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Unorganized Computer Manufacturing: Impending Challenge of E-Waste Hazards in Pune (India)

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Abstract: *The objective of this article is to throw light on practices of Unorganized Computer market in Pune , India .It unveils several facets on human resource engagement , employability ; price differentiation ,market share and E-WASTE disposal . Unfortunately, the discarding of electronics is one of the fastest growing segments of our nation's waste. Rapid growth in this industry coupled with advancement in technologies has led to the accumulation of e-waste stream, which is expected to increase further in the coming years. The article provides innovative ideas to create value from the challenge in the Unorganized Sector.*

Keywords: *Assembled PC, Grey market, E-waste Problem · Suggestions for management; ·Developing countries*

I. Introduction

Computer Hardware industry comprises of companies engaged in assembling and manufacturing computers, computer hardware and computer peripherals. The industry includes dealing with storage devices, keyboards, printers, monitors, mouse and other pointing devices, Webcams and PC cameras, as well as ATM machines. The Computer Hardware industry excludes semiconductor computer components, such as microprocessors and circuit boards.

Over last -3 decades there has been interesting change in trend of the Computer Industry in India .The golden period between 1984 and 1990, saw the economy opening for foreign investment .Since the 1990s, the Indian economy moved away from being tightly regulated by the Government to the regime of liberalization .In 1997, the Information Technology Agreement (ITA) was signed at the World Trade Organization (WTO) whereby India eliminated all customs duties on the Information Technology (IT) hardware by 2005.

With Modigovernment coming inpower , in June 2014, the Indian development has focus on 3P's strategy . Public -Private partnership, which creates opportunities for further growth in Computer and Electronic Industry in alignment with NPE Policy from "Department Of Electronics" .

Computer Market in India saw huge growth between period 1994 to 2009 with increase in demand for Computers - PC and laptops . This also encouraged growth of the Assembled Computers under local brands which offered lower prices .In 1999-2000, Assembled Computers had a 58 per cent market share, according to data collated by MAIT (Manufacturers Association of Information Technology, India).The unorganized sector (including local brands) in fact improved its market share in 2001 to a staggering 65 per cent from 58 per cent in the 2000. (IDC includes local brands also in the unorganized category). The market grew mainly in `B' and `C' class cities and towns. In these markets, the assemblers are well positioned as compared to the branded PC makers who are now making expansions to these areas. Besides, these markets are very price-conscious and obviously, assembled PCs come cheaper.Another reason why the assembled PCs did well was the easy and uninterrupted flow of parts and components to the unorganizedsector. There is huge amount of computer equipment being imported to India, fromseveral countries;Germany,China,Taiwan and Israel contribute to majority of proportion which is used to cater for the Assembled PC Market [2].

With Computer Segment expansion, Pune is also transitioning as one of the major hubs of e-waste generation in India. According to several studies conducted in India, Pune is a major repository of WEEE. Mumbai-Pune industrial belt is one of the electronic items manufacturing hubs of the country.

According to a study conducted on E-Waste Assessment in Mumbai – Pune Area by the Maharashtra Pollution Control Board (MPCB) in 2007, there is very small amount of dismantling activity occurring in Pune, Pimpri - Chinchwad region. According to this study, the total e-waste generation in Pune is 2584.21 tons and in Pimpri-Chinchwad 1032.37 tons.

With industrial revolutionisation and small EOL of equipment the problem is projected to grow.

Objective ofthe Study

1. E-waste disposal is becoming big problem within Pune which would further increase if not treated now .
   The branded PC's are accounted under law via EPR (Extended Producer Responsibility)for E-waste management,however for Assembled PC the regulations have not been distinctly laid out, which leaves gap There is lack of awareness onEwaste management techniques within the Assembled PC sector. No formal process for disposal.

2. The Research also covers the study on Work hours and environment provided to employees in this sector based on the size of the company.

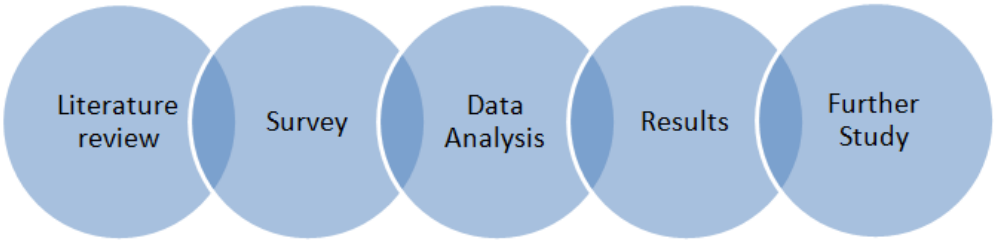
It provides recommendations and unveils opportunities that can be further harnessed by the Govt , Small Business Unit (SBU) owners and consumers.

Hypothesis

1. The working hours of the employee are inversely proportional to the size of the company.
2. There is substantial price differentiation between the branded equipment and assembled PC which keeps the sector alive and thriving.
3. The E-waste generated is not tracked and formally disposed by the manufacturers and consumers.

II. Methodology

The constructive research was carried out which encompassed 5phases.



Study was performed on 50 PC Assemblers in Pune Region in Maharashtra,India in interval Mar-2014 to Oct-2014.

The data gathering was done via face to face interview andTelephonicinterview.

Limitations of the study

1. E-waste is now treated as a very sensitive issue, which made it difficult for us to acquire detailed information about the ways of e-waste disposal.
2. Questions related to health effects and wages wentunanswered during interviews.
3. In most places, permission to take photographs andthe entry into the yards was denied.

Disclosing the real identity and the real purpose of thestudy discouraged the subjects to provide information.

So we had to devise innovative ways to engage in Conversations in order to obtain information.

Hypothesis Testing

Hypothesis I-The working hours of the employee are inversely proportional to the size of the company.

Size of the Organization was the control variable. The population was categorized into the following parts based on the number of staff with the organization.

		Frequency	Percent
Valid	<10	10	22.7
	<20	17	38.6
	<30	14	31.8
	<40	2	4.5
	<50	1	2.3
	Total	44	100.0

Table 1: Size Of the company

The Average number of working hours for the employees per firm wastaken, to understand the working culture.

Work_hrs_wk

		Frequency	Percent
Valid	>45	16	36.4
	>60	19	43.2
	>70	9	20.5
	Total	44	100.0

Table 2 : Work hours per week for the employees

Report Work_hrs_wk

Mean	N	Std. Deviation
3.30	44	.632

Table 3: Mean Work Hours

The mean shows that if the test is carried in similar interval of population would give average working hours of employees between 60-70 hrs per week for unorganized computer manufacturers.

$$\sigma = \sqrt{\frac{1}{n-1}\sum_{i=1}^{i=n}(X_i - \bar{X})^2} = 0.632$$

The standard deviation gives an idea of how close the entire set of data is to the average value. Data sets with a small standard deviation have tightly grouped, precise data.

The linear correlation coefficient is a test that can be used to see if there is a linear relationship between two variables. The following equation is used:

$$r = \frac{\sum(X_i - X_{mean})(Y_i - Y_{mean})}{\sqrt{\sum(X_i - X_{mean})^2}\sqrt{\sum(Y_i - Y_{mean})^2}}$$

The quantity r, called the linear correlation coefficient, measures the strength and the direction of a linear relationship between two variables. The linear correlation coefficient is sometimes referred to as the Pearson product moment correlation coefficient in honor of its developer Karl Pearson.

Correlations

		Num_emp	Work_hrs_wk
Num_emp	Pearson Correlation	1	-.637**
	Sig. (2-tailed)		.000
	N	44	44
Work_hrs_wk	Pearson Correlation	-.637**	1
	Sig. (2-tailed)	.000	
	N	44	44
****. Correlation is significant at the 0.01 level (2-tailed).**			

Table 4:Pearson Correlation

The range of the correlation coefficient is from -1 to 1. Our result is -0.607 or60.7 %, The value of Pearson's Correlation coefficients. Lies between Interval -0.40 to -0.69 which shows a strong negative relationship between the 2 variable..

Fig 1 shows the strong negative correlation, the graph has a downward slope from left to right:; as the x-values increase, the y-values get smaller..

This proves the alternate Hypothesis and rejects the null hypothesis .

The Assembler PC dealers handle several type of jobs:

1. They register themselves as support firms with big IT organizations and provide the laptop/PC maintenance services. They also provide the maintenance services to small consumers like shops and households. Maintenance services include, hardware and software support . Either it could be to upgrade the systems with additional RAM , graphics card etc or to upload the software or AntiVirus .
2. They also do Computer Assembly, which involves buy the computer component and build new machines with Customized configuration per the Order .

As per the study the companies that have < 10 employees have average Weekly working hours between 60- 70 hrs . The reason for long hours could also be to build the Clientele and good will of the company .

The minimum education for technical staff is 10 th standard pass with formal training on Computer HW. Study showed interesting mix of the graduates and under-graduates employed for the job . Supervisors in 62% of the companies were graduates and were managing the group of under-graduates . The support model is 12 hours a day and 7 days work. People work in shifts which average 6 days ,

The average income range per month is between Rs 13,500 to 17,500 , trained and skilled staff receiving in the . higher end based on their throughput

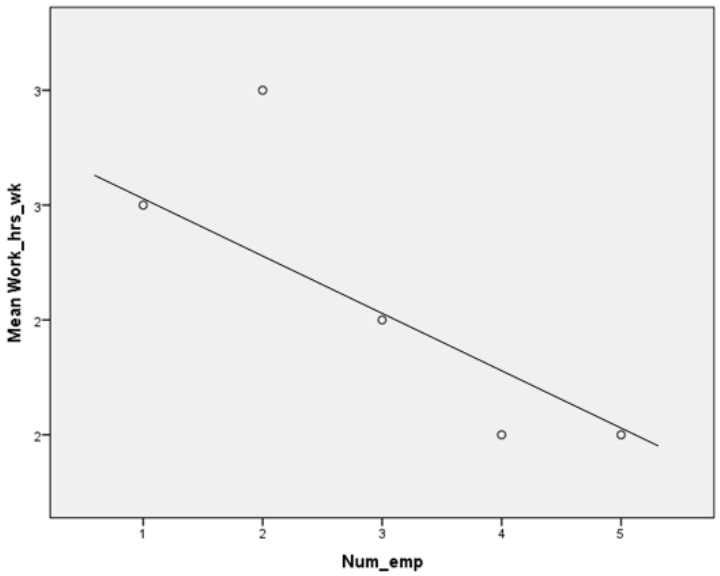


Fig 1: Negative Correlation

Hypothesis 2: There is price differentiation between the branded equipment and assembled PC , with Respondents were questioned on the price differentiation between the products and their equivalent configuration branded equipment's . The Frequency table provides the average frequency of the answer . Maximum frequency of price differentiation between 10- 20% interval .

Price Differentiation		Frequency	Percent
Valid	<10%	7	15.9
	<15 %	19	43.2
	<20 %	16	36.4
	None	2	4.5
	Total	44	100.0

Table 5: Frequency Test

Average Price differentiation is 15-20 %.
Chi Square test wasapplied to test the association and degree of significance between the 2 variables Size of the company and Price differentiation with Brand .

			profit margin				Total
			2	3	4	6	
Num_emp	<10	Count	6	1	1	2	10
		Expected Count	1.6	4.3	3.6	.5	10.0
	<20	Count	1	3	13	0	17
		Expected Count	2.7	7.3	6.2	.8	17.0
	<30	Count	0	14	0	0	14
		Expected Count	2.2	6.0	5.1	.6	14.0
	<40	Count	0	0	2	0	2
		Expected Count	.3	.9	.7	.1	2.0
	<50	Count	0	1	0	0	1
		Expected Count	.2	.4	.4	.0	1.0
Total		Count	7	19	16	2	44
		Expected Count	7.0	19.0	16.0	2.0	44.0

Table 6: Num_emp * Price_Diff Cross tabulation

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	57.106[a]	12	.000
Likelihood Ratio	57.555	12	.000
Linear-by-Linear Association	.018	1	.894
N of Valid Cases	44		
a. 16 cells (80.0%) have expected count less than 5. The minimum expected count is .05.			

Table 7: Chi-Square Tests

Alpha <0.05 for 95% level of Confidence.

The P- Value from the test shows 0.000, which shows a strong association between the Size of the company and the price differentiation offered bythem withrespect to the branded equipment.

		Value	Approx. Sig.
Nominal By Nominal	Phi	1.139	.000
	Cramer's V	.658	.000
N Of Valid Cases		44	
A. Not Assuming The Null Hypothesis.			
B. Using The Asymptotic Standard Error Assuming The Null Hypothesis.			

Table 8:Cramer's V Correlation

Cramer's V correlation varies between 0 and 1. Avalue close to 0 means that there is very little association between the variables. A Cramer's V of close to 1 indicates a very strong association.
Cramer's V as 0.658 represents very strong relationship between the variables number of employees in the company and the price differentiation.
Therefore null Hypothesis is rejected .
The companies having bigger staff base are able to take bigger orders and able to accomplish them fast with larger human resources available to handle. They are able handle multiple orders and services at a time, which creates opportunity for bigger revenue base.
The electronic components required for building PC are bought from one of the below channels, which assists in keeping the Cost of the equipment low -

- Authorized dealers who import them .
- Retail outlets
- Grey market where they are brought through unorganized route - Smuggled , Chor bazaar, second hand market etc
- Used components from E-waste
  99% of the respondents confirmed in the survey to buy the components from the authorized dealers , and using branded processors like Intel , Gig power or AMD .

Hypothesis 3: The E-waste generated is not tracked and formally disposed by the manufacturers and consumers.

EwasteDisposal optionsand the proportion user by companies based on their size is shared in below table . Most popular options wasEwaste created while making computers, is collected over a period of 6 to 8 months in the firm's premises /warehouse . They are sold to scrap dealers or thrown along with the garbage as Solid Waste .

			E-waste		Total
			Scrap Dealer	Thrown	
Num_emp	<10	Count	6	4	10
		Expected Count	9.1	.9	10.0
	<20	Count	17	0	17
		Expected Count	15.5	1.5	17.0
	<30	Count	14	0	14
		Expected Count	12.7	1.3	14.0
	<40	Count	2	0	2
		Expected Count	1.8	.2	2.0
	<50	Count	1	0	1
		Expected Count	.9	.1	1.0
Total		Count	40	4	44
		Expected Count	40.0	4.0	44.0

Table 9: Num_emp * E-waste Crosstabulation

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.960[a]	4	.005
Likelihood Ratio	13.348	4	.010
Linear-by-Linear Association	7.729	1	.005
N of Valid Cases	44		
a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .09.			

Table 10: Chi-Square Tests

P Value is 0.005 , it is less than 0.05 , which is 95% confidence level .

		Value	Approx. Sig.
Nominal by Nominal	Phi	.583	.005
	Cramer's V	.583	.005

N of Valid Cases	44	
a. Not assuming the null hypothesis.		
b. Using the asymptotic standard error assuming the null hypothesis.		

Table 11: Cramer's V value

Cramer's V correlation varies between 0 and 1. A Cramer's V of close to 1 indicates a very strong association. Thevalue 0.25 or higher gives very strong relationship between the variable. This validates the hypothesis.

III. Conclusion

1. Entrepreneurship and Employment:

Unorganized Computer anufacturing sector provides empowerment and ability for business startups . It requires good network to form consumer base in domestic and corporate market. It facilitates the indigenous business .26% of the companies owners were engineering or Technicalgraduates, 84 % were non graduates. They learned the skills and hired the skilled people to do the job.

92.4% of companies were small firms with staff from 7 to 40 people. The technical staff were 10 th passed who had done small courses on Microsoft certification , hardware or network certified.The remuneration varied from Rs 15,000 to 17,500 based on the experience and knowledge and sales in the month.

2. Penetration into Class B and Class C cities.

India's majority of the population stays in rural areas .Low cost startups , huge demand and good earnings give immense motivation to the assemblers to start business from home .They have good understanding of the local market and are able to reach out to customers conveniently. Low or negligible advertisement and marketing cost. FDI's and big brands usually have high cost of advertisement, also the cost of computers are much higher than what local assembler quotes. From the study 45% Assembling firms in Pune confirmed that during festive season and weekends , they had huge sales when people from rural areas came and took bulk orders for running businesses in small towns and villages.

Current Problems

1. **Restriction of Hazardous Substances Directive (RoHS)** Regulation are not applied on the products in unorganisedsector . There no distinctive Quality certification for the products manufactured /assembled in this sector .
2. There are no formalized records to monitor Sales from unorganized channel. The data is not available , which severely impacts the body of knowledge . This would eventually create hindrance on predicting the turnover and earnings from the sector at City/State or national level
3. ERP regulation[E-waste regulation on extended producer responsibility] are not clearly defined on the assembled Computers , hence no formal responsibility exists to the Assembled PC's manufacturers/dealers for the Recycling of the Computers E-Waste once it is discarded by the users .

This creates very big problem , as e-waste is untracked .

There is need to create awareness on OnEwaste problem and create formal process for Ewaste disposal for the suppliers and the consumers.

IV. Recommendation

1. Government needs to look into formalizing the Assembled PC Market which constitute 44% of Computer Hardware market share in India and 67 % share in Pune .

There needs to be ROHS quality checks for the Assembled PC to assure the percentage of Hazardous substances are within limits .

2. Currently we do not have measurements on the exports of assembled PC's , Sales of PC's within Indian market and the revenue generated through the informal channel . It leaves critical gap in the GDP and Tax calculation from this sector.

Online One Stop Shop for computer sales and Online payment will formalized revenue and Tax channels to bring the revenue generated into main stream for the country's development.

3. Current processes and technologies simply are not sufficient for measuring the true destination of e-waste as it passes through each level of the disposal process..The ability to track products to their final destination and ensure safe, legal and transparent disposal is critical; [5]

- The use of a unique 12-digit code printed directly onto each subsystem component using passive radio-frequency identification (RFID) ink, recommended by Sumit Bhardwaj, a digital marketer in London;

- Eelectronic identification bee (e-Bee) that combines electronic identification codes printed on components with an online crowdsourcing platform that together yield a holistic picture of where electronic components end up; and
- A tracking system that leverages a sheet of labels printed with unique, encrypted codes for each major component in the system. Similar to those used in the fresh food industry, the labels would be applied to and follow subsystem components as they move through the disposal process.

These are some of the way which can be used to track the computer components disposal which contain hazardous and heavy metals.

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