The Prospect of Oil Palm Trunk for Manufacturing Laminated Veneer Lumber (LVL)

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ABSTRACT

Since 1995, Malaysia has faced a shortage of supply of logs for local wood based industry in order to maintain existing production level in the country. The increase in prices for logs has worsened the wood-based industry especially the furniture industry. Continuous campaigns by environmentalists against the use of tropical hardwood have also influenced our hardwood production. As such, the introduction and utilisation of oil palm biomass as an alternative source of raw material, is indeed timely for our wood-based industry. Oil palm trunk (OPT), a biomass by-product used in this project, is an agricultural waste of oil palm plantation. Technically, it is considered as 'environmentally friendly' or 'green' material, renewable resources, harvested and managed under sustainable plantation by established and certified corporations. OPT-based products are considered new and at the infancy stage of development. Research has been carried out for the pass few years on the lab scale basis. Being pioneers in oil palm, the source of matured OPT are abundant in Malaysia. A series of R&D that has been carried out by FRIM indicates that OPV has tremendous commercial potential as core-materials for industrial application especially the LVL. With the LVL, many other panel-products can be produced such as furniture and components, panelling, door and flooring core content, wall frames and partitions, door frames, building components and etc. However, none of these studies worked on the commercial applications, i.e. machinery and economic scale. Using this technical-know-how, this paper studies the viability of the establishment of the LVL plan on the commercial scale in Malaysia with the Malaysian experience. However, the existing machinery, equipment and production set up for making plywood could be further modified *for making the LVL using OPT. Furthermore, anatomically OPT is not truly a woody material; it requires a special type of machine to enable OPT for the LVL. Most of the woodworking machinery manufacturers are mainly from overseas such as USA, Germany, Italy, Japan, Taiwan and Chin., They may not know much about the characteristics of oil palm trunks. Findings from this paper should be able to support the supply of raw materials for the wood-based industry.*

Keywords: *Laminated Veneer Lumber (LVL), Oil Palm Truck (OPT), viability*

Introduction

Malaysia has long been involved in the economy spheres with evolution of its economic transition from agricultural-based (including forestry), service-based and now to the much talk-about knowledge-based economy. She has undergone three decades of sound economic growth and development. The 1960s and 1970s witnessed an easier phase of growth based on low labour cost and strong public sector support. Nevertheless, in the 1980s Malaysia experienced a setback in the economy due to external shock when commodity prices collapsed twice, in 1980 and again in 1985 (Bureau of National Economic Policy Studies, 1994). The economic growth thereafter was not remarkable though some recovery took place in 1987. This was the time when the manufacturing sector for intermediate goods started its expansion and to lead in the Malaysian economy. This established a new structural change from merely producing primary commodities to basic manufacturing and advanced manufacturing including electric semiconductors and components of electrical products. Since than, the Malaysian furniture industry has increased their production and managed to increase export market. A few years after that, the raw material supply caused problem for the furniture industry. Nevertheless, FRIM managed to come up with a good technique for rubber wood treatment which could be used for making high class furniture for export market. However, the rubber wood could only supply the raw material for the furniture industry for only one decade. Now the furniture industry is facing shortage raw material again. There are about 400 palm oil mills in Malaysia, where the overwhelming bulk of the empty fruit bunches (EFP) are being burned off every day (Soong, 2005). Overall, the oil palm plantation produces about 40 million of dry biomass per year consisting of OPT, EFP and oil palm frond (OPF) (Mohamad, Anis and Wan Hasammudin, 2005). In fact, the introduction and utilisation of oil palm biomass as an alternative source of raw material is indeed timely for our forest-based industry. OPT and other parts of the oil palm could be another alternative for furniture raw material supply, which is currently an agricultural residue of oil palm plantation. OPT-based products are considered new and at the infancy stage of development. Research has been carried out for the past few years on the lab scale. It has proven that the OPT can be used for making furniture of high quality. The new OPT development could boost the furniture industry again to cater to the ready export market.

Problem Statement

It is troublesome to the furniture industry when there is shortage of tropical logs and rubber wood for the local wood-based industry. This has caused difficulties to maintain existing production of furniture industries level in Malaysia since 1995 (Thang, 1985; Mohamad, Anis and Wan Hasamudin, 2005). This situation worsened with the increase of prices of logs, even for the lesser known mixed species or the 'chap char'. Continuous campaigns by environmentalists against the use of tropical hardwood have also influenced our hardwood production. As such, the introduction and utilisation of oil palm biomass as an alternative source of raw material is indeed timely for our wood-based industry (Hashim, et al., 2005). Oil palm trunk (OPT), a biomass by-product used for this project, is an agricultural waste of oil palm plantation. Technically, it is considered as 'environmentally friendly' or 'green' material, renewable resources, harvested and managed under sustainable plantation by established and certified corporations.

The new development of OPT-based products is considered new and at the infancy stage of development. The products are currently manufactured in small quantity, with low recovery and productivity, constrained by the fact that existing machineries, equipment and production set up are designed to process tropical hardwood. Furthermore, anatomically, oil palm trunk is not truly a woody material. Apart from that, as woodworking machinery manufacturers are mainly from USA, Germany, Italy, Japan, Taiwan and China, they may not know much about the characteristics of oil palm trunks, which may not be suitable to process OPT. The success of manufacturing OPT-based panel-products largely depends on the knowledge of OPT characteristics, proper processing parameters, specially designated machinery, correct processing layout and strict quality control.

It is an advantage to the OPT which can turn to plywood and veneer and, later, it can be manufactured into many types of panel-products. A series of R&D that has been carried out by FRIM indicates that OPV has tremendous commercial potential as core-materials for industrial application especially the LVL.[1] With LVL, many other panel-products can be produced such as furniture and components, panellings, doors and flooring core content, wall frames and partitions, door frames, building components and etc.

The study has succeeded in producing the OPT to panel-products on an experimental scale. At the moment the panel-products are at the infancy stage and development of the production technology should be enhanced to improve the quality and quantity for local and global market consumption. After years of excessive exploitation of our forest, the Government has introduced sustainable forest yield management concept to protect the forest and the environment. This limits the production of logs by more than half, from about 44 million tones in 1992 to just over 19 million tones in 2005. This caused more than 40% of the existing 50 plywood plants in Malaysia to cease operations due to difficulties in securing local timber supply as the raw material. Recently, more plywood manufacturers had to stop production all together due to the short supply of timber and the inability to obtain timber from neighbouring countries to substitute for this short supply.

After several years of decline due to low price of plywood, panel products and high costs of logs, world demand surges due to good economic recovery of some Asian nations. The inability of China to supply cheap plywood to the importing countries also contributes to the demand and good price of plywood. Thus, the need for alternative raw material, low in cost, green and in abundant supply is needed if the industry is to survive. This substitute is OPT which can be manufactured into plywood and LVL panel products and other products.

It has been forecast by FAO that wood-based panel trade balance for 6 major exporters for the year 2010 is as stated in Table 1 below. It clearly shows the demand, market size and market growth of LVL panel products.

Table 1: Forecast Wood-based Panel (WBP) Trade Balance for Six Major Exporters – 2010

Country or Territory	Product	Production '000 m^3	Imports '000 m^3	Exports '000 m^3	Consumption '000 m^3	Exports (%)
Indonesia	OSB & LVL	600	42	540	102	90.00
Malaysia	OSB & LVL	750	0	448	302	59.73
Thailand	OSB & LVL	750	0	680	70	90.67
Philippines	OSB & LVL	20	20	20	20	50.00
New Zealand	LVL	150	0	90	60	60.00
Australia	OSB & LVL	100	20	80	20	80.00

This paper proposes the feasibility study for the development of new processing and manufacturing technologies to produce industrial scale Laminated Veneer Lumber (LVL) from oil palm trunks in Malaysia.

Price Competitiveness

The LVL from OPT fetches the same price as the LVL of tropical hardwood panel products (subject to grade quality). This provides an enormous advantage to the LVL from OPT because the price of the raw material used to produce the LVL from OPT is very cheap compared to the price of the raw material for the production of the LVL from ordinary hardwood. In addition, the cost of production is 30-35% cheaper compared to the conventional hardwood (Table 2).

Objectives of the Study

The general objective of this study is to find out the economic viability of producing the LVL from OPT. The specific objectives are:

i. to assess the financial analysis of the establishment the LVL using OPT in Malaysia;
ii. to compare the financial analysis for different mill production capacity; and
iii. to recommend the best option of mill production capacity.

Table 2: Price Competitiveness of LVL Manufactured from OPT versus LVL Manufactured from Tropical Hardwood

Subject [LVL]	Tropical hardwood based LVL	Oil palm based "Green LVL"
Market price m^3	USD350 – USD550 (subject to grade quality)	USD350 – USD500 (subject to grade quality) LVL
Durability (same weight)	Could be enhanced by chemical preservative	Could be enhanced by chemical preservative
Strength	Better	Low – moderate
Source of Raw Material	Depleting and non-sustainable	13.6 million OPT readily available
Objective of Usage	Most for structural applications	Extensive applications for non-structural purposes. Has potential for structural applications
Resources	Tropical rain forest	Conformity to sustainable plantation – green, renewable, 'eco-friendly'

LVL Production Process from OPT

Knowing the production process of the LVL from OPT is necessary before we can proceed to conduct this study in assessing the viability of the LVL production. This is because each process involves cost in order to produce any amount of the LVL. The details of the LVL production are as depicted in Figure 1 and each of the production process detail is explained below.

OPT Yard/Matau

The oil palm trunk is cut into the required length. OPTs are then categorised into at least two groups by its density, log portion and or log quality. OPTs of the same group will be processed in the same batch to increase efficiency and recovery.

Rounding OPT/Lathe Peeling

The peeling process is done by the Rotary Lathe and Spindleless Lathe for maximum recovery rate. The dedicated lathe is required for peeling oil palm trunk due to the unique properties of the trunk. There are 3 stages of the peeling process, namely, outer, middle and finally inner layer. Each layer requires different awareness due to its different density at each layer. Conventional lathe is inefficient because of high loss production time during gear change and knife adjustment, log spin out (softer portion at core), frequent down time on mechanical parts, such as bearing due to high moisture content, and low recovery rate.

Clipped to Size/Sorting

The veneer is clipped into the required size. Due to the density variations from the outer and inner section of the trunk, the veneers are separated into groups of different density range.

Chemical Treatment

The veneers are treated with chemical to improve resistance against fungus and pesticide attack so that it can last longer.

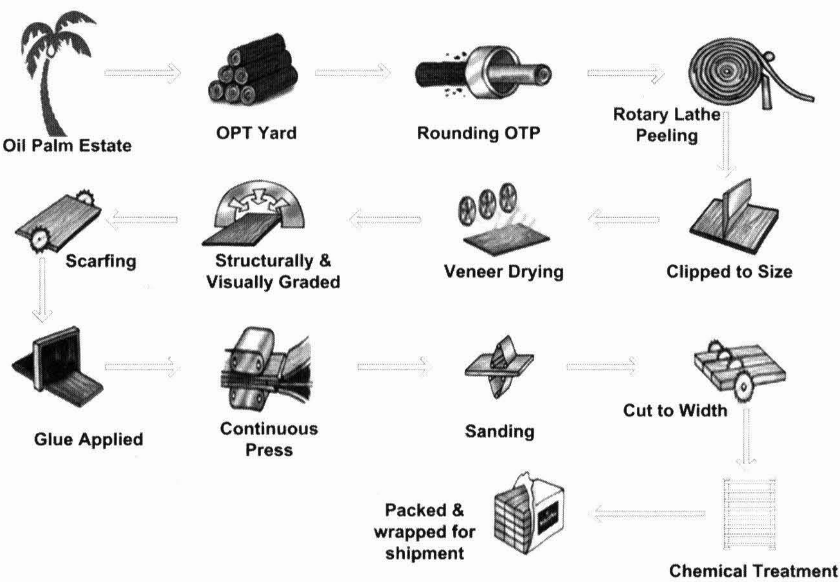

Figure 1: The Sequence of LVL Production Process form OPT

Veneer Drying

In order to maximise output, the wet veneer is dried at the right speed and temperature. Uncontrolled drying process will result in over shrinkage and brittle veneer. It requires extra careful with the right temperature control.

Visually Graded (R&D for a Mechanical System)

As the veneer comes out of the drier, they are automatically graded by a mechanical system (that will be designed and developed locally) for specific customer requirements and for the LVL production in the plant. All veneer produced will be sorted and graded based upon the quality and the physical properties. Some veneer is exported for further processing, while most is used for production of the LVL.

Adhesive Application

A special glue spreading system will be used to ensure uniform application of the glue and the right quantity of adhesive is being applied. Uneven glue spreading may affect the quality.

Hot Press

Once the veneer has had the glue applied, the veneer is skewed aligned then laid up onto a mat. The veneer mat begins the heating process from the inside the veneer mat and then into the hot and cold presses where the hot oil platens complete resin cure and an LVL panel is formed.

Sanding

The online sander is an optional part of the production process for products that require a sanded finish. This section is very important and needs extra care to ensure the quality of the LVL.

Cut to Width

The panels are cut to widths required by the customer. Each piece of LVL is also marked with an inkjet print marking and paint spraying system with the logo and grade for clear visual identification.

Additional Chemical Treatment

The LVL panels are treated (exterior only) with selected chemicals so as to reduce moisture uptake during transportations (for dimensional stability purposes) and improve resistance against fungus and pesticide attack. This additional treatment is only conducted especially for sensitive market such as Japan.

Packed and Wrapped

The LVL is packed into specific sizes for forklift handling. The packages are wrapped with plastic wrap showing the logo. The packages are then transported to the Port for shipment to customers around the world.

Research Methodology

This study focused on the feasibility of the LVL production using mill plan capacity of 18,000 m^3 per year. However, this study not only analysed the financial viability as required by the mill plan capacity but also the financial analysis based on the hypothetical mill plan capacity scenarios from 7,660 m^3 to 30,000 m^3 per year. The details for the financial analysis are as follow:

a. Financial Analysis

The usual financial analysis tools used for this study are Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (B/C) and payback period (PBP) in order to know the level of viability of the LVL industry for all possible options in the PVL production.

Net present value (NPV)

The term net present value is usually computed by finding the difference between the present worth of the benefit stream minus the present worth of the cost stream. In other words, the net present value is the present value of income generation by the investment (Gittenger, 1982; Ahmad Fauzi, 2003). In evaluating a single project, the project should be carried out if the net present value is positive. It is not worth for implementation if otherwise. In the case where evaluation of more than one project is involved, the selection should be made for the highest internal rate of return as well as nett present with high benefit cost ratio. The formula used for calculating the net present value is as below:

$$NPV = \Sigma (B_t - C_t)/(1 + i)^t$$

Benefit cost ratio (B/C)

Net present value only tells us how much the expected present profit could be earned from the investment but it does not reveal the proportion of total benefits against the total costs invested. To do this, benefit cost ratio analysis is the appropriate financial tool to be employed. The project should be carried out if the benefit costs ratio is more than one. In a situation where they are more than one project, then the highest benefit cost ratio is preferable.

$$B/C = \Sigma \{B_t /(1 + i)^t\}/\Sigma \{ C_t/(1 + i)^t\}$$

Internal rate of return (IRR)

Apart from the net present value and benefit cost ratio analysis, the internal rate of return is another financial tool that could be used to judge the milling operation. The internal rate of return is measured when the discounted total benefits minus discounted total cost is equal to zero. The investment should only be carried out if the internal rate of return is more than capital cost interest rate (i.e. bank loan interest rate charged). The mathematical formula for the above financial tool can be summarised as follows:

$$IRR: = \Sigma\{ (B_t - C_t)/(1 + i)^t\} = 0$$

Payback period (PBP)

Payback period is a very important element that people used to ignore to include in the financial analysis. This element is very important for bankers to know how fast the project will generate income. The earlier money is generated from the project, the more comfortable bankers are in assessing the project. The cash flow could determine the payback period when the accumulated nett farm income is equal to zero. The payback period formula could be written as follows:

$$PBP = \Sigma \{\Sigma (B_t - C_t)\} = 0$$

The study mainly used secondary data available from the LVL mill industry in Malaysia. The primary were only collected when necessary from the Department of Forestry, the Department of Statistics and any relevant central agency.

Mill Production

The financial analysis can only be carried out if the elements for all productions and all costs are available in the time series manner. Using these data, only the gross and nett profit can be calculated from day one of the operation till to a certain period of time such as 10 or 15 years depending on the type of project. In agriculture, this is normally up to 25 years but for this study, a 10 year period had been used as the project time frame.

In this particular case, it is assumed that the mill production in the first and second year is running below the capacity of requirement. The mill will only run at full capacity in the third year in operation. During the first and second year period, the mill is still in trial and error basis or at the leaning stage in familiarising with the system as a whole. This period is a research and development period before operating at a full capacity (Table 3). The mill's full capacity is at 30,000 m^3 per year.

Table 3: Mill Production

Month/ Year	Production (m3)	Month/ Year	Production (m3)	Month/ Year	Production (m3)
1	-	14	125	Year 3	22, 464
2	-	15	125	Year 4	22, 464
3	-	16	125	Year 5	22, 464
4	-	17	125	Year 6	22, 464
5	-	18	125	Year 7	22, 464
6	52	19	125	Year 8	22, 464
7	78	20	125	Year 9	22, 464
8	104	21	125	Year 10	22, 464
9	125	22	125	Year 11	22, 464
10	125	23	125	Year 12	22, 464
11	125	24	125	Year 13	22, 464
12	125	Year 1	733	Year 14	22, 464
13	125	Year 2	1,373	Year 15	22, 464

LVL Mill Expenditure

The estimated total expenditure required to produce the LVL is about RM18.3 million. Out of this total, 40.6% is allocated to the Main Plant & Equipment, 5.4% to Market Testing, 11.6% to Mechine Modification, 5.4% to Technical advisory concultancy and R&D and the rest, 36.9%, is allocated to the other plan equipment in the assembly line (Table 4).

Table 4: LVL Mill Expenditure

	Expenses	Costs (RM)	%
1	Main Plant & Equipment	7, 531,200	40.64
2	Market Testing of Commercial Ready Prototype	1,010,385	5.45
3	Regulatory and Standards Compliance	-	-
4	Contract Expenditure		-
	Machine modification	2,150,000	11.60
	Technical advisory consultancy and R&D	1,00,000	5.40
5	Expenditure other plan equipment	6,842,160	36.92
	Total Proposed Project Cost	18,533,745	100.00

Assumptions Used in the Analysis

These analyses have made a few assumptions to enable the calculation to be made especially the prices of direct materials used, direct labour used, electricity, water, plan maintenance, transportation and other general office expenses. In case of output, it has been estimated as in Table 5, based on the LVL mill capability.

Table 5: LVL Production

Year 1	1, 148
Year 2	8, 262
Year 3	18, 000
Year 4	18, 000
Year 5	18, 000
Year 6	18, 000
Year 7	18, 000
Year 8	18, 000
Year 9	18, 000
Year 10	18, 000

This analysis has assumed that the LVL products produced can be sold at the price of RM850 per m^3 for local market. This assumption is very low as compared to the current market price of between RM1,110 to RM1,300 per m^3. The assumption is reasonable.

The total direct cost per cubic meter is estimated at about RM290, overhead and management cost is estimated at RM175 per m^3 and other administration cost is about RM4 per m^3. Other than that, rental for office and factory space is about RM30,000 per month, fire plan insurance is about RM150,000 per year and other utilities RM600 per month.

Financing (Bank Loan)

This analysis has included the financing component, which could be useful for the user to use as a guide. In this particular study, the total cost was RM18,533,745 and it is expected that 80% of the cost will be financed by any commercial bank and 20% balance will be funded by the company (Table 6).

Table 6: Calculation of Loan Payment

Estimated Cost of Project	18,533,745.05	
Assumptions	Commercial Bank	Self-funded
Financing	80%	20%
	14,826,996.04	3,706,749.01
Loan Amount	3,706,749.01	
Finance Rate	8%	
Term	10 years	
Int=PeTeR	4,448,098.81	
Total Loan	8,154,847.82	
Yearly Repayment	815,484.78	
Monthly Repaymenr	67,957.07	

Based on Table 6, it is estimated that the monthly loan repayment is about RM67,957.07 for the period of 10 years with the yearly interest rate at 8%. It is quite a substantial amount of money but it is manageable to run the LVL business because it is only 3.2% from the average total sale.

Analysis of Results

The financial analysis study has been computed based on the 18,000 m^3 mill capacity for a period of 10 years under two types of scenario without bank loan and with bank loan for the amount of 80% from the total cost. Without a bank loan, the financial analysis has found that the NPV is estimated at RM17,359,404, the IRR at 38.8%, the B/C Ratio at 1.30 and the PBP is at 5 years. Without a bank loan, the NPV is RM12,348,603, the IRR is 29.9% and the PBP is at 5 years (Table 7 and Appendix 1).

Table 7: Financial Result for 18,000 m^3 Capacity

Items	Before Loan	After Loan
Nett Present value (RM)	17,359,404	12,348,603
Internal Rate Return	38.8%	29.9%
Benefit / Cost Ratio	1.3	1.2
Pay back Period (Year)	5	5

The results of the analysis in Table 7 shows that the LVL processing mill from OPT is a very viable project running at 18,000 m^3. Using this financial analysis, it means that the LVL processing can earn NPV of about RM17.4 million for the period of 10 years without any bank loan support and even with bank loan support it could earn NPV of about RM12.3 million for the same period. This is because the IRR without bank loan is higher as compared with bank loan, which are 38.8% and 29.9% respectively. The B/C ratio is higher without bank loan too as compared to bank loan support which is 1.3 and 1.2 respectively. It is very certain that, for every RM1 invested for the LVL, the Processing Mill could get back RM0.30 without bank loan and RM0.20 with bank loan. The PBP is within the period of 5 years.

These financial analyses have been run several times for different levels of mill capacity from 7,660 m^3 to 30,000 m^3. The results of NPV, IRR, B/C and PBP are as in the Table 8 and the cash flow for the LVL manufacturing is as in Appendix 1.

Table 8 shows the LVL Processing Mill is only viable if the LVL mill is operating at more than 7,660 m^3 a year without support from bank loan or 10,645 m^3 a year with bank loan. At this level of operation, the LVL mill is running at break even. Therefore, this LVL mill should operate more than these capacity levels in order to gain some profit.

Table 8: Results of NPV, IRR, B/C and PBB at Difference Mill Capacity per year

Mil Capacity	Before Loan				After Loan			
	NPV	IRR	B/C	PBP	NPV	IRR	B/C	PBP
7,660	1,251	10.0%	1.00	7	(5,009,550)	-2.4%	0.88	11
10,000	3,929,499	18.2%	1.10	6	(1,081,302)	7.7%	0.98	8
10,645	5,012,285	20.2%	1.12	6	1,484	10.0%	1.00	7
15,000	12,323,189	31.9%	1.24	5	7,312,388	22.8%	1.13	5
20,000	20,716,880	43.0%	1.34	4	15,706,079	34.2%	1.24	4
25,000	29,110,571	52.5%	1.41	4	24,099,770	43.9%	1.31	4
30,000	37,504,261	61.1%	1.46	3	32,493,460	52.4%	1.37	4

NPV = Net Present Value, IRR = Internal rate of return, B/C = Benefit Ratio, PBP = Pay back Period

Conclusion

The feasibility study is done to develop the LVL from OPT in a profitable manner. The study has found that this financial analysis for the LVL Mill Manufactured from OPT in Malaysia is a good prospect for commercialisation. It has huge ready market not only locally but also for the global market. The results of the financial analysis have found that this type of manufacturing business is a very attractive business. However, the LVL Mill should operate at a minimum capacity of 7,660 m^3 per year without bank loan or 10,645 m^3 per year with bank loan. The LVL Mill should operate more than this minimum level in order to gain profit, which is very easy to achieve. The profit margin for the manufacturing of the LVL will be increased as the volume capacity increases up to the full mill capacity level.

Endnote

1 For this stage the LVL will be produced for non-structural applications and plywood.

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Appendix 1

Financial Analysis for LVL Processing Mill from OPT in Malaysia

DETAIL ITEMS	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
	-	-	-	-	-	-	-	-	-	-
PRODUCTION (m3)	1,148	8,262	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000
REVENUE (RM)	975,375	7,369,500	15,300,000	15,300,000	15,300,000	15,300,000	15,300,000	15,300,000	15,300,000	15,300,000
Less:	-	-	-	-	-	-	-	-	-	-
Fixed Costs	-	-	-	-	-	-	-	-	-	-
Machinery	7,531,200	-	-	-	-	-	-	-	-	-
Contract Expenditure	-	-	-	-	-	-	-	-	-	-
CSO & Sons Engineering	2,150,000	-	-	-	-	-	-	-	-	-
FRIM's Technical & Advisory	500,000	500,000	-	-	-	-	-	-	-	-
Office & Factory Space Rental	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Plant Fire Insurance	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000
Freight Charges/Insurance for Machineries	376,560	-	-	-	-	-	-	-	-	-
Others Utilities [telephone, streamyx]	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200
	-	-	-	-	-	-	-	-	-	-
GENERAL & ADMINISTRATIVE COSTS	-	-	-	-	-	-	-	-	-	-
Office Management (Salary)	186,816	201,761	217,902	235,334	254,161	274,494	296,454	320,170	345,783	373,446
Travel Cost for R&D Activities	234,000	201,761	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Promotion and Marketing	165,769	844,615	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
Total Fixed Costs	11,661,545	2,265,338	735,102	752,534	771,361	791,694	813,654	837,370	862,983	890,646
	-	-	-	-	-	-	-	-	-	-
Variable Costs	-	-	-	-	-	-	-	-	-	-
PRODUCTION COSTS	-	-	-	-	-	-	-	-	-	-
DIRECT MATERIAL	-	-	-	-	-	-	-	-	-	-
Oil Palm Trunk	28,688	216,750	450,000	450,000	450,000	450,000	450,000	450,000	450,000	450,000
Face & Back Veneer	160,650	1,213,800	2,520,000	2,520,000	2,520,000	2,520,000	2,520,000	2,520,000	2,520,000	2,520,000
Adhesives	114,750	867,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000	1,800,000
Packaging	17,213	130,050	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000
Consumables	11,475	86,700	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000
Sub-total Production Costs	332,775	2,514,300	5,220,000	5,220,000	5,220,000	5,220,000	5,220,000	5,220,000	5,220,000	5,220,000
	-	-	-	-	-	-	-	-	-	-
DIRECT LABOUR [Contract System]	109,013	823,650	1,710,000	1,710,000	1,710,000	1,710,000	1,710,000	1,710,000	1,710,000	1,710,000
	-	-	-	-	-	-	-	-	-	-
OVERHEADS	-	-	-	-	-	-	-	-	-	-
Electricity & Water	34,425	260,100	540,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000
Plant Maintenance	22,950	173,400	360,000	360,000	360,000	360,000	360,000	360,000	360,000	360,000
Transportation	17,213	130,050	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000
Production Management (Indirect Labour)	17,213	130,050	270,000	270,000	270,000	270,000	270,000	270,000	270,000	270,000
Miscellaneous Costs	4,877	36,848	76,500	76,500	76,500	76,500	76,500	76,500	76,500	76,500
Sub-total Production Costs	205,689	1,554,098	3,226,500	3,226,500	3,226,500	3,226,500	3,226,500	3,226,500	3,226,500	3,226,500
Total Variable Costs	538,464	4,068,398	8,446,500	8,446,500	8,446,500	8,446,500	8,446,500	8,446,500	8,446,500	8,446,500
	-	-	-	-	-	-	-	-	-	-
Total Costs [Fixed + Variable] Before Loan	12,200,010	6,333,735	9,181,602	9,199,034	9,217,861	9,238,194	9,260,154	9,283,870	9,309,483	9,337,146
Total Costs [Fixed + Variable] After Loan	13,015,494	7,149,220	9,997,087	10,014,519	10,033,346	10,053,679	10,075,638	10,099,355	10,124,968	10,152,631
	-	-	-	-	-	-	-	-	-	-
Net Profit Before Loan	(11,224,635)	1,035,765	6,118,398	6,100,966	6,082,139	6,061,806	6,039,846	6,016,130	5,990,517	5,962,854
Accumulated Revenue	(11,224,635)	(10,188,870)	(4,070,472)	2,030,493	8,112,632	14,174,438	20,214,285	26,230,415	32,220,932	38,183,786
Less:	-	-	-	-	-	-	-	-	-	-
Finance Charges [Amortize]	815,485	815,485	815,485	815,485	815,485	815,485	815,485	815,485	815,485	815,485
Net Profit After Loan	(12,040,119)	220,280	5,302,913	5,285,481	5,266,654	5,246,321	5,224,362	5,200,645	5,175,032	5,147,369
Accumulated PBT	(12,040,119)	(11,819,840)	(6,516,927)	(1,231,446)	4,035,208	9,281,530	14,505,891	19,706,537	24,881,569	30,028,938
Before Loan										
Net Present Value(NPV) @10%	17,359,404									
Internal Rate of Retuen (IRR)	38.77%									
Benefit Cost Ratio	1.30									
After Loan										
Net Present Value(NPV) @10%	12,348,603									
Internal Rate of Retuen (IRR)	29.90%									
Benefit Cost Ratio	1.20									