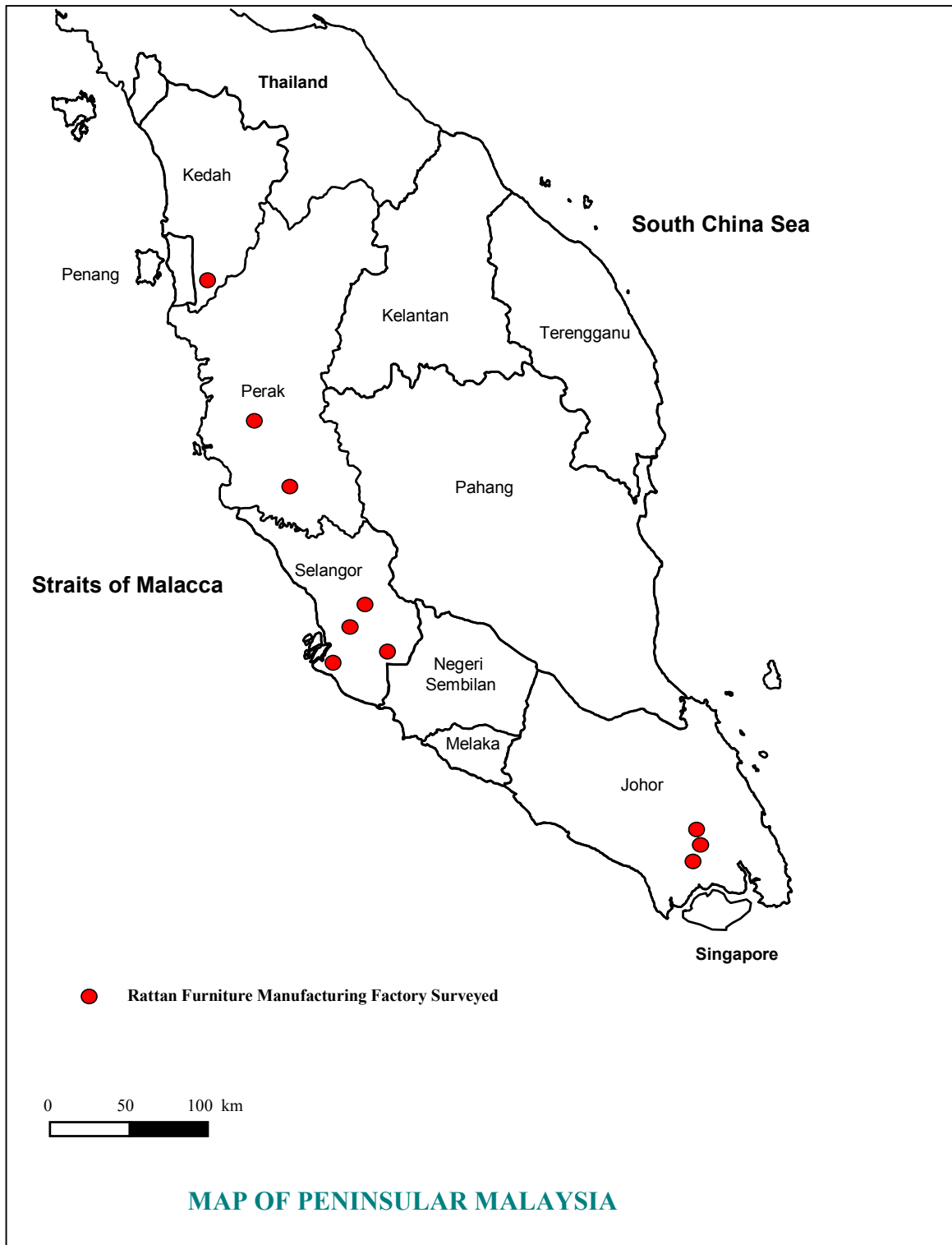
Rattan Type: Poles? Skins? Cores?

% Recycled: % from total Wastage? For what purpose?

Factory Lay-Out:

FRIM Researcher: _____ Date: _____ Signature: _____

APPENDIX II: LOCATIONS OF FACTORIES SURVEYED



APPENDIX III

DESCRIPTIVE PHOTOGRAPHS OF RATTAN FURNITURE MANUFACTURING PROCESSES



Photo 1 →

Straightening rattan poles using pneumatic straightening machine.



← Photo 2

Cross cutting rattan poles to desired lengths.

Photo 3 →

Bench drill to cut rattan poles end into half-moon shape (coping). The same bench drill can also be used to drill holes and make groove on the rattan poles.



← Photo 4

Rattan poles are steamed inside the steaming chests for 20 to 30 minutes before bent into desired shapes.



Photo 5 →

2-D jig (made from plywood and wooden blocks) for moulding rattan poles into 2-D components. Manual clamps are added to the jig.



← Photo 6

A more complicated 3-D jig.



Photo 7 →

Rattan furniture components could also be shaped with the aid of a shaping machine.



← Photo 8

Assembling of the components into furniture. Hand tools such as pneumatic nailer and screwdriver are used to speed up the process



Photo 9 →

Proper method of
assembling using
jig placed on a
workbench.



← Photo 10

Binding is done while
sitting down. This
posture is preferred over
standing up because it
allows better handling of
the work piece.



Photo 11 →
Simple weaving.



← Photo 12

Rattan core is plugged in to hide the head of nail or screw. This method is getting more popular as a way to maintain high quality look of the furniture.



Photo 13 →

Scrapping off the protruding plugged in cores using pneumatic hand scraper.



← Photo 14

Pneumatic hand scraper.



Photo 15 →

Rattan furniture components are polished using a sanding machine.



← Photo 16

A rattan furniture product is stained and polished (using sanding paper).



Photo 17→

Stacks of products awaiting
for finishing process



← Photo 18

Rattan furniture product
is sprayed with finishing
material in front of a
spray booth. It is highly
recommended that the
worker is wearing
proper PPE while doing
the spray work.

APPENDIX IV

Recommended Literature on Rattan Furniture Manufacturing

FRIM through its Forest Products Technology Division has published many handbooks and guidelines on various aspects in rattan furniture manufacturing field. Among others are the following:

1. Abdul Latif, M. 1990. *Garis Panduan Pemilihan dan Pengolahan Rotan untuk Perindustrian* (Guidelines for the Selection and Preparation of Rattan for Industrial Use). RIC Handbook No. 2. Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur. 26 pages.

'The selection of rattan for utilization is based on its characteristics and processing methods used. The disregard of these two criteria often leads to inferior quality of finished products. This paper compiles all information obtained from personal experiences and interviews with entrepreneurs on the characteristics of rattan suitable for processing and furniture making. It is envisaged that this publication will provide a basic guideline especially to new and would-be entrepreneurs who are keen on venturing into rattan businesses.'

2. Wan Tarmeze, W. A., Hamdan, H. and Mohd Tamizi, M. 1992. *Sistem Paip Saluran Udara Mampat Untuk Kilang Pembuatan Perabot Rotan* (Compressed Air-Line System for Rattan Furniture Manufacturing Factory). FRIM Technical Information No. 33. Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur. 12 pages.

'This paper aims at introducing and encouraging the use of compressed air-line system to rattan furniture manufacturers as a way to upgrade the quality and productivity of the industry. The brief description, in layman terms, on compressed air and pneumatic equipment would be able to guide the manufacturers in their efforts to build the system.'

3. Wan Tarmeze, W. A. 1994. Strength Properties of Joints in Rattan Furniture. Master of Science thesis. Universiti Pertanian Malaysia. 168 pages.

'This thesis was aimed at generating knowledge on the strength behaviour of joints in rattan furniture. Through the knowledge, better jointing methods and system would be developed to maximize the strength properties of the joints and thus prolong the service life of the rattan furniture.'

4. Hamdan, H, Wan Tarmeze, W. A. and Wan Abdul Nasir, H. 1997. *Panduan Ikatan Sendi Perabot Rotan: Analisis Kuantiti dan Kos* (Guidelines on Rattan Furniture Joint Binds: Quantity and Cost Analyses). FRIM Technical Information Handbook No. 13. Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur. 50 pages.

'Binding is the process of wrapping rattan furniture joints with materials such as rattan skins, splits or cores. Since the amount of binding materials and time needed to complete the process determine the overall cost and price of the furniture, the information would be very useful to the manufacturers, designers, production supervisors and those involved in rattan furniture manufacturing business. With this in mind, FRIM has conducted a research work to study in detail on bill of materials and costing needed for various types of joints and designs of the binding. The results are presented in tabulated forms as well as in mathematical formulas'

Also useful is

5. United Nations Industrial Development Organisation. 1996. Design and manufacture of bamboo and rattan furniture. UNIDO General Studies Series. UNIDO, Vienna. 245pp