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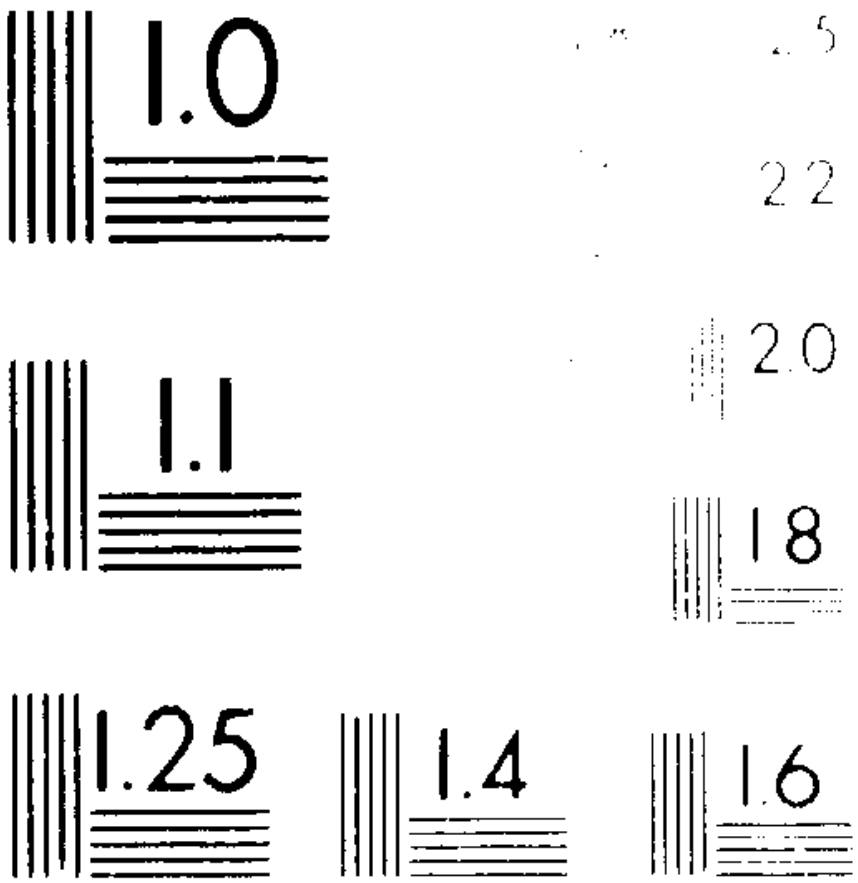
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UNIDO/UNDP

14547

ASSISTANCE TO THE DEVELOPMENT OF SMALL INDUSTRY IN INDONESIA

(PROYECT DP/INS/78/078)

DEPARTEMEN PERINDUSTRIAN

DIREKTORAT JENDERAL INDUSTRI KECIL

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(ASSISTANCE TO THE DEVELOPMENT OF SMALL INDUSTRIES)

DP/INS/78/078

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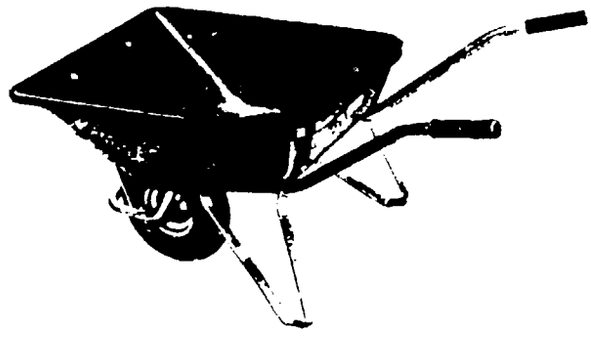
14547

Bjørn Eidsvig:

Indonesia - GENERAL FEASIBILITY STUDY for a Industrial Project to manufacture WHEELBARROWS



Report No. 50

24th March 1984.

Appendices:

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

NO.: IE.84-16/IV-06.

Project for Manufacturing and Sales of WHEELBARROWS.

1. INTRODUCTION AND SUMMARY.

Wheelbarrows can rationalize a large amount of short distance transport, reduce costs, and make the life easier for many in Indonesia.
There is a great potential market for wheelbarrows in Indonesia, but manufacturing and sales of wheelbarrows is still very limited. This is partly due to that the available wheelbarrows are of very poor quality and performance, while some imported high quality wheelbarrows are extremely expensive. Also no efforts have been done to introduce the advantages of wheelbarrows.

This project aims to introduce functional high quality wheelbarrows to the Indonesian market. Even if 4 similar projects will be implemented, proposed with a capacity of 50 wheelbarrows per day each, they can still only satisfy a limited part of the market.

The project is an open one as no entrepreneurs have been identified in advance. It is recommended for implementation in North Sumatra, East, West and Central Java for a start.

The project is expected to require Rp. 67 million in investment, whereof Rp. 13 million should be provided by the entrepreneur as equity.

46 employees are required, whereof 33 operationals. The project is expected to sell its production to hardware traders with an annual turnover of Rp. 250 million, (3rd year).
The net profit is calculated at 13 % on sales, with a return of 48 % on the investment and 249 % on equity, with a safe break even point of 47 %.
It is for a start recommended to concentrate solely on wheelbarrows.

2. ENTREPRENEURIAL SITUATION.

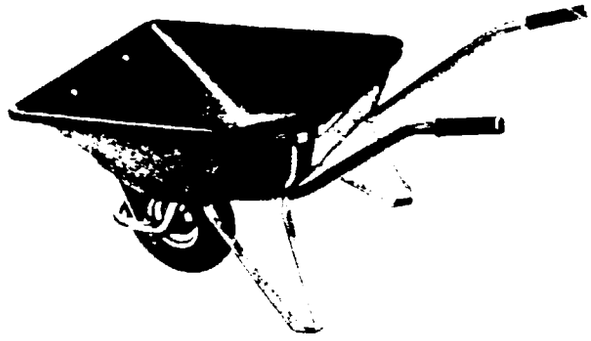
The project is open for application from potential entrepreneurs in North Sumatra, East, West and Central Java.
The entrepreneur must be able to invest Rp. 13 million into the project, and he must prove capable as a manager for the project and be able to provide necessary understanding of metal working technology. He may or he may not be able to provide a suitable [illegible] project.

It is recommended to make the project known to a reasonable number of potential entrepreneurs, and after a thorough scrutinization to select the most potential among them.

3. THE PRODUCT.

THE WHEELBARROW

PRODUCT:



Drawings of the wheelbarrow are given as follows:

In total	Appendix	1.1
The wheel	"	1.2
The box	"	1.3
The frame	"	1.4

The main data of the product are as follows:

- Volume: Flat filled: 65 liter
  Hipped : 90 "
- Box Measurements : 880 x 690 x 215 mm - 1,2 mm sheet thickness
- Carrying Capacity : 250 kg
- Wheel diameter : 300 mm. With contact exchangeable spring rubber and lubricated roller bearings
- Handles : 25 mm steel pipes with rubber grips
- Weight distribution : On the wheel, 83 %

Comparison with the present local products on the market turns out as follows:

Design Comparison between proposed and existing products:

Quality:	Proposed product:	Products from Existing Industries.
Rolling situation	Thick compact durable and exchangeable rubber, with spring device acting partly like an air filled tyre.	Steel, or on the smallest wheels: compact thin rubber without any spring effect
1) Wheel dimensions	300 Ø mm diameter x 75 mm width. The large diameter and the wide wheel are both necessary for easy rolling on uneven soft terrain.	with rubber: 240 Ø mm x 75 mm. Without rubber: 290 mm Ø x 32 mm.
2) Wheel Bearings	Roller bearings with large roller surface. Lubricated and with grease nippel	Rough dry iron pipes on each other. Gives noice, high function, and quick wearing out.
3) Volume capacity	Net: 65 liter hipped: 90 liter	Net: 50 - 60 liter hipped: 58 - 72 liter
4) Surface capacity	58 dm^2	33 - 38 dm^2
5) % of weight on the handles during carrying	17 %	33 %
6) Tilting of the load into mould frame etc.	Easy due to the shape. Also tilting support exist.	Very difficult due to shape. No tilting support.
7) Easy cleaning after use	Yes	No
8) Handles	25 Ø mm pipe with rubber grips	20 or 25 mm pipe without any grips
9) Materials	New and plane	Partly old and bulky
10) Strenght	Satisfactory	Douptful.
11) Appearance	Modern design (folded box)	Very clumsy with welded box
12) Dispatchment Volume	Can be sent far at low costs. The receiving trader assembles 3 parts by fastening 7 screws. Volume of 10 wheel barrows: 0,9 m^3	Can not be dismantled. Volume of 10 wheel barrows: 2 - 2,5 m^3
13) Price to consumer	Rp. 20.000	Rp. 15.000

As can be seen from the above table, the differences in capacity, durability and performance are very major. Still the increase in price to the consumer is limited to 33 %

If the qualities were only moderately increased, 33 % would be a too high price to defend any substantial sales, but not with these differences where the use values are at least 2 - 3 doubled. The wheel-barrows to be available at Rp. 20.000, compare reasonably in quality with imported Japanese wheel barrows, presently available in Jakarta at Rp. 45.000.

For the time being only wheel-barrows should be made, and only one variety of them. The proposed model is what can be expected to be the most requested type.

As long as the market is big enough, there will be no need to go into manufacturing of other varieties. Any diversification of the production at this stage can only mean limitation in standardization, increased tools requirements, less rational and more expensive production.

At a much later stage, when the project want to develop further, may it be considered to engage in other varieties of wheel-barrows, and possibly additional products, aiming at the same market and utilizing similar raw materials and processes.

In appendix 2 are illustrated some possible products of that nature.

4. THE MARKET SITUATION.

4.1 The need for the Product.

The wheel-barrow project is particularly important to Indonesia for two reasons:

I : The wheel-barrow will improve the working conditions and easen the burdens of the lowest class of workers, within construction work, gardening, and farming in Indonesia.

II: The wheel-barrow will improve the economy of construction work, farming, and others, and improve the possibilities to pay more reasonable wages.

The use of wheel-barrows is yet almost non existent in Indonesia. Wheel-barrows are yet taken in use only by large scale contractors and very few others. Still it is one of the most labour saving and low cost transport devices that exist.

The Indonesian alternative is to carry the total weight in one or 2 buckets or baskets, in the hands, or hanging in each end of a stick carried over the shoulders.
Carried on the shoulders, 20 kg is a fairly heavy weight, soon making the worker exhausted, or in the long run creating a dull life and early ageing. Obviously one can also not work continiously and fast with such burdens.

Carrying 100 kg in a well constructed wheel-barrow, loads the hands with 17 kg. The handles are easier to hold.
Stops for rest are also easier. Using the wheel-barrow one can safely say that the carrying capacity will be 5 doubled. These considerations are however dependant on the quality of the wheel-barrow, first of all determined by:

- The shape of the box and the location of the wheel
- The wheel circumference surface. (Not to hard, and not too soft)
- The friction of the wheel shaft.
- The shape and the material of the handles.

For the present locally made wheel-barrows, all these factors are very inadequately solved, and they do not offer much relief to the worker.

One may think that this is one of the reasons for why those products have not brought any revolution to Indonesia.

Wheel barrows are presently found and have been found over the last 50 years without much changes over the whole of Amerika, Europe, and Africa. They are on those continients found present for most small and big scale contractors, farmers, industries, craftsmen and in most gardens, and are considered as important and obvious as hoes and spades.

It is only fair to ask, why are the wheel-barrows yet to make any impact in Indonesia, and why are people still, as they did hundreds of years ago, carrying the loads hanging in a stick over the shoulders ?

- The wheel-barrows are not less fit for our conditions than elsewhere; the ground is, compared with manywhere else, both firm and fairly flat.
- The movement requirements here are fairly high, considering also that more advanced alternatives are only limited developed and seeing the very high amount of manual carrying that actually takes place.

More likely reasons for the limited use of wheel-barrows seem being the following:

- Limited press on exchange of old habits. Indonesian labourers are hard working and modest, and do not easily complain over unreasonable working conditions. They suffer quietly and accept their situation without any protest.
- Also there is not present, over any close borderline to any other country, any visual example to display for everybody that easier solutions are available.
- The wheel-barrows that are available are of such poor quality and performance that they are really not fit to create any revolution.

- The wages are low and not any very pressing factor to ease the work. The jobs are not obviously available for everybody, so why not accept the situation in order to keep the job ?

- It seems not yet fully realized by everybody that for the country to develop, to get a prosperous industry, to fight the importation and to create export, to crete new jobs, and to improve the working conditions, more rational working methodes are required.

However it seems being no reason to believe that these throughts are so firm, that when the products become available, that they will not find their legitimate market.

Still, however, can it not be expected that the availability of the product at reasonable quality and price is enough to create the necessary sales. Sales activities, advertising and information will be required. The possibilities of doing practical demonstrations, comparing with old methods, are also available.

With these efforts there seem being no reason to doubt the "wheel-barrow revolution".

4.2 Existing Supplies, Local Manufacture.

Wheel-barrows are classified under industry group 3499 "Transport equipment other than Motor vehicles, motor cycles, bicycles, becaks and motor vehicles bodies and equipment".

Obviously wheel barrows cater for a very limited part of the production programme of these industries. Group 38490 includes all kinds of hand carts, animal wagons, trolleys, transport containers and also stationery transport equipment.
According to the most recent statistics, there are in Indonesia 4 medium/large scale manufacturers classified under group 38490.

They employ all together 67 people and have a annual manufacturing value of Rp. 66 million. However, wheel barrows are not made by any of them.

Of industries classified as small scale, there are 31 companies within the same group of products, distributed in Indonesia as follows:

Sumatra Utara	4	Industries
" Barat	2	"
DKI Jakarta	1	"
Jawa Tengah	3	"
Jawa Timur	14	"
Sulawesi Utara	5	"
" Tenggara	1	"
" Selatan	1	"
Total	31	Industries.

The main data for these 31 industries are as follows in total:

No of paid workers, total	127
No of man days/annum	37.[illegible]
Average wages per day Rp.	933

Annual	raw material consumption	Rp. 26,2 millio	
"	cost of electricity in total	Rp. 1,3	"
"	total goods production value	[illegible]	"
"	total repair work or services done	Rp. 28	"

From these figures one can read that:

- The engagement in repair work in terms of man hours are much higher than in manufacturing.
- The activities are farily manual.
- The employees are very lowly paid.

The amount of wheel barrow production can not be determined but it is hardly more than 20 % of the total. I.e., according to the statistics, wheel barrow production from small scale industries does not amount to more than 10 million Rp./year or something like 1.000 wheel barrows p.a.

Considering the information from the traders, however, the sales is very much higher, which may mean that much of the production is done by not spezialised industries, categorized under e.g. manufacturing of agricultural hand tools and equipment.

4.3 Existing Supplies Import.

Importation of wheel-barrows is permitted, and a limited number of Japanese wheel-barrows have been seen in the market in Jakarta. The quality of the imported wheel-barrows that have been seen are quite high, may be very slightly better than those proposed for this project.

Measurements and proportions are good, the wheels are of high standard and the box is deep drawn in one piece. However, the price is in general 3 times as high as for the local ones, selling in retail at Rp. 45.000 per piece.
Still, those traders who sell both local and imported wheel-barrows report that the sales of imported wheel-barrows amount to at least 10 % of the total number.

In the statistics, wheel-barrows are grouped under CCCN code No. 871439 "Other vehicles for other purposes" with a total annual import value of 86 million Rp. It can not easily be determined how much of it is represented by wheel-barrows. If one consider that about 30 % of the wheel-barrow traders also sell imported wheel-barrows, and that these for them represent 10 % of the trade, the share of sales of imported wheel barrows may amount to something like 3 % of the total.

4.4 Trading of the Product.

Discussions have been held with a number of traders in Jakarta. From their information we extract the following information/assumptions:

- No of hardware traders in Jakarta : 300
- Percentage of them selling wheel barrows: 5 %
- No of wheel barrows sold per trader annually: 300 - 1.000.
- No of wheel barrows sold in/from Jakarta annually: 5.000
  Annual sales of imported wheel barrows: 150 - 300 pieces
- Customers: To 90 % large scale contractors
- Use for wheel barrow: Concrete transport to 80%
- Lifetime of wheel barrow for construction work: = erection time for the construction, 1 - 2 years.
- Normal sales price per wheel barrow (locally make): Rp. 15.000
- Normal profit per wheel barrow: Rp. 1.000
- Normal credit from wheel barrow manufacturer: 1 - 2 weeks
- Normal purchase quantity from manufacturer: 50 - 100 pieces
- Normal sales quantity to consumer customer simultaniously: 10
- Normal credit and discount to consumer: None

- Geographical distribution of customers:
  Jakarta and surroundings.

- Normal trading system:
  80 % from manufacturer via retail trader directly to consumer, 20 % partly directly from manufacturer to consumer and partly involving resale from a major trader to a minor trader.

- Manufacture:
  A few small local workshops making wheel barrows and a few similar products. One of them Aneka Timbangan is told to manufacture 200 wheel barrows per month and sells his production to cunsumers approaching him and to some of the hardware dealers in the nearby surrounding streets in Jakarta Kota (Confirmed by a material supplier).

- Hardware dealers not selling wheel barrows:
  A number of them have been approached by us. Only few of them knew what a wheel barrow is. None of them had ever been offered wheel barrows for sale. Most of them, when informed, expressed interest in trying to sell them.

4.5 Product Demand.

As described under para 4.1, there is an important need for the people to get wheel barrows to make the work easier and more efficient.

These are some of the major fields where wheel barrows are required:

Agriculture: When a larger animal cart or tractor wagon is not available or not suitable on the farm or estate.
For short distance moving of soil, manure, animal feed, sundry crops harvesting, fuel, stone, roots, sundry implements and tools, in the field and to and from the farm.
Taking bagged products to local destinations or to the roadside.

Mining and quarrying: For short distance moving of quarry products, where, and at occasions when, less advanced equipment is lacking or can not be used. For moving of soil, explosives, equipment and consumeables.

Manufacturing : For industrie especially within the building products sector, chemical sector and other bulk product consuming or manufacturing industries.
For the movement of raw materials, consumeables, fuel, wastes, bulk products, etc.

Construction : The major implement for short distance carrying of soil, stones, sand gravel, cement, concrete, bricks and tiles. On the site and within the building.

For plastering and brick work to be used, not only for transport, but also as the mortar container during the working.

Transport and storage : For loading and unloading of lorries and other transport means, when these can not reach the spot of the goods location.
For movement of bulk products within the warehouse or the site.

Gardening and House holds: For movement of soil, wastes, sand, stones, grass plants, etc.

Needs related to the work force:

The volume of the needs, and the requirement for wheel barrows, can most easily be related to the number of people engaged within the different trades as specified above.

The needs are hence estimated in the table as follows. The major numbers of workers refer to the official statistics.
The demands as distributed on different locations have been proportioned in ratio with the distribution of the work force.

The number of people per wheel barrow and the expected wheel barrow lifetime refer to general experience figures. Considering Indonesia's limited experience with wheel-barrows, the number of workers per wheel-barrow has been set particularly high.

According to the table, 1,2 million wheel barrows are required at any one time, whereas the annual need for replacements amounts to 156.000.

All the 1,2 million wheel-barrows will not be required from the start. Even if a programme of information and campaigning will be carried out, people must experience the usefulness of the equipment before it can reach really widespread use.

Minimum Requirement for wheel barrows, in Indonesia.

Related to the employement within the major trades that require wheel barrows:

	Agriculture	Mining and Quarrying	Manufacturing	Construction	Transport, storage and communication	Gardening	Road maintenance, city clearing, institutions etc.	Total
Number of workers within the sector in (000)	31.500	120	3800	800	1.300	200	350	38120
Maximum number of workers per wheel barrow	40	15	30	5	25	5	8	-
Lifetime of wheel barrow. Years	15	3	6	25	10	20	5	-
Totally required number of wheel barrows	787.000	8000	128000	160000	52000	40000	44000	1.220000

According to this, and to the geographical distribution of the population and the activities, to maintain the mount of wheel barrows, once established, the demand for wheel-barrows will be distributed as follows:

Jakarta	50	50	1200	3200	500	400	[illegible]00	7400
Jawa Barat	8550	650	4400	22400	1000	200	1500	38700
Jawa Tengah + Yogya	11700	150	6700	8000	300	300	1700	29350
Jawa Timur	12200	750	3900	12000	900	300	1800	31850
Jawa Total	32500	1500	16200	45600	3200	1200	7000	107300
Sumatera	10000	800	2400	8300	1000	400	1000	24400
Rest of Indonesia	10000	300	2900	9600	1000	400	1000	25200
Total	52500	2700	21500	64000	5200	2000	9000	156900

The building up period for the wheel-barrow population may take a few years. It may therefore be fair, in order to be on the safe side, to expect that the maintenance volume will equal not more than the total maintenance requirement. That is 150,000 wheel-barrows annually.

Needs related to the volume of construction work:

The easiest, and may be also the most reliable, is to relate the requirement for internal transport, and hence also the number of wheel-barrows to the volume of the cement consumption in Indonesia.

The cement consumption is about 7 million tons annually. One may roughly estimate the following ratio between cement requirements and other building material requirements as follows:

Building Commodity:	Volume ratio.	Number of times to be carried in a wheel-barrow.	Volume ratio no x of times.
Cement	1	2	2
Sand	5	2	10
Stone	8	2	16
Concrete	7	1	7
Mortar	2	1	12 *
Earth moving	8	2	16
Bricks and tiles	4	2	8
Other materials to be carried in wheel-barrow	1	2	2
Total ratio factor			73

* One time only, but pending in the wheel-barrow for a long time during brick laying and plastering.

Considering an average wheelbarrow load of 60 kg, and a intensive wheelbarrow use of 5000 times per year, the total needs on the building site corresponds to a number of wheelbarrows as follows:

$$\frac{7.000.000 \text{ tons cement} \times \text{ratio factor } 73}{0{,}06 \text{ ton load} \times 5000 \text{ loads/year}} = 1.700.000 \text{ wheelbarrows}$$

This means that if wheelbarrows would be used fully, as uses to be experienced as rational, 1,7 million wheelbarrows would be needed on the construction sites alone in Indonesia.

Earlier was calculated with 1[illegible].000 wheelbarrows to be required on the building sites. According to the transport volume demand calculation here 160.000 wheelbarrows can not cater for more than 9 % of the requirements on the building sites.

Similar calculations could be made for the requirements within agriculture and other trades. Even without going further, it appears that the market expectances are moderate and that there is already room for a limited number of wheelbarrow manufacturing units.

4.6 Concluding of Sales and Demand.

As a[illegible] from the statistics, the production of wheelbarrows may be limited to something like 1.000 wheelbarrows annually in Indonesia.

Most of the transport material production appears to be located to East Java.
According to the traders in Jakarta, the sales from Jakarta manufacturers via the Jakarta traders looks like being about [illegible] wheelbarrows p.a.

These figures do not tally well. The statistics are from 1980, obviously the traders' information from Jakarta of today is more reliable than the not quite up to date statistics.
Manufacturing in other provinces have not been investigated. Most likely the production in East Java is higher.
The major and obvious conclusion is it however, that the production and use is only a fraction of the potential demand.
The need for at least 1,2 million wheelbarrows is concluded, requiring an annual supply of 156 000 wheelbarrows or more.

According to the distribution of the demand, it may for start be recommended to initiate 4 wheelbarrow projects as follows:

Jakarta or Jawa Barat	1	project	13500	units year
Jawa Tengah or Yogya	1	"	13500	- " -
Jawa Timur	1	"	13500	- " -
Sumatera Utara	1	"	13500	- " -
Total	4	"	54000	- " -

Only after getting these projects into operation and being their problems, should the further development be discussed.

5. SALES PROGRAM AND MARKET STRATEGY.

The project will when in full production 3rd year, have to sell 13.500 wheelbarrows per year or 50 wheelbarrows per day. Whether for a project in North Sumatra, East, West or Central Java, the project should cater for a market within its own region, requiring 25 - 40.000 wheelbarrows annually to build up and maintain a population of 200.000 - 350.000 wheelbarrows.

The project hence does not require to utilise more than maximum 30 - 50 % of the market within the region, and will have available 15 - 25 years to cover the requirements.

Still it must be considered that it is a fairly virgin market. A more or less new product will have to be introduced, and old traditions will have to be changed. The change can not be expected to be automatic, even if benefits are considerable and costs are limited.

The following activities can be proposed in order to increase the understanding of the usefulness of the wheelbarrows:

- To arrange demonstrations for entrepreneurs, village chiefs, traders, etc. including competition between wheel-barrow use and traditional carrying methods.

- To provide placards for dealers etc. displaying the benefits of using wheelbarrows.

- To deliver with the wheelbarrows, instruction for use and calculation of its economy.

- To obtain recommendations for the use of wheelbarrows from associations of contractors, farmers, etc. and ministry of health, public work, and agriculture.

- To arrange information programmes in the mass media about the use and usefulnes of the products, again displaying comparison with other methods.

- To instruct salesmen how to arrange demonstrations in the villages, comparing with the traditional methods.

- Occasionally to advertise, but to a limited extent.

The product must be conveniently available for sale both from ordinary hardware dealers and from ambulant salesmen on a purchase/sales basis.

Price to consumer Rp. 20.000 whether from traders or ambulant salesmen.

In distant areas the price may be slightly higher due to the transport costs. Because of the compact packing however these additions will be quite limited.

Price ex factory Rp. 18.500 whether to stationery trader or to ambulant salesmen, including transport within the town.

It is expected that sales will be directly from the factory to the retailes, and 2 salesmen to be employed for sales to the dealers. Both will mainly be on the move, visiting the traders, the one mainly in the town, the other one also travelling within the district. The salesmen to be paid partly a fixed salary and partly a sales bonus dependent on sales volume.

Payment conditions to the traders, 2 weeks net. and to ambulant salesmen cash on delivery unless securities will be arranged.

3. TECHNOLOGY SELECTION.

The major technology consideration concerns the manufacturing method for making the box. In general 3 different methods exist:

A. Welding the box from individual pieces of sheet.

The method is very labour intencive, but utilizes the sheet well. The welding costs are however high, and the product will look very clumsy and be of an inferior quality. It easily becomes dented during the production and it will be difficult to keep clean.

B. Folding the box from one piece of sheet, spot welding the corners.

Slightly more material will be required, but the working is far less labour intencive. A box folding machine will be required, while when welding an ordinary folding machine will be sufficient. The product will be good looking and easy to keep clean.

C. Deep drawing the box from one piece of sheet.

The material utilization will be very good. The production will be rational, the product will get a very advanced appearance and it will be strong with large radii in all the corners without any joints.

It will be very easy to keep clean. The capacity will be very high. The only problem is the high costs of the press and the forming tools.

The costs for the different matters that will differ between the alternatives, are expected to appear approximately as follows:

Cost comparison in Rp. 000 for the 3 methods:	Cost in Rp. 000 for the 3 Alternatives. A. Welded	B. Folded	C. Pressed.
Net capacity for the method. Boxes/day	50	50	250
Differing Investment:			
Folding Machine or Box folder	1.800	2.800	
Tripple acting hydraulic press			50.000
Press tools			15.000
Extra welding equipment, 2 sets	800		
Cost of additional equipment required for a capacity of 50 wheelbarrows per day	2.600	2.800	65.000
Annual Fixed costs:			
Depreciation, 10 % p.a.	260	280	6.500
Interest at 12 %	310	336	7.800
Total	570	616	14.300
Variable costs:			
- Extra labour: 2 welders + 2 assistants at Rp. 60.000. full time	3.456		
2 Folding operators 60 % of the time at rp. 60.000.		864	
At Rp. 50.000, 50% of the time	720		
2 press operators, 20% of the time, at Rp. 60.000			346
2 Spot welders, 50% of the time at Rp. 40.000		576	
- Material consumption, 13.500 pieces sheet 0,7 m^2 - 0,75 m^2	42.971	49.110	46.040
- Welding consumables costs and electricity	3.200	200	800
- Maintenance of equipment etc.	83	50	214
Total Variable Costs	50.430	50.800	47.400
Total annual costs at 50 wheel-barrows/day	51.000	51.410	61.700
Difference in costs per wheel-barrow:	Rp. 3 less	-	Rp. 762 more

As can be seen, method A and B turn out to cost practically the same both in investment and annual costs.
Folded wheelbarrows have value comparatively much higher than the difference in cost of Rp. 30.
Method A can therefore not be recommended.

Pressed wheelbarrows would make the costs to increase by Rp. 762 compared with folded ones.
Undoubtedly even this cost difference can easily be defended for the better pressed quality.
If later on the production would increase, the difference would further decrease.

However, the total variable investments for the project with pressed bones would increase by Rp. [illegible] million which means a [illegible] - doubling.
That represents a unnecessary risk for a new project, and the break even point would be several times higher.
Alternative B is therefore recommended.

When the project is in steady operation, if the development shows that it will be wise, the investment in a press for deep drawing of the box can always be considered.

7. PRINCIPAL PRODUCTION.

7.1 Production Process.

The flow of the production is outlined in the flow diagram as on page 30. The detailed application machinery and manpower is specified on page 31 and 32.

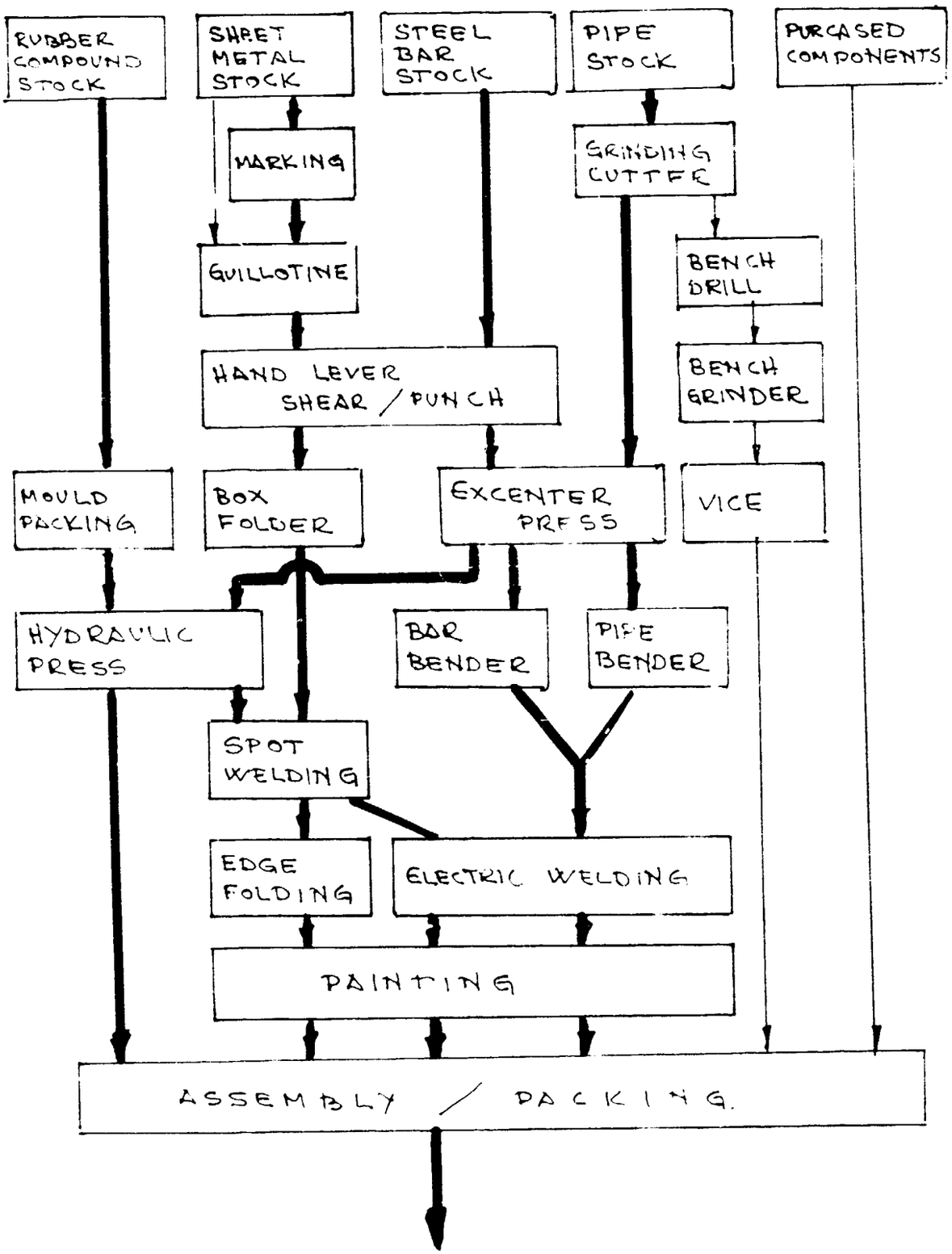
In general the major part of the production involves.

Sheet metal box : cutting, folding and spot welding

Pipe frame : cutting, bending and welding on of legs etc. in rolled flat steel.

Wheel : Pressing of 2 sides, welding on to a pipe hub and spot welding together, embracing a rubber ring, prevulcanized within the project.

Assembly : Only wheelbarrows to be sold in the nearby surroundings will be completely assembled. For long distance transport, boxes and frames will be stacked together separately.



PRODUCTION FLOW DIAGRAM.

Specification of operations. Man and machine requirements:

Product and operation.	Machine/ method.	Time each operation. Seconds.	No of operations per wheelbarrow	No of operators working together	Net machine time. Minutes.	Net mantime per Minutes.
1 - 9 Box.						
- Marking of sheet	Template	60	1	2	1.0	2.0
- Cut sheet to size	Guillotine	20	1	2	3.5	7.0
- Punch holes	Shear/punch	15	6	2	1.5	3.0
- Make slits	- " -	30	6	2	3.0	6.0
- Fold corners	Box folder	25	1	2	0.9	1.8
- Spot welding	Spot welder	5	4	2	0.3	0.6
- Folding edge bar	Manual w/jigg	120	3	2	6.0	12.0
- Painting	Hand brush	240	1	1	-	4.0
2. Handle						
- Cutting of pipe	Cutting grinder	20	1	2	0.4	0.7
- Punching of holes	Excenter press	10	4	2	0.7	1.4
- Bending	Pipe bender	20	9	2	3.0	6.0
- Welding of legs supports and wheel holders	Jigs and transformator	40	8	2	5.4	10.8
- Painting	Hand brush	200	1	1	-	3.4
3 - 4 - 5 Legs, support, Wheel holder.						
- Cutting	Shear	12	6	2	1.2	2.4
- End [illegible]	Excenter press	6	4	2	0.4	0.8
- Hole punching	- " -	6	4	2	0.4	0.8
- Bending	Jigs	30	8	2	4.0	8.0
10. Tyre Vulcanization.	Fly wheel press + double heated tools	2 min	0.5	2	10.0	20.0

Product and operation.	Machine/ method.	Time each operation. Seconds.	No of operations per wheel arrow	No of operators working together	Net machine time. Minutes	Net man time. Man-minutes.
14. Wheel rim discs						
- Cut sheet squares	Guillotine	2[illegible]	4	2	1.4	2.8
- Cut corners	Excenter press	[illegible]	2	1	1.4	1.4
- Centre hole punch	Excenter press	1[illegible]	[illegible]	1	0.5	[illegible].5
- Lubrication hole punch	Excenter press	15	2	1	0.5	0.5
- Draw into shape	Excenter press	20	[illegible]	2[illegible]	1.4	2.8
- Spot welding	Press jigs + spot welder	150	1	2	2.5	5.0
- Hub welding	Transformator /jigs	120	1	2	2.0	4.0
- Painting	Hand brush	120	1	1	2.0	2.0
15 - 16 Hub pipe and shaft pipe						
- Cutting	Cutter grinder	10	2	1	[illegible].4	0.4
- Drilling/ treading	Bench drill	60	1	1	.0	1.0
- [illegible] and [illegible]	Vice, working bench, and hand tools	150	2	1	5.[illegible]	5.[illegible]
17. Steel needles						
- Cutting	Cutter grinder	[illegible]	20	1	1.7	1.7
- End rounding	Bench grinder	1[illegible]	20	1	1.7	1.7
Assembly/ Packaging	Work bench/ vice	12 min	1	3	12	36
Total Net						1[illegible]9.7

Production Programme.

The application and loading of production equipment is shown on page 33, based on 5[illegible] wheelbarrows per day.

The loading of the equipment, based on gross time consumption including all time loss factors, varies from 16 to 34 %. It is expected that the vulcanization of rubber wheels, and the welding will be done on 2 shifts, at times also the box folding.

With 8 working hours per day, 44 hours per week and 48,1 working weeks per year, is expected to be manufactured 12.500 wheelbarrows yearly.

This production is expected reached the 3rd year of operations, to be developed as follows:

1st year 50 % = 6,750 wheelbarrows

2nd " 80 % = 10,800 - " -

3rd " 100 % = 13,500 - " -

Machine loading and Machine Requirement.

Machine	Net Machine time, as to operation list. Minute/ wheelbarrow	Machine setting time. + %	Reworking and waste time + %	Production technology & personal time waste. +%	Gross Machine loading time. Minutes/wheelbarrow	No. of machines	No. of shifts.	Machine capacity utilization at 60 wheelbarrows/ day and 8 hours/day	Comment.
- Bench vice	,7	10	10	25	2	1	1	90,[illegible]	
- Flywheel press	11,4	20	5	15	17	1	2	89,[illegible]	For vulcanization.
- Welding machine	7,4	10	10	30	12	1	2	63,[illegible]	
- Spot welder	5,9	10	10	25	9	1	1	94,[illegible]	
- Box folder	5,9	30	10	25	11	1	2	58,[illegible]	
- Guillotine	4,9	10	5	25	7,1	1	1	74,[illegible]	
- Shear/punch	4,7	10	5	25	6,8	1	1	71,[illegible]	
- Exenter press	3,9	80	10	20	9	1	1	94,[illegible]	Also for hub pressing
- Pipe bender	3,0	25	15	25	5,4	1	1	56,[illegible]	
- Grinding cutter	2,5	5	5	20	3,3	1	1	35,[illegible]	
- Bench grinder	1,7	5	5	25	2,4	1	1	25,[illegible]	
- Bench drill	1,0	5	15	25	1,5	1	1	16,[illegible]	

7.3 Raw Materials.

The required raw materials are specified in the table on page 35. Gross quantities, prices and the resulting costs are specified, totaling Rp. 10.941 per wheelbarrow.

All raw materials are readily available from local dealers in any developed town in Indonesia. They will generally provide transport to the factory. It is not expected to use any secondhand materials.

Sheet materials are available in roll of required width 1.03 m when specifically ordered. This is important for the limitation of waste. Minimum order quantity 1 ton, which amounts to about 3 days requirement.

For other materials will not apply any particular minimum supply quantities. As long as the supplies are regular, raw material purchase on a weekly basis may be sufficient, having ½ week minimum stock and an average stock holding of 1 week.

Based on regular supplies from regular contacts, 30 days credit for the supplies can be expected. The specified prices are net. A limited discount may possibly be negotiated.

Material specification, Wheelbarrow.

Item	No.	Material Specification.	Quantity and Unit	Unit price Rp.	Total cost Rp.
1	1	Sheet for box, 1,2mm x 1.[illegible]mm, mild steel	7,5 kg	4,[illegible] Rp/kg	3.6[illegible]
2	1	Handle 25Ø x 1.4mm x 2.[illegible]mm, steel pipe	3 m	[illegible] Rp/m	1.32[illegible]
3	2	Leg, 25 x 5mm x 80[illegible]mm, flat steel bar	1,64 kg	[illegible]00 Rp/kg	984
4	2	Box support, 25 x 5 x50mm, flat steel bar	0,1[illegible] kg	[illegible] Rp/kg	[illegible]
5	2	Wheel support 3[illegible] x 5 x 50mm, flat steel bar			
6	4	Cup head screws/ nuts, 5/16" x 38mm	[illegible] pieces	35 Rp/piece	14
7	2	Cup head screws/ nut 5/16 x 20mm	2 "	30 "	[illegible]
8	2	Handles, rubber, 25 mm Ø	2 "	15[illegible] Rp/each	3[illegible]
10	1	Paint	0,5 liter	3.500 Rp/liter	37[illegible]
11		Welding electrodes	0,15 kg	1.0[illegible] Rp/kg	1[illegible]
12	6	Washers 5/16 "	6 piece	3 Rp/each	[illegible]
13	1	Rubber rim compound 1,4 Kg/liter x 1,5 liter	2,1 [illegible]	7[illegible] Rp/k	1.4[illegible]
14	3	Wheel plate, 1.5mm x 2.75Ø mild steel	1,77 kg	4,85 Rp/kg	859
15	1	Steel pipe 32 Ø x 3mm x 120mm	[illegible],12 m	1.[illegible] Rp/m	1[illegible]
16	1	Steel pipe 1"/ x3" x 12Ø mm	[illegible],12 m	[illegible] "	7[illegible]
17	30	Steel [illegible] Ø x 1[illegible]mm	0,1[illegible] kg	1.[illegible] Rp/kg	[illegible]
18	[illegible]	Washer, 1/2" Ø		5 Rp/each	[illegible]
19	1	Springwasher, 1"/		10 "	[illegible]
20	1	Bolt/nut 1"/x15[illegible]		2[illegible] "	[illegible]
[illegible]	1	[illegible]			[illegible]

.4 Manpower Requirements.

Operative manpower.

The operative manpower requirements are specified in the table, page 31 and 32.

The net requirement adds up to [illegible] man-minutes per wheelbarrow. To this can be added [illegible] 25 % machine setting time, 15 % remedying and waste time, 30 % time loss for technical and organizational reasons, and 5 % personnal time. The total time requirement hence amounts to 832 manminutes per day or in terms of operatives:

$$\frac{320 \text{ manmin. per wheelbarrow} \times 1.5 \text{ wheelbarrow / day}}{480 \text{ min/day}} =$$

32 operators at 100 % production.

This can be divided on different jobs as follows:

Machine operators:

2	rubber press operators
2	welders
1	spot welder
3	plate making, cutting, [illegible]
1	exenter press operator
1	hand lever shear operator
1	pipe bender
1	foundry machine worker
1	fitter

=	10 Machine operators and trained labourers at average Rp. 65.000 per month	= Rp. 10.140.000
+	10 Semiskilled workers at Rp. 3..[illegible] per month	= Rp. [illegible]
+	10 Unskilled assistants and trainees at Rp. 24.000 per month	= Rp. 2.880.000
	Sub total	= Rp. 17.100.000
	+ 20% social costs	= Rp. 20.500.000

Fixed and inoperative staff and manpower:

The following fixed staff is required:

		Rp/month	Rp/year
1	Manager	180.000	2.160.000
1	Production engineer	120.000	1.440.000
2	Sales executive (+ commission)	80.000	1.920.000
1	Accountant	120.000	1.440.000
1	General clerk	50.000	600.000
1	Office boy	24.000	288.000
1	Foreman	80.000	960.000
1	" assistant	70.000	840.000
1	General mechanic	80.000	960.000
1	Watchman	24.000	288.000
2	Sundry assistant workers	24.000	576.000
13	Fixed staff total	=	Rp.11.472.000
	+ 20 % social costs	=	Rp.13.770.000

It is expected that people in skilled jobs have some experience from other industries. Especially important is this for the manager, the engineer, the accountant, the foreman and the welders.

The presense of a highly skilled production engineer will be required for a week or two to supervise and guide during the initial production.

8. LOCATION.

The project is an open one, initially recommended for implementation in North Sumatra, East, West and Central Java.

The project may in the principle be located anythere within these regions, but the following matters should be within reach as well as possible:

1 As close as possible to prospective traders and of users of wheelbarrows

2 As close as possible to low cost suppliers of the required steel materials.

3 Telephone available, suitable road connection

4 Suitable and reasonable building or site available.

Appendix 3 shows a suitable lay-out for the project, occupying 176 m^2.

9. THE ECONOMY OF THE PROJECT.

9.1 Investments.

Rp.000:

Land and Building.

- Land, 220 m^2 at Rp. 10.000	= 2.200
- Building, 176m^2 steel/wood structure with corrugated steel sheets at Rp. 50.000 per m^2	8.800
- Road, fence, water installation, sewer installation (estimated)	= 1.000
Total building costs	= 12.000

Machinery and equipment.

A. Machines:

The required machines are all available locally, and from many different traders. The specifications below refer to quotation from P.T. Teknik Makmur, Pasar Lindeteves, Jakarta Kota, as of February 1974:

- 1 Excenter press, 50 tons, 3 1/2" max stroke, 30" x 21" bed, 5 Hp motor, 2.800 kg weight, "International"
- 1 Fly wheel press, 6 tons, 16" width, 16" stroke, "International", [illegible] w/fly wheel. "

			Fr.(S...)
-	1	Guillotine, 1,25 m cutting width, 2mm sheet capacity, "Joy cut" manual	1.600
-	1	Box folding machine, 1,25 m width, 2mm sheet capacity, "Fong Jia", manual	3.800
-	1	Combined Hand lever shear and punch, capable of 8mm sheets, profiles, 10 flats and 8mm punch thickness "Tubea"	900
-	1	Pipe bender, Manual, 40 mm steel tube capacity, with automatic lenght and angle controls and inside the pipe bending core "All-Bend 26 M/3.000"	3.200
-	1	Grinding cutter, for 12" - 16" Ø grinding blade, 2 HP motor	300
-		Welding Transformator, 340 Amp. complete	400
-	1	Spot welding machine for 2mm sheets, stationery, floor model	1.500
-	1	Bench drilling machine, 3/4" Ø, 0,75 HP motor	800
-	1	Bench grinder 6", 0,75 Hl motor	300
-	2	Bench vices, 4"	200
		Sub total	23.800
			========

DM ... :

F. Additional Tools, (estimated)

- Press tools for wheel rim discs	1.600
- Corner cut tool for wheel discs	600
- Hole punches for wheel discs	400
- Other hole punch tools	500
- 2 Rubber vulcanisation tools with heating, double	1.400
- Rod bending jigs (self made)	300
- Welding jigs	200
- Sundry hand tools	1.300
Sub total	7.300

G. Installation

- Machine fundation and physical machine installation (self made)	200
- Electrical installation	600
- ELL connection	1.200
- Working benches and factory furniture	200
- Fire fighting equipment	200
Sub total	2.400

Total Machinery and equipment 39.200

[illegible]:

Other Assets Required:

Office furniture	[illegible]
Typewriter & office equipment	[illegible]
Telephone installation	200
Total	1.200

Safety Factor:

Contingencies and allowance for price increases, 10 % on the above investments	[illegible]

Pre-operational Expenses:

- Construction of preparatory works	[illegible]
Engineering and supervising installation costs	[illegible]
- Training costs, 1 engineer for 1-2 weeks on a visit to rubber rationalization factory	[illegible]
- Interest before start of regular production, 10 % p.a. on building costs in 6 months	[illegible]
10 % p.a. on further cash investments in [illegible] months	[illegible]
- Salaries and wages before start, 1 month on 50 % of the staff	1.150
- Other overheads before start of operation, 1 month	[illegible]
- Manufacturing and testing of prototype, [illegible]	[illegible]
- [illegible]	[illegible]
Total	[illegible]

Working Capital Requirements:	Rp. m.
Raw materials stock: 1 week on Rp. 14.[illegible] mill	1.836
Work in progress, [illegible] days on Rp. 172 mill	1.[illegible]
Products in stock, [illegible] weeks on Rp. 200 mill	7.692
Debtors, 80 [illegible] weeks, half sold, at Rp. 200 mill	9.230
Creditors 70 [illegible] days on Rp. 11[illegible] mill	
30 [illegible].D	(9.917)
Cash in Hand, 1 month [illegible]	
Rp. 19 m	1.667
Total	12.6[illegible]

Financing.

The investment and financing totals are as follows (Rp.000):

		Total	Loan	Equity
Land and Building				
Land	2.2[illegible]			
Buildings & Improvements	9.800	12.000	12.00[illegible]	
Machinery, etc.				
Machines	23.800			
Tools	7.000			
[illegible]	.400	31.2[illegible]	[illegible]	
[illegible]		1.60[illegible]	[illegible]	
[illegible]		[illegible]		[illegible]
Working Capital		12.[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	34.000	[illegible]

The Loan is expected to be obtained ... from ... loan for ... local bank, Rp. ... for fixed investment at 13,5 % interest and Rp. ... for working capital at 13,5 % interest, i.e. ... 13,7 %.

20 % or Rp. 13.000.... of the interest ... expected to be provided by the entrepreneur himself.

It is expected that ... additionally to the securities within the project, ... require investment security for ... Rp. ..., 5 % of the ... for machinery ... working capital.

Expected grace period 1 year ... repayment Rp. 5.773.000 in interest, ... repayment of the loan thereafter over 8 years ... annuity which at 10,7 % interest requires an annual repayment of Rp. 11.780.000.

The Cash flow (para 9.4) shows that these conditions can easily be accomodated. The annual income could allow for a 4 - double repayment and ... loan could be repaid faster, even if we would not recommend to calculate with that.

7.3 PROFITABILITY EVALUATION.

	Yearly Cost in Rp.000.		
	1st year	2nd year	3rd year
Production in % of normal production.	50 %	80 %	100 %
Production in Number of wheelbarrows per year.	6.750	10.800	13.500
Gross Sales receipts, 13.500 pieces at Rp. 18.500	124.875	199.800	249.750.
Less discount to customers	1.250	2.000	2.500
Less commission to sales agents and sales representatives	1.250	2.000	2.500
Local product transport	750	1.200	1.500
Net Sales Receipts	121.625	194.600	243.250
Variable Costs:			
Wages for Production workers (see part 7.4)	18.000	17.500	20.500
Raw materials, 1.250 MT at Rp. 1.111 (part 7.3)	72.717	111.947	139.934
Consumables and lubricants etc	150	250	300
Electricity consumption, 24.000 kwh at Rp. 14	1.320	2.040	2.520
Sundry raw material transport	500	600	700
Water	330	350	420
Total Variable Costs	89.017	134.687	171.874
Gross Profit	32.608	55.913	71.376
Fixed Costs:			
Salaries and fixed wages (see part 7.4)	13.770	13.770	13.770
Electricity, fixed part, 26 KW at 2.300	550	550	550
Maintenance and repair	1.000	800	800
General transport costs	400	400	400
Travelling costs	1.000	1.000	1.000
Office expenses, telephone, postage, stationery	800	800	800
Special sales promotion expenses	2.300	2.300	1.800
Insurances, 4 ‰	300	300	300
Depreciations			
5 % on building, Rp. 800.000	500	500	500
10 % on machinery, Rp. 40.000.000	4.000	4.000	4.000
Interests, 10,7 % on Rp. 54.000.000	5.780	5.420	4.700
Sundries	380	380	380
	30.780	30.220	29.000
	1.828	25.693	42.376
	548	7.708	12.713
x	1.280	17.985	29.663
	1,	13	13
			4
	13	14	14
		54	47

9.4 Cash Flow (in Rp. '000).

	Year 0	Year 1	Year 2	Year 3
Sources of Fund:				
Profit before tax		1.5[illegible]	25.0[illegible]	31.3[illegible]
Depreciation		[illegible]	4.500	4.500
Loan availability	54.000			
Equity injection	13.[illegible]00			
Total Sources	6[illegible]	[illegible]	[illegible]	[illegible]
Uses of Fund:				
Building	12.[illegible]00			
Machinery & Installation	3[illegible].300			
Working capital application	6.300	3.800	2.5[illegible]	
Pre-operational expenses	3.[illegible]00		548	7.707
Tax payment			548	7.707
Loan Repayment	5.780	4.6[illegible]	4.960	5.680
Total Uses	[illegible].[illegible]80	8.40[illegible]	[illegible].008	13.38[illegible]
Cash Surplus	[illegible].800	(2.7[illegible])	21.195	[illegible]1.499
Accumulated Cash		[illegible].7[illegible]	26.91[illegible]	[illegible]1.[illegible]08

As can be seen, the proposed loan may not be utilized to more than 94 %, and the project expected to still retained a cash surplus.

4. [illegible] PLAN.

The project can, when the entrepreneur is found [illegible] and the equity is secured, be implemented as shown on the next page, if all needs, provided the matter is sufficiently followed up.

The following matters should be [illegible] after each other, can will probably be the most determining the implementation time:

1. Identify a suitable client and make sure that the required equity really is available

2. Identify a suitable building site, make building plans and get tenders (If a ready building is not available)

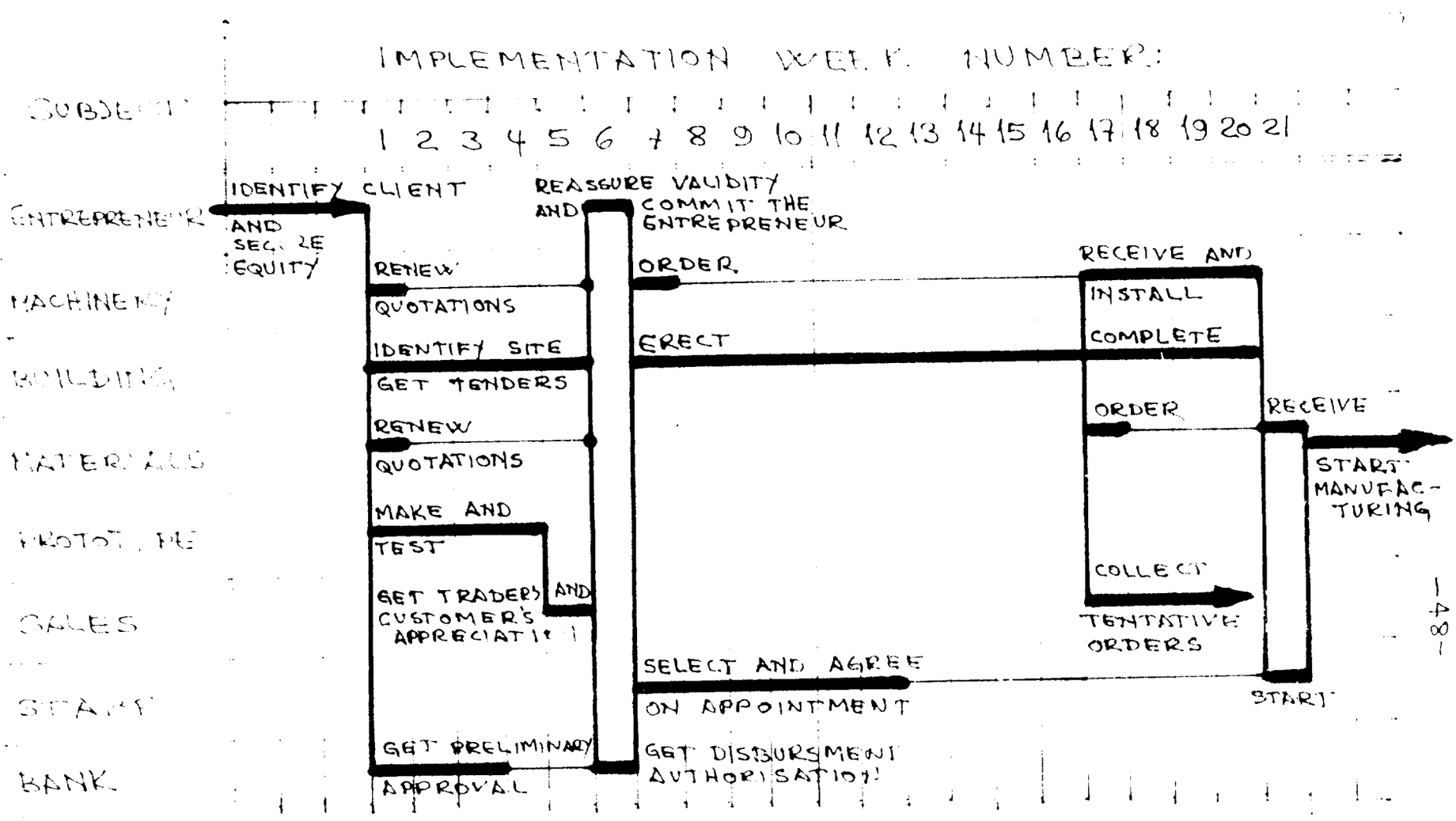
3. After collecting the different information, recalculate the figures of the study and make sure that the entrepreneur is committed to the project, and has provided the required equity capital.

4. Erect the building as soon as possible up to the stage that machinery can start to be installed.

5. Install the machinery that should arrive at that time.

6. Make sure that all material arrive and that the staff earlier arranged for can start as soon as the machinery is installed.

IMPLEMENTATION PLAN.

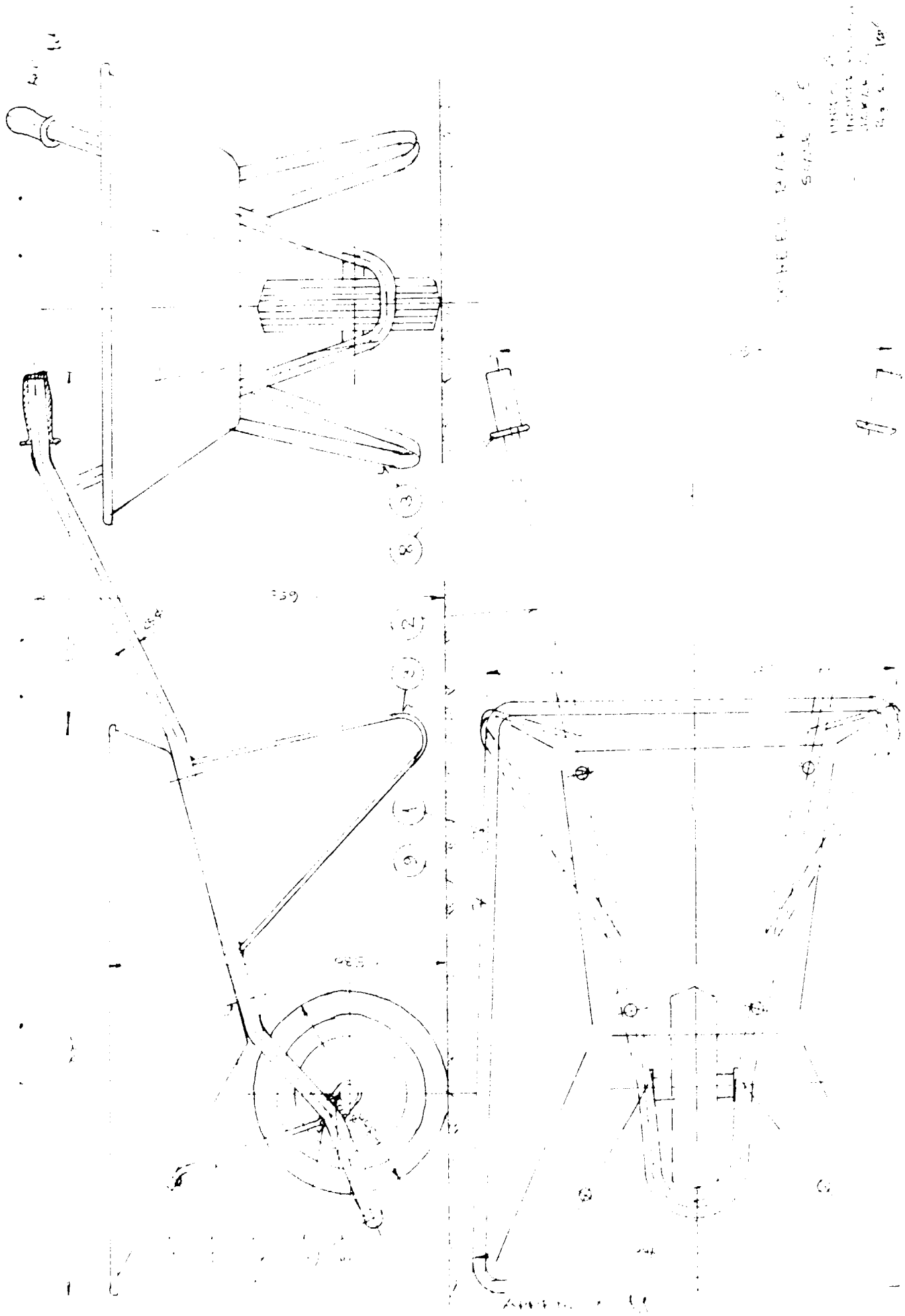


11. CONCLUSION AND RECOMMENDATIONS.

The project has been found sufficiently viable and feasible for being implemented for a start in four locations; North Sumatra, East, Central and West Java.

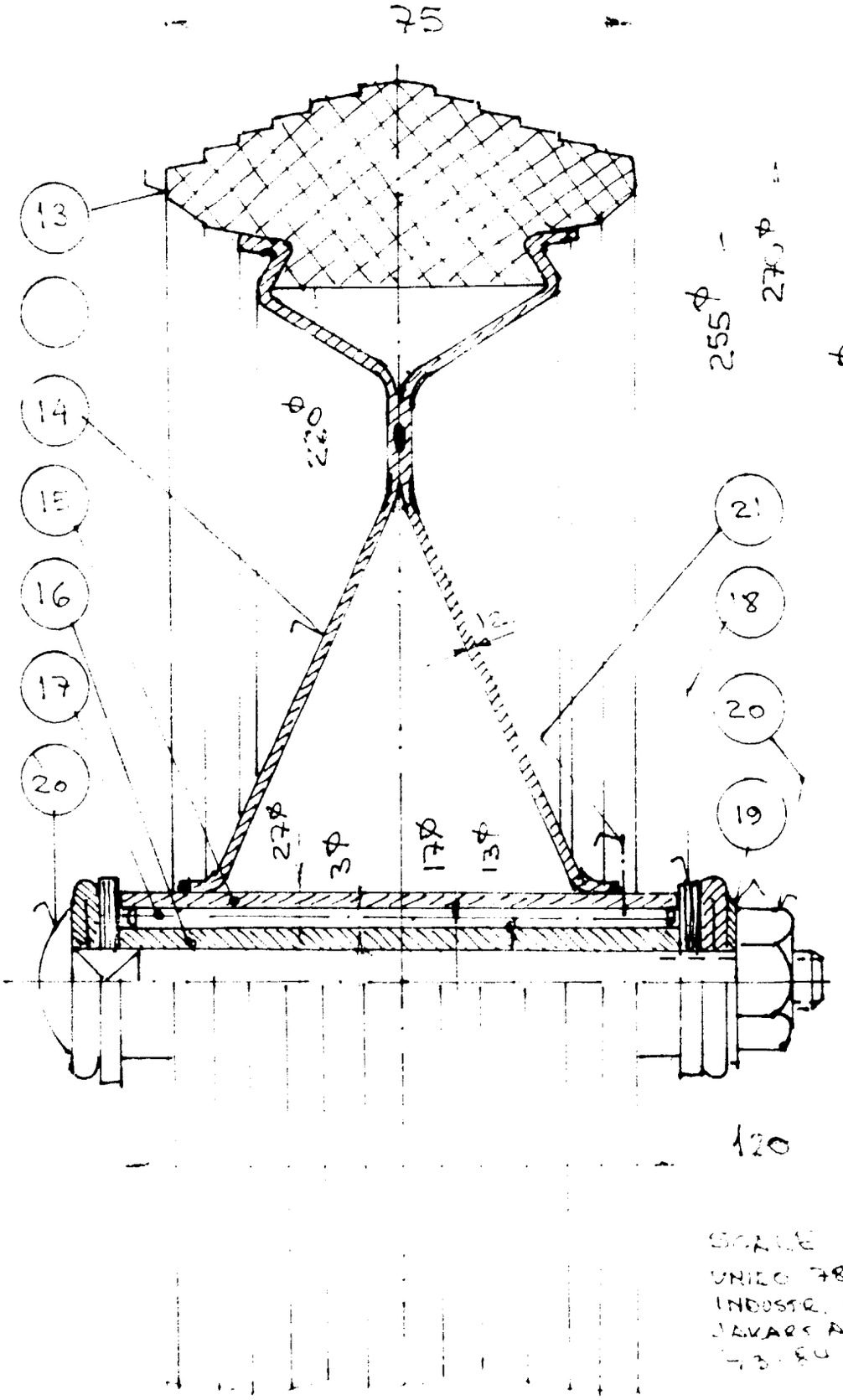
It is recommended to give a bank feasibility loan to the project of Rp. 54 million.

Before the loan is released and expenses are committed, the different matters as specified in the implementation plan should be rechecked for the viability of the project, the entrepreneurial equity be provided, and it must be made certain that a sufficiently qualified manager is available.



Appendix 1.2

WHEE - BARROW WHEEL



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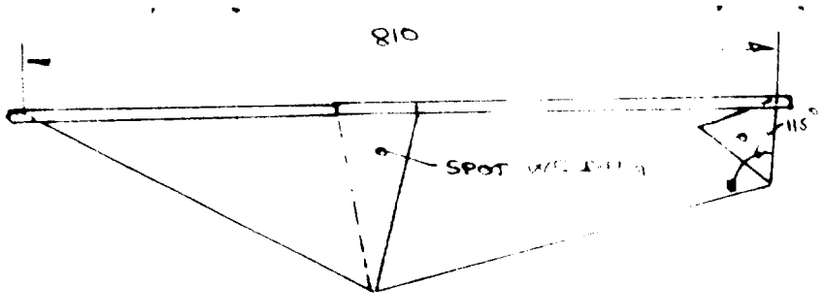
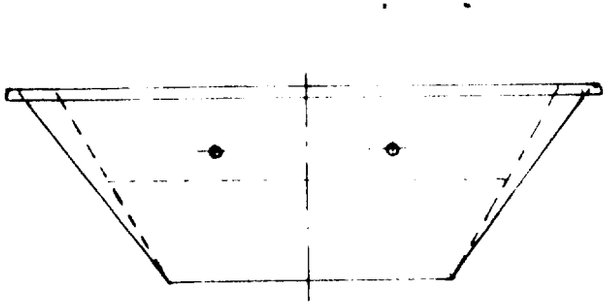
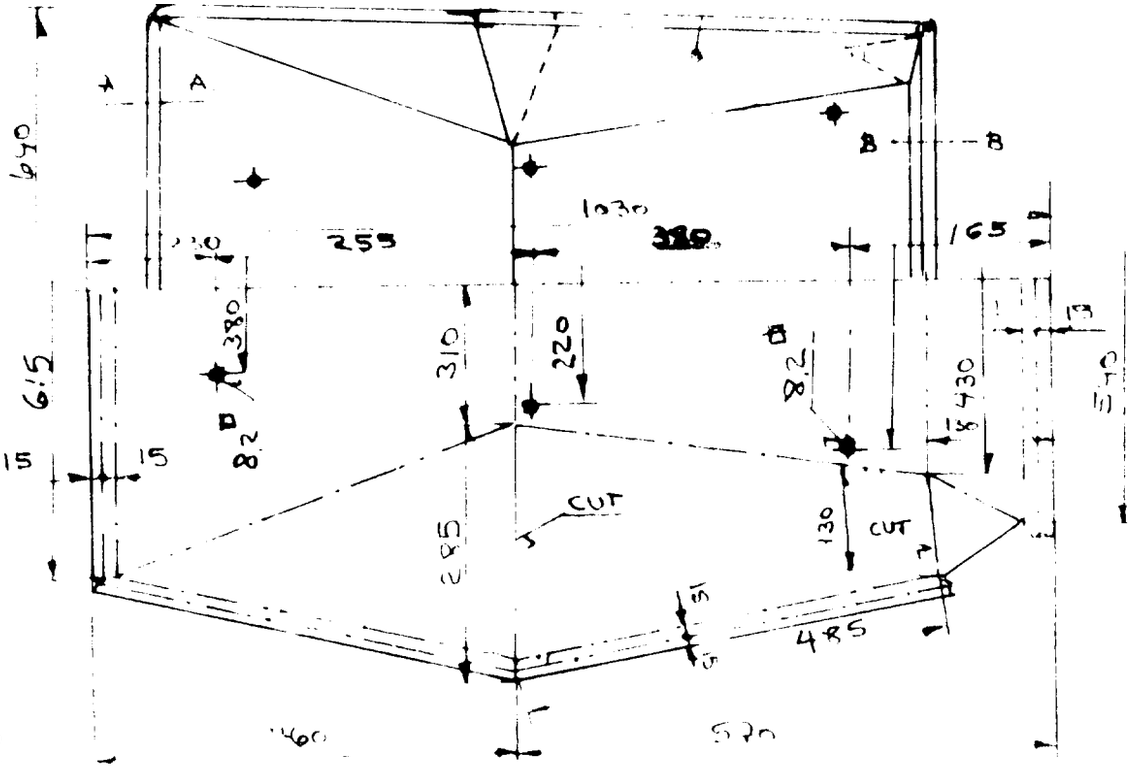
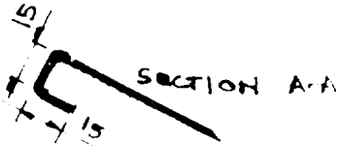
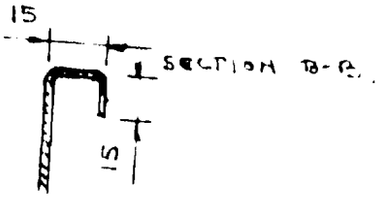




1,2 MM SHEET





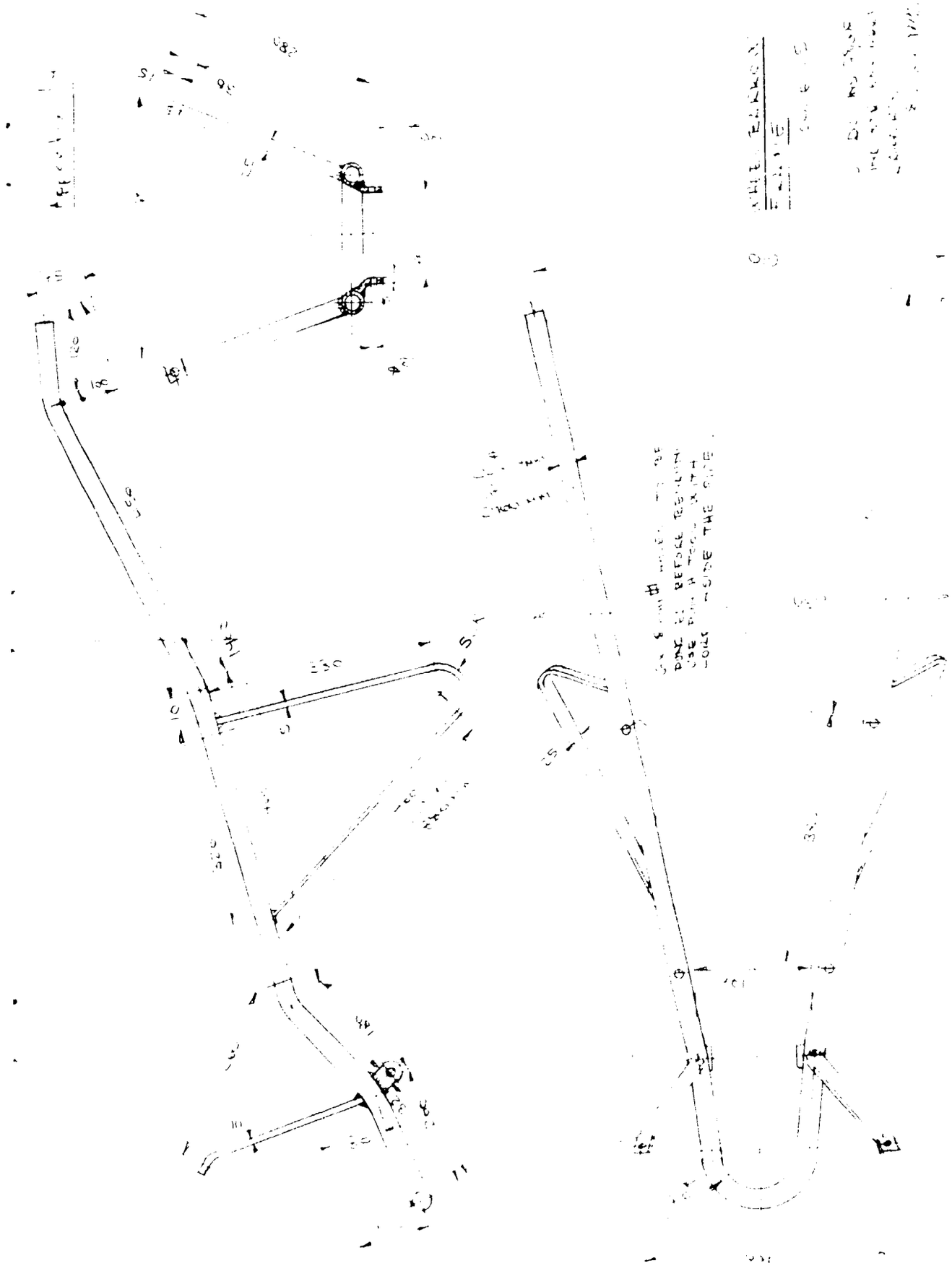


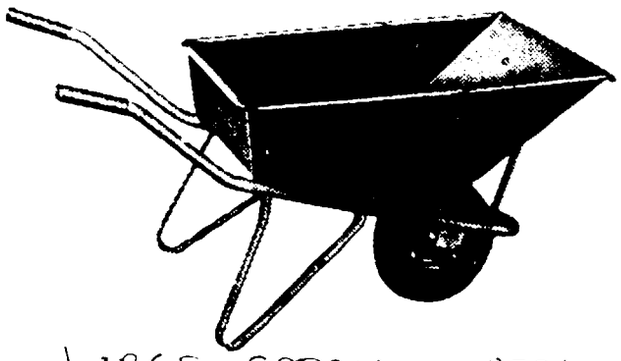
WORKING :

1. Cut sheet to size
2. PUNCH HOLES
3. Mark for cutting (Template
4. Cut to shape
5. Fold edges
6. Fold box
7. Spot welding
9. Welding corner top

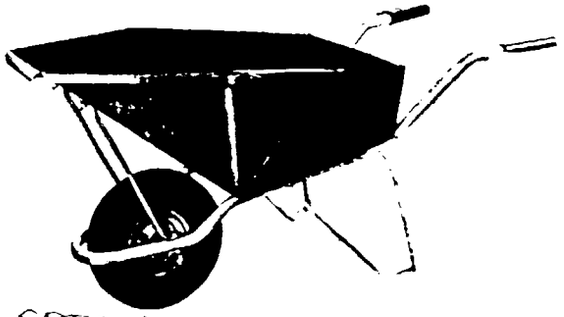
WHEEL BARROW Type V.

UNIDO 78/078
INDUSTRY ENGINEER
JAKARTA
8/8 84



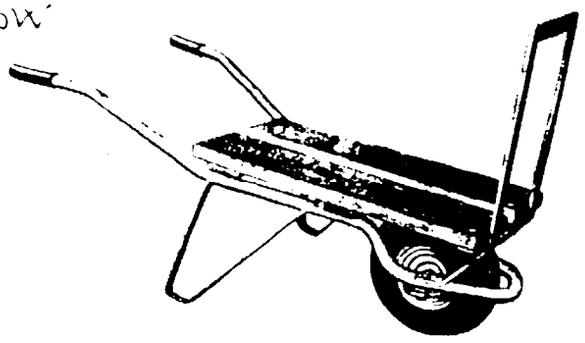


LARGE SPECIAL WHEEL BARROW FOR CONCRETE

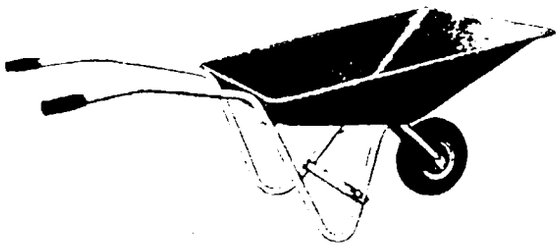


SPECIAL WHEELBARROW FOR INSIDE PLASTER WORK

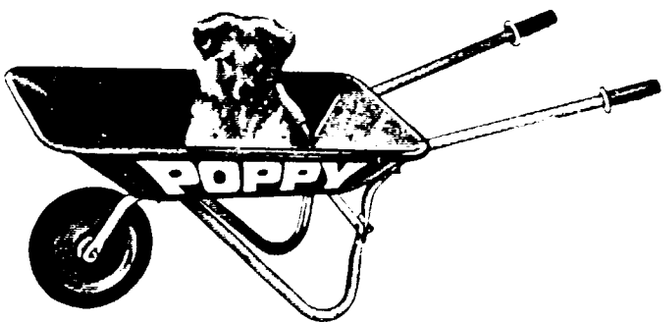
SPECIAL WHEELBARROW FOR BRICKS, BLOCKS, TILES ETC.



SMALL 1- OR 2-WHEEL-BARROW FOR OLD PEOPLE ETC.

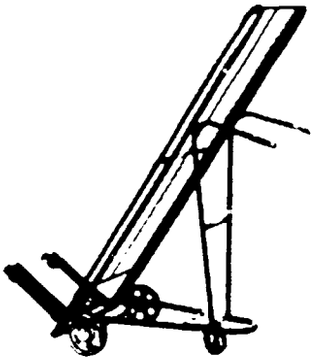


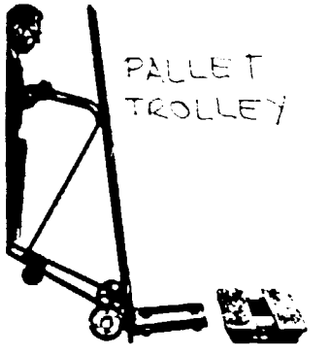
LEIGH WEIGH LOW COST WHEEL BARROW FOR GARDEN USE



CHILDRENS WHEELBARROWS

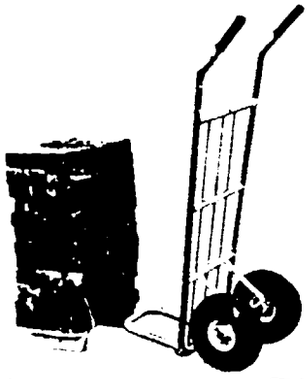
OTHER POSSIBLE WHEEL BARROW MODELS THAT MAY BE INCLUDED IN THE PRODUCTION IN THE FUTURE



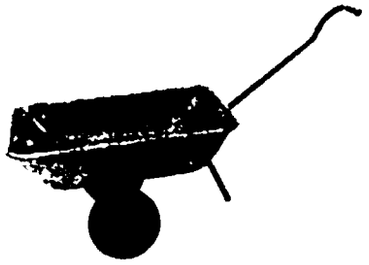


PALLET TROLLEY

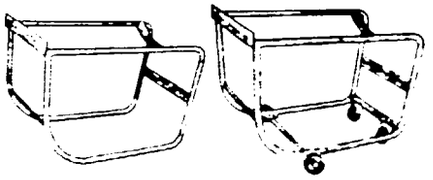
LUGGAGE TROLLEY



BRICK TROLLEY

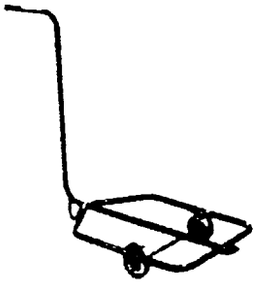


SHOPPING TROLLEY

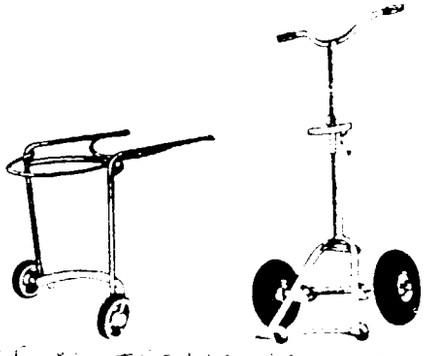


IRON HANDELES WITH ALL WHEELS

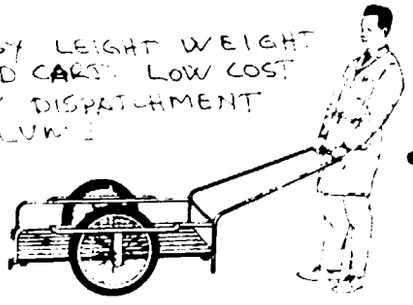
CAKE TROLLEY



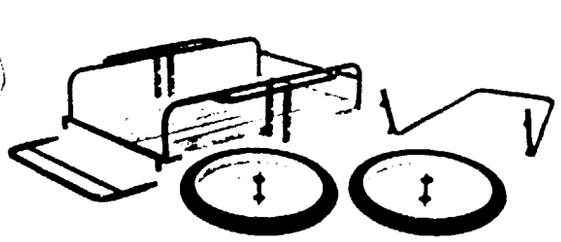
SHOP TROLLEY



DRUM TROLLEYS, ALSO FOR OPEN DRUMS

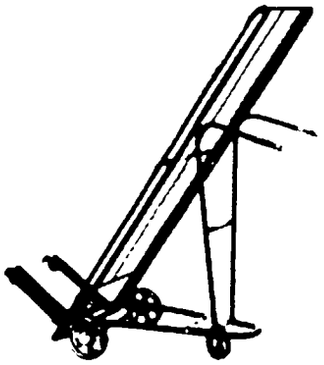


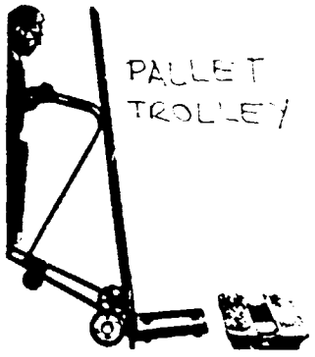
EASY LEIGHT WEIGHT HAND CART LOW COST LOW DISPATCHMENT VOLUME



STEEL POSSIBLE PUT RE PRODUCTS FOR THE PROJECT.

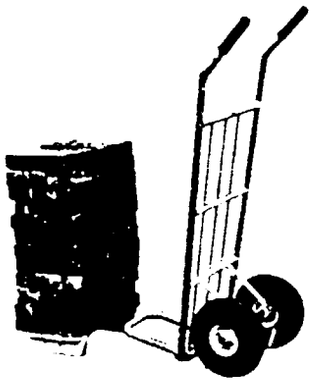
APPENDIX 2.2



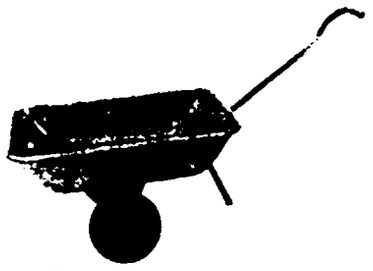


PALLET TROLLEY

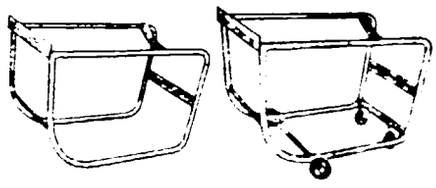
LUGGAGE TROLLEY



BRICK TROLLEY

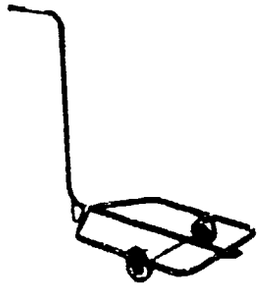


SHOPPING TROLLEY

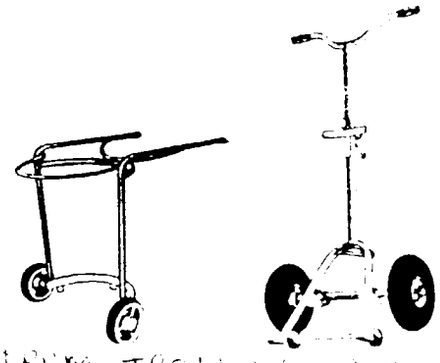


DRUM HANDELER WITH AND WITHOUT WHEELS

CAKE TROLLEY

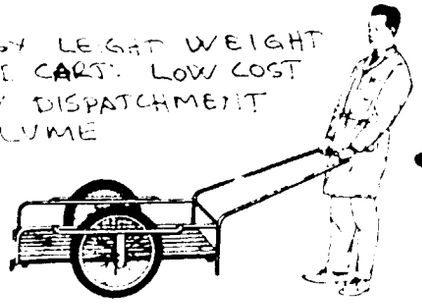


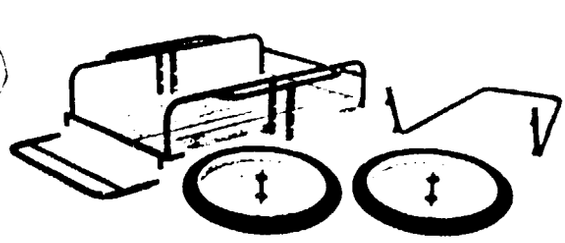
SHOP TROLLEY



DRUM TROLLEYS ALSO FOR OPEN DRUMS

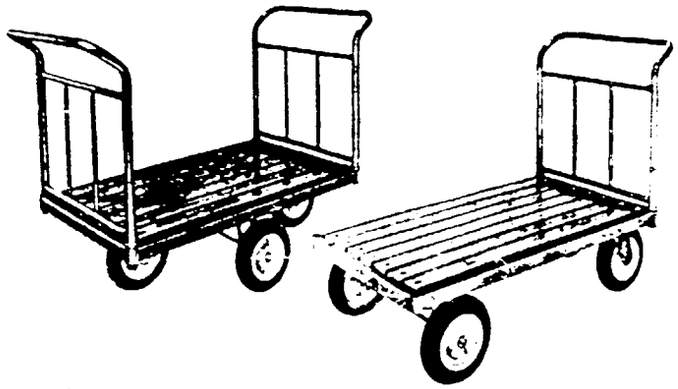
EASY LEGAT WEIGHT HAND CART. LOW COST LOW DISPATCHMENT VOLUME



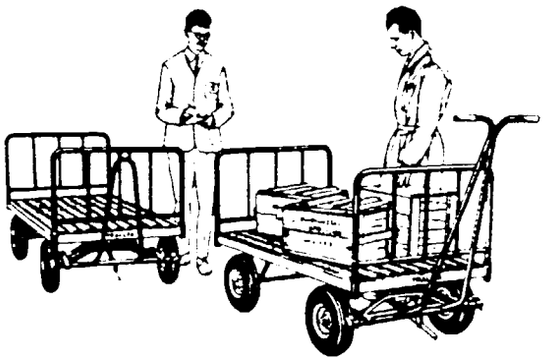


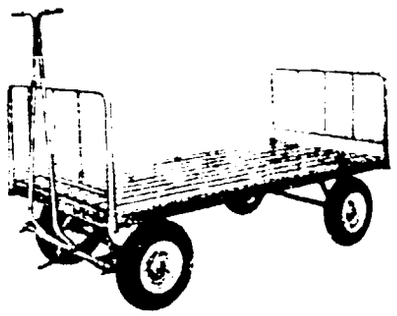
OTHER POSSIBLE FUTURE PRODUCTS FOR THE PROJECT.

SIMPLE HAND CART

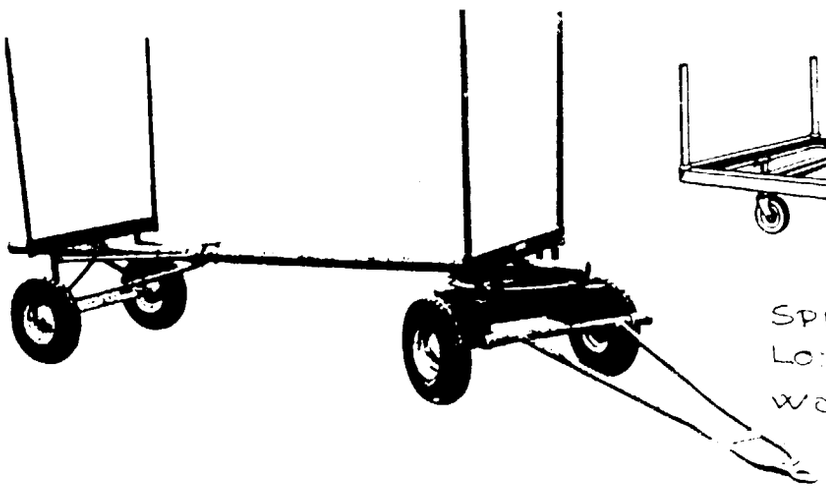


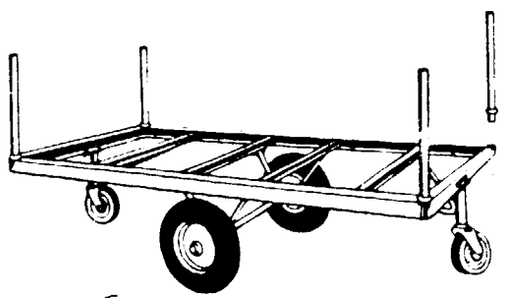
PUSH TROLLEYS 500 KG.





HEAVY DUTY
HAND CARTS
1000 - 2000 KG.

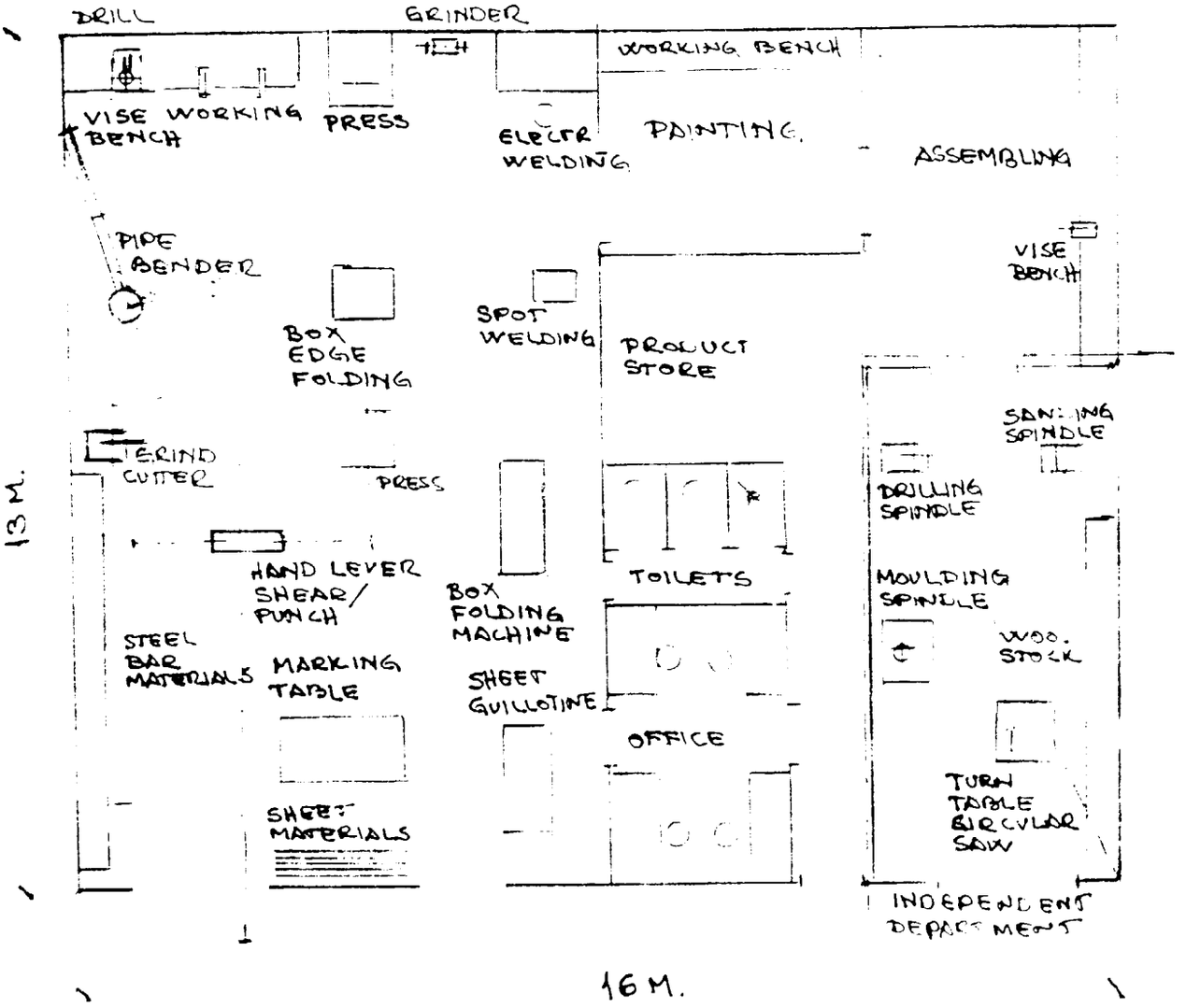




SPECIAL TROLLEYS FOR
LONG RODS.
WOOD AND STEEL.

OTHER POSSIBLE FUTURE PRODUCTS
FOR THE PROJECT: HAND CARTS

APPENDIX 3



LAY-OUT PRODUCTION OF

WHEEL BARROWS

176 M²

SCALE 1 100.

C/1-84

UNDIP JAKARTA.