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STUDY AND FINANCIAL ANALYSIS OF PROPOSED MODEL FOR E-WASTE MANAGEMENT

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Abstract : India with population of over 1 billion,is one of the fastest growing economies of the world .The growing economy and increasing consumption is estimated to be generating approximately 4, 00,000 tons of waste annually (computers, mobile phone and television only) and is expectedto grow at a much higher rate of 10-15%.

The situation is alarming as India generates about 1.5 lakh tones of e-waste annually and almost all of it finds its way into the informal sector as there is no organized alternative available at present. E-waste generated in few cities across the nation show an alarming picture. Mumbai generates 11,000 tons of E-waste , Delhi 9000tons ,Bangalore 8000 tons and Chennai 5000-6000 tons each year. Maharashtra State (including Mumbai city) alone produces 20270 tons of E-waste annually.

According to surveys conducted about 50%of PC's which are sold all over the country are basically from the secondary market and are reassembled on the old omponents. The rest of market share cover by MNC's

(30%) and Indian brands (20%). Besides manufacturers are major contributors of e-waste. The waste consists of defective IC chips, motherboards, CRTs and other peripheral items produced during the production process. It also includes defective PCs under guarantee procured from consumers as replacement items.

Introduction : This paper is aimed at highlighting the process designed with the aid of a process flow diagram, network diagram and material balance, giving a full description of the process being undertaken.

The process is aimed to be carried out in two stages. In the first stage, the collected electronic items are sorted and dismantled manually. The primary aim in the first stage is to separate the PCBs and other items. The PCBs are further processed in the second stage. Plastics, glass and

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ferrous and non- ferrous metals obtained from the first stage are baled and sent to respective recyclers.

The process has been designed with the target of 1600 kg of PCB per cycle. Further a layout of the plant has also been designed.

Stages of the proposed model

The proposed model is designed in two stages with specific work assigned to each stage in the process of e-waste management

Stage 1 : The primary aim in the first stage is to separate the PCBs and other items.The PCBs are sent for further processing. Other items such as cases, covers,glass panels etc. are removed and processed a bit further.

Stage 2 : The second stage deals with complete treatment of PCBs for extraction of precious metals. The process starts with PCB sampling and crushing after which the non-metals and other irrelevant components are removed. The remaining portion is mixed and treated for extraction of gold, silver and copper.

Financial Analysis for the proposed model

For the commercial success of the project, financing estimation of project cost (fixed cost and Working capital) ,estimation of manufacturing unit cost, and calculation of annual net cash Flows were done to determine the economic feasibility of the project using profitability Estimators such as payback period (PP), return on investment.

- **Capital Investment**

The total fixed capital required for the process is ₹ 53, 12, 91,420.00. Capital investment = fixed capital + working capital.

s.no	Description	Cost
1	Equipment	₹ 14,03,32,200.00
2	Buildings	₹ 5,26,00,000.00
3	Land	₹ 7,00,00,000.00
4	Piping and electrical equipment	₹ 80,00,000.00
5	Instrumentation and control	₹ 2,40,00,000.00

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	total direct cost	₹ 29,49,32,200.00

Table 3 Direct costs for the recycling process

Cost source: matche.com and Alibaba.com

The fixed capital cost (money needed to supply the necessary manufacturing and plant facilities) comprises of direct and indirect cost. The direct costs and indirect costs for the processes are given in table 3 and 4 as shown below respectively, with table 5 showing the equipment costs.

Item	**Cost**
Engineering and supervision	₹ 50,00,000.00
Contingencies	₹ 2,71,53,220.00
Total	₹ 3,21,53,220.00

Table 4 Indirect costs

Fixed capital = direct cost + indirect cost

= ₹ 29, 49, 32,200 + ₹ 3, 21, 53,220 = ₹ 32, 70, 85,420

	equipment costs				
S.no	**Machine**	**No.**	**Unit Price**	**Total Price**	**INR**
1	Shredding Machine 4 shaft	3	$40,000.00	$1,20,000.00	₹ 72,00,000.00
2	Shredding Machine 2 shaft	2	$20,000.00	$40,000.00	₹ 24,00,000.00
3	Baler	2	$80,000.00	$1,60,000.00	₹ 96,00,000.00
4	magnetic separator	5	$30,000.00	$1,50,000.00	₹ 90,00,000.00
5	Eddy current separator	5	$30,000.00	$1,50,000.00	₹ 90,00,000.00
6	specific gr. Separator	5	$25,000.00	$1,25,000.00	₹ 75,00,000.00
7	conveyor belt 181m length @200/m	181	$70.00	$12,670.00	₹ 7,60,200.00
8	Filters	6	$54,700.00	$3,28,200.00	₹ 1,96,92,000.00
9	Tanks 3000L capacity glass lined	6	$8,800.00	$52,800.00	₹ 31,68,000.00
10	Reactor (mixer/settler)	2	$90,500.00	$1,81,000.00	₹ 1,08,60,000.00
11	oxygen generator	1	$35,000.00	$35,000.00	₹ 21,00,000.00

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11	oxygen buffer tank	1	$5,000.00	$5,000.00	₹ 3,00,000.00
12	precipitation tank	6	$28,200.00	$1,69,200.00	₹ 1,01,52,000.00
13	ozone generator	1	$3,000.00	$3,000.00	₹ 1,80,000.00
14	Vehicles	10	$41,700.00	$4,17,000.00	₹ 2,50,20,000.00
15	Total			$19,48,870.00	₹14,03,32,200.00
				SALVAGE VALUE	₹ 1,40, 33,220.00

Table 5 Summary of equipment costs

Cost sources: matche.com and Alibaba.com

Working capitalis needed for the operation of the plant. The working capital for the recycling process has been take as 35% of the total sales and is equal to ₹ 18, 27,09,430

Capital investment = fixed capital + working capital

= ₹ 32, 70, 85,420 + ₹18, 27, 09,430

= ₹ 50, 97, 94,850

- **Sales Calculation**

Feed stock of the process = 1600 kg/cycle Number of cycles = 169

	Price (Per	**Amount Recovered Per Year**	
Gold	₹ 28,00,000.00	18.25	₹ 5,11,00,000.00
Silver	₹ 39,000.00	11830	₹ 46,13,70,000.00
Copper	₹ 377.00	25350	₹ 95,56,950.00
		TOTAL	₹ 52,20,26,950.00
		working capital	₹ 18,27,09,432.50

Table 6 calculation of sales

Total sales of metal = ₹ 52, 20, 26,950

- **Total cost**

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Total costs are the costs for operating the plant and selling the product. Total cost comprises manufacturing costs and general expenses. For this process it was calculated on an annual basis.

Annual basis is the best calculation because it takes into consideration the seasonal variations, equipment operation and smoothens out peaks and troughs in production volumes. Total Cost = Manufacturing cost + general expenses + plant overheads Manufacturing cost is divided into direct/variable and indirect/fixed cost.

Fixed manufacturing costs are expenses which remain practically constant from year to year and do not change with production rate. These include depreciation , loan interests and insurance

S.No.	Component Description	Cost
1	Chemicals	₹ 8,88,27,000.00
2	Operating Labour	₹ 3,60,00,000.00
3	Power	₹ 53,99,212.00
	Total	₹ 4,13,99,212.00

Table 7 Direct manufacturing costs

Depreciation is to be considered as a loss of value of fixed assets. Equipment and vehicles are estimated to have a usefull life of five years and a salvage value of ₹1,40,33,220.00

$D = (V – Vs) / t_u$

Where 'D' is the depreciation, 'V' is the initial value of the assets, 'V_s'is salvage value and t_u is the Useful life.

D = (₹ 14, 03, 32,200 - ₹ 1, 40, 33,220)/5 = ₹2, 52, 59,796

DESCRIPTION	COST
DEPRECIATION	₹ 2, 52, 59,796
INSURANCE	₹ 12,00,000
TOTAL FIXED MANUFACTURING COSTS	₹ 2, 64, 59 ,796

Table 8 Fixed manufacturing costs

Direct costs	₹ 4,13,99,212

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Indirect costs	₹ 2, 64, 59 ,796
Plant overheads	₹ 20,00,000
Total manufacturing costs	₹6, 98, 59, 008

Table 9 Total manufacturing costs

Total product costs = ₹6, 98, 59, 008

- **Profitability evaluation**

Profit = Sales – Total product cost = ₹ 52, 20, 26,950 - ₹6, 98, 59, 008 = ₹452167942

Return on investment = profit /investment = 452167942/50, 97, 94,850 =0.887

Payback period = investment / profit = 50, 97, 94,850/452167942 =1.13 years

Conclusion

1) Since metals have been recovered through a profitable and highly efficient process, Burning of e-waste in open environment or uncontrolled burning is considerably reduced thus reducing the environmental pollution.
2) As the GOLD, SILVER AND COPPER are non-renewable resources thus recycling of these leads to re involvement of these resources in the material flow in the market. If we assume that of all the e- waste generated in India which is 1.7 million tonnes (as per UNO report 2015), eighty percent of which has been recycled then on a scale it would save almost 578 tons of gold, 2, 55,000 tons of silver and 4, 25, 000 tons of copper and that is such an amount that cannot be ignored.
3) Since it is much economical to extract precious metals from e-waste therefore it has saved a lot of extraction from mining ,which in addition saved crores of rupees, many KW- hours of energy and uncountable as well as irreplaceable human hours.
4) If recycling is compared to mining for precious metal extraction, recycling is much economical and better method. Besides this, recycling is much environmental friendly and avoids the environmental degradation that would have been occurred due to mining of these resources. Thus, mining of acres of land is saved and hence this has avoided the health hazards to humans and entire ecosystem.
5) As many people think of being entrepreneurs in e-waste management but they seldom get to know the exact economics, the most efficient processes and plant design that would be required on a minimum. This document provides an insight into the issues that one would encounter while someone wants to setup business in e- waste management.

6) Our team also researched through the policies and rules regarding the e-waste management and treatment that are prevailing the current times in India and found some discrepancies that hamper the proper management and treatment of e-waste which in turn also makes it difficult to do business in this line, for example, absence of proper collection system.
7) In India, most of the people who are involved in this business are either illiterate or they are not much aware about the processes and handling of such kind of waste which not only cause health hazards to them as well it causes environmental pollution
8) The effluent after the leaching processes which contains harmful chemicals like CYANIDE compounds etc. is treated with the process named OZONE OXIDATION which produced containment free product and also safeguarded the environment from the negative effects of it.
9) There is no provision for putting the components or materials used in the manufacturing of a particular electrical or electronics equipment.

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