Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 4, April -2017

# Waste Reduction At Small Scale Plastic Industry

Kajal Sejpal

[#]*Department Of Industrial Engineering*

Shri Ramdevaba College of Engineering And Management

*Nagpur-India*

**Abstract**— *The objective of this research is to improve the productivity by identifying and correcting lean waste in production process of plastic bags. The waste were identified by using Ishikawa diagram or cause and effect diagram. By changing the raw material blending the defects in bags were reduced. This lead to an increase in costing of raw material, but at the same time increased the net production which lead to increase in total profit.*

***Keywords***— Plastic bags, Ishikawa diagram, Raw material blending.

## I. INTRODUCTION

The Indian packaging industry is growing at 18-20% annually. The highly fragmented packaging industry is estimated at Rs 8,000 Cr. In the next five years, the sector is expected to triple to around $ 60 billion. Among the total packaging sources, plastic packaging is at 6.8 million tones and growing at 20-25 per cent per annum, whereas paper packaging is 7.6 million tone. RS Plastics represents the small-scale Indian industries sector which plays a vital role in the growth of the country. R.S Plastics was established in the year 1998. R.S Plastics is manufacturer of: Plastic Bags, Sheets, Envelopes, Garbage Bags, and Liners. The company caters to hospitals, pharmaceuticals, spice manufacturers, Incense sticks manufacturers, bottle manufacturers and various wholesalers. There are 12 workers working in the company. RS Plastics is aiming at improving the quality of packaging product.

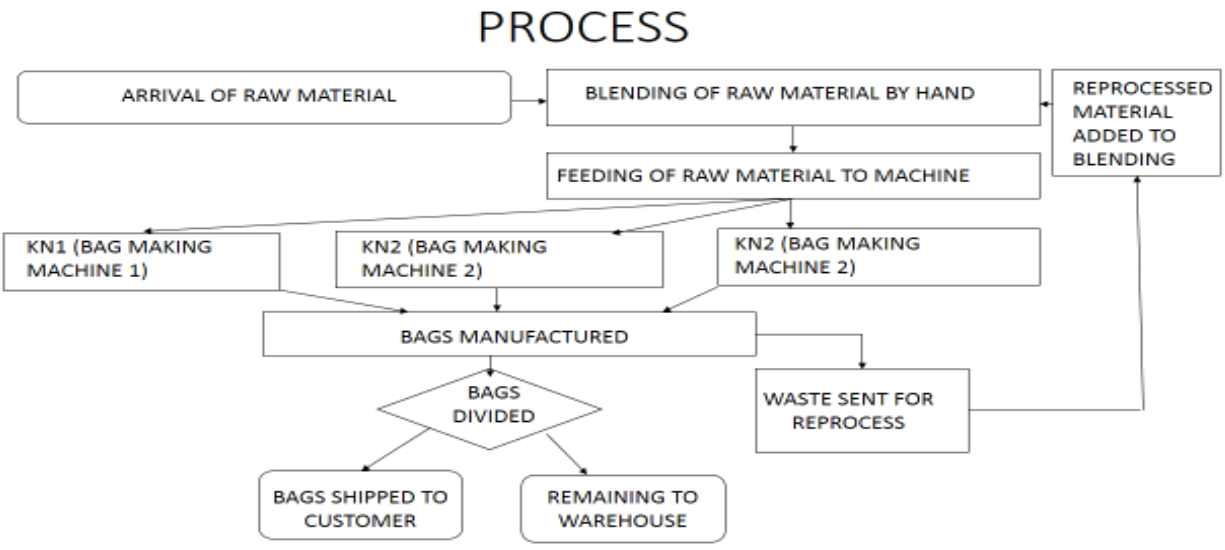
## II. Current Process

### *A. Current Blending of raw material:*

The raw material used in the bag making process are:
HDPE- High density polyethylene, LDPE- Low density polyethylene, TINOPAL- Optical brightener, LOW GRADE HDPE- Low grade high density polyethylene. The blending used in the process of bag manufacturing is:
HDPE (80%) + LDPE (9.75%) + Low grade HDPE (10%) + Tinopal (0.25%)

### *B. Flow Process chart*

Flowcharts are used to document the current process. The flow process chart for manufacturing plastic bags id given below:



*C. Number Of Defective Bags Identified*

Defective bags were manufactured from bag making machine. The defects were improper cuts to the handle and deformed bags.

TABLE 1. THE NUMBER OF DEFECTS FOUND IN BAGS PRODUCTION PER MONTH

| Description | Bag making machine 1 | Bag making machine 2 | Bag making machine 3 |
|---|---|---|---|
| Production /month | 6513307 | 6447172 | 5800102 |
| Defects (Improper handles)/ month | 22372 | 19394 | 21899 |
| Defects (Deformed bags)/ month | 106068 | 93061 | 87330 |

*D. Defect Data*

TABLE 2. OBSERVATION FOR BAG MAKING MACHINE 1

| Days | Production (bags/day) | Improper cutting of Handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 214295 | 440 | 1401 |
| 2 | 231781 | 161 | 2213 |
| 3 | 213878 | 354 | 1295 |
| 4 | 95402 | 294 | 3117 |
| 5 | 273411 | 579 | 2056 |
| 6 | 241735 | 1696 | 1677 |
| 7 | 170344 | 358 | 1691 |
| 8 | 103870 | 322 | 1473 |
| 9 | 240289 | 442 | 1573 |
| 10 | 160971 | 1160 | 3422 |
| 11 | 368224 | 370 | 1440 |
| 12 | 249653 | 496 | 4490 |
| 13 | 161919 | 1563 | 7349 |
| 14 | 150212 | 553 | 2475 |
| 15 | 107367 | 1864 | 3530 |
| 16 | 265522 | 644 | 2586 |
| 17 | 303697 | 578 | 652 |
| 18 | 202066 | 896 | 5987 |
| 19 | 191088 | 1398 | 5243 |
| 20 | 296718 | 194 | 7465 |
| 21 | 303163 | 617 | 3971 |
| 22 | 310953 | 1095 | 8106 |
| 23 | 449134 | 312 | 8619 |

| | | | |
|---|---|---|---|
| 24 | 110495 | 648 | 3770 |
| 25 | 181548 | 1628 | 3062 |
| 26 | 165098 | 1739 | 5274 |
| 27 | 360518 | 883 | 8341 |
| 28 | 389956 | 1088 | 3790 |
| | 6513307 | 22372 | 106068 |

TABLE 3. OBSERVATION FOR BAG MAKING MACHINE 2

| Days | Production (bags/day) | Improper cutting of Handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 469413 | 303 | 1339 |
| 2 | 66147 | 115 | 947 |
| 3 | 271332 | 339 | 1839 |
| 4 | 228204 | 203 | 1099 |
| 5 | 279067 | 239 | 4044 |
| 6 | 177015 | 696 | 3624 |
| 7 | 435956 | 466 | 901 |
| 8 | 106970 | 489 | 2675 |
| 9 | 323564 | 459 | 1807 |
| 10 | 379582 | 924 | 2241 |
| 11 | 192385 | 833 | 1899 |
| 12 | 266038 | 595 | 2312 |
| 13 | 124970 | 770 | 4206 |
| 14 | 156310 | 633 | 4847 |
| 15 | 131674 | 1193 | 5023 |
| 16 | 162677 | 1184 | 2677 |
| 17 | 125662 | 1199 | 1438 |
| 18 | 211404 | 1353 | 4826 |
| 19 | 221089 | 584 | 2635 |
| 20 | 161619 | 346 | 4733 |
| 21 | 271734 | 630 | 3572 |
| 22 | 270880 | 804 | 6343 |
| 23 | 299991 | 589 | 3883 |
| 24 | 144155 | 529 | 3304 |
| 25 | 308440 | 1493 | 3251 |
| 26 | 208254 | 659 | 7007 |

| | | | |
|---|---|---|---|
| 27 | 251087 | 537 | 7147 |
| 28 | 201553 | 1230 | 3442 |
| | 6447172 | 19394 | 93061 |

TABLE 4. OBSERVATION FOR BAG MAKING MACHINE 3

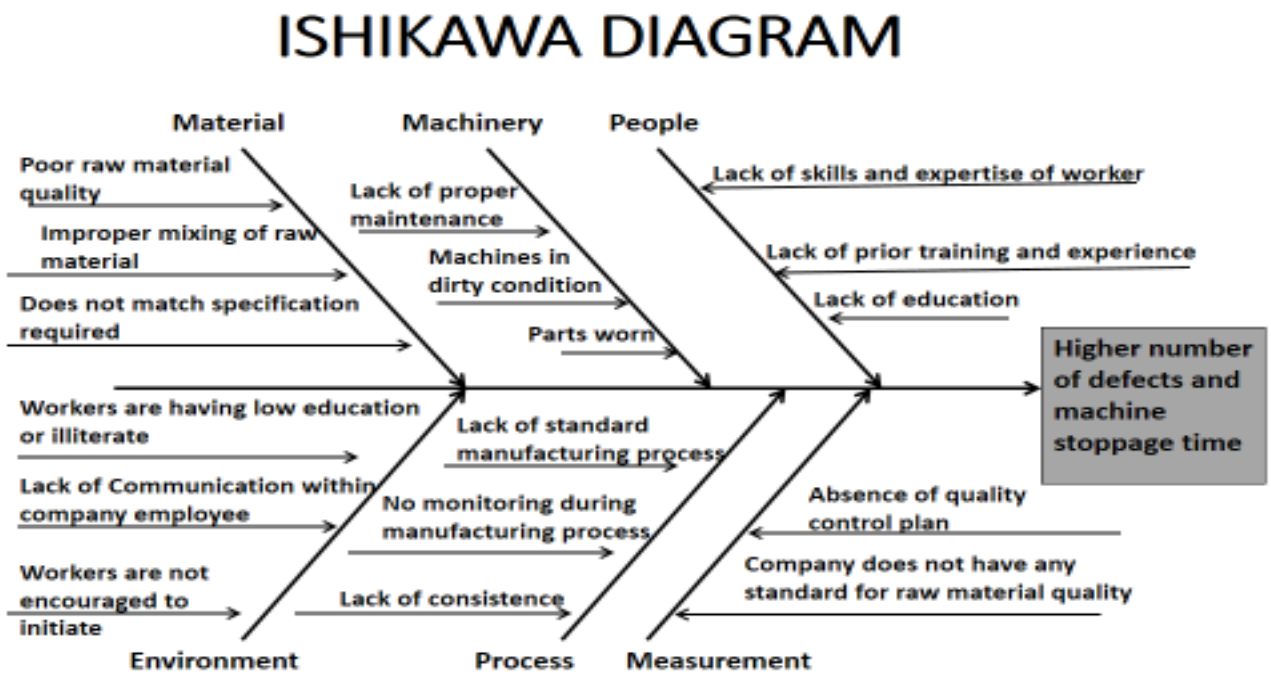
| No | Production (bags/day) | Improper cutting of Handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 212678 | 319 | 1576 |
| 2 | 196580 | 126 | 1179 |
| 3 | 274544 | 288 | 1310 |
| 4 | 296591 | 146 | 1732 |
| 5 | 125657 | 266 | 2031 |
| 6 | 228540 | 775 | 1749 |
| 7 | 123391 | 384 | 1304 |
| 8 | 171407 | 810 | 2332 |
| 9 | 211503 | 1089 | 988 |
| 10 | 125610 | 1039 | 4302 |
| 11 | 284118 | 846 | 3696 |
| 12 | 117095 | 567 | 2829 |
| 13 | 246968 | 1085 | 5674 |
| 14 | 143265 | 1212 | 3583 |
| 15 | 240413 | 1525 | 5740 |
| 16 | 298989 | 1047 | 2568 |
| 17 | 185591 | 494 | 1512 |
| 18 | 302567 | 1124 | 4066 |
| 19 | 205678 | 428 | 2170 |
| 20 | 175672 | 524 | 4686 |
| 21 | 213850 | 612 | 5332 |
| 22 | 324899 | 935 | 5331 |

| | | | |
|---|---|---|---|
| 23 | 197995 | 815 | 3009 |
| 24 | 287861 | 513 | 3500 |
| 25 | 127417 | 1906 | 5474 |
| 26 | 214264 | 1101 | 2650 |
| 27 | 151127 | 1162 | 4363 |
| 28 | 115832 | 761 | 2644 |
| | 5800102 | 21899 | 87330 |

## III. **Analysis of defects by lean tool**

ISHIKAWA DIAGRAM: Ishikawa diagrams (also called fishbone diagrams, or herringbone diagrams, cause and effect diagrams or Ishikawa) are causal diagrams that show the causes of a certain event.




The causes of defects are:
Improper raw material blending
Overheating
Improper feeding of raw material
The only reason company is using 10% of Low grade HDPE is to make the bags at cheaper Price. In order to reduce the price of bags company has to deal with inferior quality of HDPE. This research is trying to show that less amount of low grade HDPE can effect quality of bags produced in company. The company is earning profit by reducing the costing of material but on the other hand is losing money in form of waste generated by defects.

## IV. **Approach**

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified. To use 5 to 7% of low grade HDPE in mixture instead of 10%. Initially half quantity of low grade HDPE was reduced so as to observe the reduction of defects.

The revised blending in the process of bag manufacturing:
HDPE (80%) + LDPE (9.75%) + Low grade HDPE (10%) + Tinopal (0.25%)
Where,HDPE- High density polyethylene
LDPE- Low density polyethylene
TINOPAL- Optical brightener
LOW GRADE HDPE- Low grade high density polyethylene
Scheduled maintenance once in week at night time rather than stop the machine for 24 hours every 15 days.

## V. **Implementation**

Company used 5% of Reproduced HDPE instead of 10% and the result were compared with previous.
New raw material mixture proportion was 85% HDPE+ 9.75% LDPE + 5% low grade HDPE +0.25% Tinopal for each 100 kilogram The data after implementation was recorded to observe the reduction of defects
The data for one month was recorded

TABLE 5.OBSERVATION FOR BAG MAKING MACHINE 1

| Days | Production (bags/day) | Improper cutting of handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 461640 | 935 | 1709 |
| 2 | 89826 | 181 | 426 |
| 3 | 440720 | 721 | 1063 |
| 4 | 352712 | 1110 | 1393 |
| 5 | 111814 | 655 | 2416 |
| 6 | 139046 | 1034 | 1007 |
| 7 | 219450 | 834 | 1080 |
| 8 | 294103 | 475 | 2130 |
| 9 | 67778 | 937 | 376 |
| 10 | 245749 | 619 | 2872 |
| 11 | 274464 | 1593 | 1257 |
| 12 | 163717 | 1225 | 3378 |
| 13 | 201254 | 1311 | 1864 |
| 14 | 229991 | 1050 | 2196 |
| 15 | 210626 | 1737 | 3417 |
| 16 | 270885 | 545 | 1053 |
| 17 | 553532 | 1220 | 2175 |
| 18 | 582693 | 1569 | 4469 |
| 19 | 195002 | 1076 | 3531 |
| 20 | 344075 | 1734 | 2518 |
| 21 | 134080 | 709 | 3309 |
| 22 | 317290 | 1369 | 2899 |
| 23 | 136787 | 290 | 3081 |
| 24 | 153691 | 601 | 2763 |
| 25 | 150271 | 1305 | 1758 |
| 26 | 388644 | 701 | 3430 |

| | | | |
|---|---|---|---|
| 27 | 272786 | 492 | 1976 |
| 28 | 137762 | 2088 | 2279 |
| 29 | 277212 | 1081 | 4552 |
| 30 | 55960 | 348 | 2073 |
| | 7473560 | 29545 | 68450 |

TABLE 6. OBSERVATION FOR BAG MAKING MACHINE 2

| Days | Production (bags/day) | Improper cutting of handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 234029 | 576 | 1040 |
| 2 | 151340 | 382 | 510 |
| 3 | 312493 | 662 | 302 |
| 4 | 351631 | 793 | 1369 |
| 5 | 261883 | 192 | 2217 |
| 6 | 355032 | 539 | 1305 |
| 7 | 287712 | 842 | 1750 |
| 8 | 392396 | 513 | 1863 |
| 9 | 120692 | 325 | 1446 |
| 10 | 351599 | 1059 | 1896 |
| 11 | 718341 | 799 | 3671 |
| 12 | 564981 | 2172 | 2390 |
| 13 | 22410 | 1750 | 2418 |
| 14 | 161891 | 2712 | 1674 |
| 15 | 411939 | 1345 | 2651 |
| 16 | 105256 | 1126 | 1139 |
| 17 | 361540 | 949 | 1777 |
| 18 | 485792 | 1139 | 2763 |
| 19 | 334679 | 2972 | 2518 |
| 20 | 26437 | 1974 | 3017 |
| 21 | 288649 | 509 | 3943 |
| 22 | 72999 | 624 | 6952 |
| 23 | 48487 | 352 | 3459 |
| 24 | 249069 | 626 | 4701 |
| 25 | 66947 | 1152 | 2582 |
| 26 | 241531 | 1802 | 2351 |
| 27 | 217381 | 691 | 5015 |

| | | | |
|---|---|---|---|
| 28 | 285284 | 777 | 2297 |
| 29 | 182730 | 721 | 5119 |
| 30 | 38845 | 339 | 1679 |
| | 7683826 | 30414 | 75814 |

TABLE.7 OBSERVATION FOR BAG MAKING MACHINE 3

| Days | Production (bags/day) | Improper cutting of handle (bags/day) | Deformed bags (bags not of correct size) (bags/day) |
|---|---|---|---|
| 1 | 170834 | 881 | 1243 |
| 2 | 166694 | 252 | 790 |
| 3 | 299320 | 760 | 523 |
| 4 | 113189 | 753 | 999 |
| 5 | 143652 | 891 | 1698 |
| 6 | 181018 | 485 | 1140 |
| 7 | 506746 | 1005 | 1681 |
| 8 | 265314 | 639 | 1929 |
| 9 | 96536 | 768 | 769 |
| 10 | 131243 | 1203 | 1302 |
| 11 | 447366 | 1105 | 2795 |
| 12 | 150971 | 1187 | 2460 |
| 13 | 217082 | 1826 | 3637 |
| 14 | 97577 | 1028 | 2687 |
| 15 | 112788 | 2279 | 3824 |
| 16 | 158111 | 839 | 728 |
| 17 | 163136 | 1607 | 2100 |
| 18 | 439791 | 2043 | 1388 |
| 19 | 131952 | 3173 | 2119 |
| 20 | 253664 | 2018 | 2155 |
| 21 | 322857 | 1210 | 2428 |
| 22 | 339661 | 1132 | 2973 |
| 23 | 135915 | 371 | 1341 |
| 24 | 135855 | 1335 | 4198 |
| 25 | 39959 | 1171 | 3618 |
| 26 | 206106 | 655 | 1351 |
| 27 | 47905 | 525 | 1525 |
| 28 | 291157 | 686 | 3221 |

| | | | |
|---|---|---|---|
| 29 | 87452 | 538 | 3370 |
| 30 | 178663 | 280 | 1094 |
| | 6032514 | 32645 | 61086 |

## VI. Cost analysis

TABLE 8.COST OF RAW MATERIAL USED IN BLENDING PROCESS:

| Description of raw material | Percentage | Weight (kg) | Price (Rupees) |
|---|---|---|---|
| HDPE | 80% | 80 | 6400 |
| LDPE | 9.75% | 9.75 | 780 |
| Low grade HDPE | 10% | 10 | 550 |
| Tinopal | 0.25% | 0.25 | 20 |
| Total | 100% | 100 | 7750 |

Labour and electricity cost for each Kilogram of bags is 5 Rupees
So, final cost is (77.5+5)=82.5 Rupees
Selling price is 100 Rupees

TABLE 9. NET PROFIT IN BLENDING PROCESS:

| | |
|---|---|
| Production per month | 18760581bags |
| Wastage per month | 350124bags |
| Net production | 18410457bags |
| Production in kilogram per month | 40912.12kg |
| Net profit per month | 40912.12 * 17.5=715962.2 Rupees |

TABLE 10.COST OF RAW MATERIAL USED IN REVISED BLENDING PROCESS:

| Description of raw material | Percentage | Weight (kg) | Price (Rupees) |
|---|---|---|---|
| HDPE | 85% | 85 | 6800 |
| LDPE | 9.75% | 9.75 | 780 |
| Low grade HDPE | 5% | 5 | 275 |
| Tinopal | 0.25% | 0.25 | 20 |
| Total | 100% | 100 | 7875 |

Labour and electricity cost for each Kilogram of bags is 5 Rupees
So, final cost is (78.75+5)=83.75 Rupees
Selling price is 100 Rupees

TABLE11.NET PROFIT IN REVISED BLENDING PROCESS

| | |
|---|---|
| Production per month | 21189900 bags |
| Wastage per month | 297954 bags |
| Net production | 20891946 bags |
| Production in kilogram per month | 46426.5 kg |
| Net profit per month | 46426.5 * 16.25=754431.3 Rupees |

450 bags weight 1kg

## VII. Result

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

TABLE12. COMPARISON OF DATA

| Categories | Blending Process | Revised Blending Process |
|---|---|---|
| Raw material price for 1 Kg | 77.5 Rupees | 78.75 Rupees |
| Labour, electricity and other cost | 5 Rupees | 5 Rupees |
| Total cost for 1 Kg | 82.5 Rupees | 83.75 Rupees |
| Selling Price of 1 Kg of Plastic bag | 100 Rupees | 100 Rupees |
| Profit | 17.5 Rupees | 16.25 Rupees |
| Net Production Per month | 40912.12 kg | 46426.5 kg |
| Total Profit in Indian rupees | 715962.2 Rupees | 754431.3 Rupees |

TABLE13. RESULT

| Category | Blending Process | Revised blending product process | Difference |
|---|---|---|---|
| No of production per month (Bags) | 18760581 | 21189900 | 2429319 Increase (12.9%) |
| Total wastage (Bags) | 350124 | 297954 | 150850 Decrease (14.9%) |
| Net production per month (kg) | 40912.12 | 46426.5 | 5514.38 Increase (13.4%) |
| Total profit per month (Rupees) | 715962.2 | 754431.3 | 38469.1 Increase (5.3%) |

## VIII. Conclusion

The aim of the project was to reduce the lean wastes found in plastic bag manufacturing. The two lean wastes identified were the waste produced in form of defective bags manufactured and the time wasted due to manual inventory system. The wastes were studied with the help of value stream mapping and Ishikawa diagram. Changes in the raw material blending were done to reduce the defects and a system was developed to record, maintain and analyses the inventory. There was an increase in the raw material price but due to the increase in the production there was 5.3% increase in the total profit. There was increase in the net production per month by 13.4%. The inventory system was made in excel and visual basics. The system was successfully installed.

## *E. **References***

F. *AnupamSihag, Vinod Kumar and UmedKhod," APPLICATION OF VALUE STREAM MAPPING IN SMALL SCALE INDUSTRIES", International journal of mechanical engineering and robotics, Vol. 3, No. 3, July 2014.*

G. *ArumugamMahamani and KaranamPrahladaRao ," DEVELOPMENT OF A SPREADSHEET BASED VENDOR MANAGED INVENTORY MODEL FOR A SINGLE ECHELON SUPPLY CHAIN: A CASE STUDY", Serbian Journal of Management 5 (2) (2010) 199 - 211 .*

H. *Anna Eskehed Emma Krusebrant ," Modeling Lean Six Sigma in the small packaging industry in India", Rochester Institute of Technology, New York 2011*

I. *Andrew Thomas, Richard Barton, ChiamakaChukeOkafor. (2009), "Applying lean Six Sigma in a small engineering company – a model for change", Journal of Manufacturing Technology Management, Vol. 20, No. 1, pp. 113- 129*

J. *Abuthakeer S S, Mohanram P V and Mohan Kumar G (2010), "Lean Thinking Activity Based Costing Value Stream Mapping", Journal Homepage (ww.thinkinglean.com/IJLT).*

K. *Chandandeep Grewal (2008), "An Initative to Implement Lean Manufacturing Using Value Stream Mapping in Small Company", International Journal Manufacturing Technology and Management, Vol. 15, Nos. 3/4, pp. 405-417*