

REFERENCES

- Arnold K.L, Holler .M ,(1999) ,Quality assurance methods and technology, McGraw-Hill, New York.
- Antony. J, (2000), Ten Key ingredients for making SPC successful in organization ,Measuring Business Excilance,p.p.7-10,MCB University Press.1368.3047
- Bergman, B. and Klefsjo, B. (1994), Quality: From Customer Needs to Customer Satisfaction, McGraw-Hill, London.
- Bird, D. and Dale, B. (1994), ``The misuse and abuse of SPC: a case study", International Journal of Vehicle Design, Vol. 15 Nos. 1 and 2, pp. 99-107.
- Joseph R. Carter, Lisa M. Ellram, (1994) "The Impact of Interorganizational Alliances in Improving Supplier Quality", International Journal of Physical Distribution & Logistics Management, Vol. 24 Iss: 5, pp.15 - 23
- Juran, J. (1988), Juran's Quality Control Handbook, McGraw-Hill, New York, NY.
- Oakland, J.S. (1999), Statistical Process Control, Butterworth-Heinemann, Oxford.
- Owen, M. (1989), SPC and Continuous Improvement, IFS Publications, Bedford.
- Owen, M. (1993), SPC and Business Improvement, IFS Publications, Bedford.
- Rungtusanatham M, (1998),” International Journal of Quality & Reliability Management”,Vol. 16 No. 4, 1999, pp. 301-329
- Roland Caulcutt (1996), “Tutorial Statistical process control (SPC)” Assembly ,Automation Volume 16 ; Number 4 ; 1996 pp 10–14 ; MCB University Press
- Sri Lanka Garment,(2011) “Journal & Directory of yhe Sri Lanka Apparel Export Association” , Issue No.86 , August 2011.
- Stoumbos, Z. G., Reynolds, M. R., Ryan, T. P., & Woodall, W. H. (2000). The state of statistical process control as we proceed into the 21st Century. *Journal of The American Statistical Association*, 95, 451.
- Suzaki, K. (1987). *The new manufacturing challenge*. New York: The Free Press.
- Vaghefi, M. R., Woods, L. A., & Huellmantel, A. (2000). Toyota story 2: Still Winning the productivity game. *Business Strategy Review*, 11, 59-70.
- Wallace, W. (1971), The Logic of Science in Sociology, Aldine -Atherton, Inc., Chicago,IL
- Womack, J. P. & Jones, D. T. (1996). *Lean thinking*. New York: Simon & Schuster.

APPENDIX: I

Research Form

This survey is conducted solely for academic research purpose under the MSc in Textile and Clothing Management programme conducted by the Department of Textile and Clothing Technology, University of Moratuwa . The information in this document will be addressed with utmost confidentiality.

Thank you,

W M S K Wijebahu

SME Training coordinator

Sri Lanka Institute of Textile and Apparel (Former CITI)

Rathmalana.

Questionnaire

1. Background Information

1. Gender Male Female

| | |
|--|--|
| | |
|--|--|

2. Position

Senior Management Middle Management Junior Management Supervisor

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

3. Period of service in this present grade.

<1 Year 1-3 Year 3 - 5 Year >5 Year

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

4. Education Level

O/L A/L Diploma Degree /Other

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

5. No of employees <350 350-500 500<

| | | |
|--|--|--|
| | | |
|--|--|--|

6. Owner ship Local Foreign Joint Venture

7. Product types

| | |
|--|--|
| | |
| | |

8. Year of lean implement

Please indicate the level of agreement by crossing ('X') the cage with the following statements describe you/your organization the most.

1= Strongly Disagree, 2= Disagree, 3= Neither Agree/Nor Disagree, 4= Agree, 5= Strongly Agree

| | 1 | 2 | 3 | 4 | 5 |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
| 1. Higher management provides visible support for the use of SPC tools | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 2. Financial resources are provided by the organization management to support the activities involved in using SPC tools | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 3. Manager are uses statistical information when planning | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 4. Higher management reacts to quality improvement efforts from SPC information. | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 5. Critical process characteristic of the supporting area of the process are monitored using control charts | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 6. Control charts are widely used in the manufacturing process | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| 7. The quality characteristic(s) associated with the process has been documented | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

8. All employees are aware the impact of the quality characteristic to the product.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
9. As a process operator, the quality characteristic(s) of manufacturing process are monitored via process control chart

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
10. As a process operator the process parameters affecting the quality of the product are been controlled using control charts.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
11. Operators collect data for critical process characteristics, either manually or via computer

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
12. Observations of process/ product characteristic are plotted on control chart by operator, either manually or via computer.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
13. I look for out- of-control points on the control charts in the manual work sheet or via computer sheet

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
14. I ensure that control charts are being correctly evaluated at out-of-control situation.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
15. In setting up control charts , an assessment was made on the trial data corresponding of critical processes.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
16. In setting up control charts , an assessment was made to observed the relationship of the trial data.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
17. In setting up control charts for processes, a trial control limits were computed on the initial assessment of process stability and capability.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
18. Prerequisite conditions to the set up of control charts on process have been verified.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
19. Decision rules are in place to allow the direction of out-of-control situations

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
20. Whenever a manufacturing process goes out of control, causes are identified and removed

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
21. Various off line tool (e.g. Pareto charts, Histograms ect.) are used to identify special causes of variation when a manufacturing process goes out of control.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 22. Manufacturing process is frequently checked for stability to see whether it is capable of meeting product specifications.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 23. Statistical data are used not only to take corrective action but also to identify the opportunity for reducing common defects and measurement of the process.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 24. A samples are taken from the process to detect special variation

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 25. Random sample selecting method to be used identify the defects in the process

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 26. A rational exists for how and why measurements of product characteristics are taken from the process

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 27. Almost everyone in this organization has being received training in the construction of SPC charts.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 28. Almost everyone in this organization can describe what a control chats is

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 29. There are on-going refresher classes in the application of quality improvement tools.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 30. Periodic refresher for SPC practices is mandated for everyone in the organization

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 31. In-house technical staff experts are available to support technical issues

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 32. Technical support for the implementation and use of SPC charts are obtainable in- house

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 33. An employee has been appointed designated to conduct meeting regularly to discuss opportunities for quality improvements

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 34. Quality improvement teams, submit recommendations for improvement through SPC tools.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 35. I often work with a team of process operators, staff engineers, and/or management to resolve out-of control situations on the process

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 36. Quality improvement team implementation and recommendations are approved by quality teams

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

- 37. Final product inspection is kept to a minimal

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 38. The organization no longer uses final inspection as a primary quality control strategy

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 39. Quality of the final product is maintained through statistical process control rather than through final inspection

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 40. This organization does not believe in inspecting “quality” of the final product as the primary quality control strategy

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 41. The capability of this manufacturing process is continually monitored.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 42. Control chart limits for parameters associated with the process, are updated as the process is changed.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 43. Any changes of the process is updated and informed to process controllers

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 44. It is easy to update information about this manufacturing process.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 45. Statistic involvement is periodically audited to identify opportunities for improvement.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 46. An audit of SPC activities is regularly conducted

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 47. The organization continually monitors SPC activities

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 48. All aspect of the SPC intervention undergoes frequent “checkups” to ensure that all are going well.

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 49. Measurements of critical process characteristic are automated

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|
- 50. Measurement data are entered electronically into a database

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Part 03

If you can provide absolute data please indicate on section "A"

If you are unable to provide absolute data please indicate level of agreement by crossing ('X') the cage with the following statements describes you/your organization the most in the section "B".

| | Section A | | Section B | | | | |
|--|-----------|----|-----------|------------|------------|-------------|------|
| 1 Average reject garments % per month | | OR | <1% | 1-2% | 2-3% | 3-4% | <4% |
| 2 Average Final audit pass % per month | | OR | <96% | 97- 96% | 98- 97% | 99- 100% | 100% |
| 3 Average rework % | | OR | 88%> | 97- 88% | 96- 92% | 100- 96% | 100% |
| 4 Average audit pass % per day | | OR | <1% | 1-2% | 2-3% | 3-4% | 4%< |

Thank you very much for time and cooperation

APPENDIX II

Respondent Details

| Respondents | Supervisor | Junior Management | Middle Management | Senior Management | Total |
|-------------|------------|-------------------|-------------------|-------------------|-------|
| 1 | 1 | 1 | | | 2 |
| 2 | 1 | 2 | 1 | 1 | 5 |
| 3 | 1 | 1 | 1 | | 3 |
| 4 | 1 | 2 | | 1 | 4 |
| 5 | | 1 | | 1 | 2 |
| 6 | 1 | 1 | 1 | 1 | 4 |
| 7 | | | 1 | 1 | 2 |
| 8 | | 1 | | 1 | 2 |
| 9 | | 1 | | 1 | 2 |
| 10 | | 1 | | 1 | 2 |
| 11 | | 1 | | 1 | 2 |
| 12 | | 1 | | 1 | 2 |
| 13 | | 1 | | 1 | 2 |
| 14 | | 1 | | 1 | 2 |
| 15 | | 1 | | 1 | 2 |
| 16 | | 1 | 1 | | 2 |
| 17 | | 1 | | 1 | 2 |
| 18 | | 1 | 1 | | 2 |
| 19 | | 1 | | 1 | 2 |
| 20 | | | 1 | 1 | 2 |
| Total | 06 | 17 | 07 | 18 | 50 |

Table 01 : Respondents' job title

A population of 50 candidates from the 20 was male and 18 were female. A population 20 organizations 100% of local ownership apparel industries as well as 100% of larger scale apparel manufacturers in Sri Lanka.

| Title | n |
|-------------------|----|
| Senior Management | 18 |
| Middle Management | 07 |
| Junior Management | 17 |
| Supervisory | 06 |

Table'02 : Respondents' Job Title in the Company

Product type

| Product Type | n |
|-----------------------|----|
| Sport active wear | 04 |
| Knit tops and Bottoms | 04 |
| Active wear | 04 |
| Swim wear | 02 |
| Under wear | 02 |
| Seamless garment | 02 |
| Pant | 02 |

Table 03: Product types

Lean implementation duration

| Number of years | Number of companies |
|-----------------|---------------------|
| 1 | 1 |
| 2 | 5 |
| 3 | 3 |
| 4 | 2 |
| 5 | 2 |
| 6 | 1 |
| 7 | 4 |
| 8 | 2 |

Table 04: Number of year's implementation of Lean principle

Summary of the SPC ingredients

| No | Ingredients | 0-1 | 1-2 | 2-3 | 3-4 | 4-5 |
|----|---|-----|-----|-----|-----|-----|
| 1 | Management Commitment | 0 | 0 | 0 | 08 | 12 |
| 2 | Identification of critical Measurements | 0 | 0 | 0 | 06 | 14 |
| 3 | Operator Responsibility | 0 | 0 | 0 | 12 | 08 |
| 4 | Process Definition | 0 | 0 | 0 | 12 | 08 |
| 5 | Control charts usage | 0 | 0 | 0 | 12 | 08 |
| 6 | Training for SPC | 0 | 0 | 05 | 14 | 01 |
| 7 | Team work | 0 | 0 | 0 | 08 | 12 |
| 8 | Organizational cultural change | 0 | 0 | 02 | 13 | 05 |
| 9 | Update the knowledge of process | 0 | 0 | 0 | 11 | 09 |
| 10 | Audit or review of the SPC | 0 | 0 | 01 | 11 | 08 |
| 11 | Computers and SPC software package | 0 | 02 | 05 | 13 | 0 |

Table 05: Summary of the SPC ingredients practices level of respondent companies

| No | Ingredients | Mean | Std. Deviation |
|----|--|------|----------------|
| 1 | Management commitment | 4.06 | 0.644 |
| 2 | Identification of critical measurement | 4.43 | 0.427 |
| 3 | Operator responsibility | 3.94 | 0.404 |
| 4 | Process definition | 3.93 | 0.542 |
| 5 | Control chart usage | 3.90 | 0.541 |
| 6 | SPC training | 3.38 | 0.180 |
| 7 | Teamwork | 4.15 | 0.518 |
| 8 | Organization culture change | 3.75 | 0.661 |
| 9 | Update of knowledge of process | 4.07 | 0.608 |
| 10 | Audit SPC activities | 3.93 | 0.689 |
| 11 | Computer software usage | 3.13 | 0.868 |

Table 06: Summary mean and standard deviation of the SPC ingredients practices

