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A Study on Quality Analytics in N. M. Zackriah & Co., Ambur

Shathikul Janna S

II MBA, Department of Management Studies, Mohamed Sathak Engineering College, Kilakarai, Tamil Nadu, India

Dr. B. Meenakshi Sundaram

Associate Professor, Department of Management Studies, Mohamed Sathak Engineering College, Kilakarai, Tamil Nadu, India

ABSTRACT: The study on Quality Analytics at N.M. Zackriah and Co., Ambur evaluates its effectiveness in improving organizational performance. Primary data were collected from 120 respondents through a structured questionnaire, supported by secondary data. Percentage analysis, Chi-square, and correlation analysis were employed. Findings reveal effective quality practices and favorable employee perceptions of quality analytics. Analytics supports early defect identification, reduces defects and rework, improves process efficiency, and strengthens managerial decisions. The study concludes that quality analytics enhances product quality, operational efficiency, and sustainable organizational growth.

KEYWORDS: Quality Analytics, Quality Management, Defect Reduction, Process Efficiency, Decision-Making, Manufacturing Industry, Continuous Improvement, Operational Excellence.

I. INTRODUCTION

Quality Analytics integrates quality management with data analytics to improve product quality, process efficiency, customer satisfaction, and operational excellence. It transforms quality-related data into actionable insights through statistical analysis, visualization, and predictive modeling. Unlike traditional inspection-based approaches, it enables proactive defect prevention, root-cause identification, and continuous improvement. Tools such as control charts, Pareto analysis, regression, and hypothesis testing help reduce process variation. Quality analytics supports manufacturing and service industries, strengthens customer-focused decisions, and enables predictive and prescriptive quality management. Successful adoption requires skilled employees, technology, management support, and a strong quality culture.

Statement of the Problem

N.M. Zackriah & Co., Ambur faces quality challenges including defects, process variations, rework, and customer complaints. Traditional methods may not adequately support prediction and prevention. This study examines quality analytics practices, data usage, and effectiveness in identifying root causes, reducing defects, improving product quality, enhancing operational efficiency, and supporting data-driven decisions.

Objectives of the Study

The objectives of this study are

1. To study existing quality management practices and standards followed within N.M. Zackriah & Co.
2. To identify major quality issues and key causes of organizational defects.
3. To examine accuracy, maintenance, and effective utilization of quality-related organizational data.
4. To analyze quality analytics effectiveness in identifying defects, reducing rework, improving efficiency.
5. To suggest measures improving product quality, performance, and organizational effectiveness through analytics.

Scope of the Study

1. The study examines existing quality control and quality assurance practices within organizations effectively.
2. It evaluates quality analytics tools and techniques for improving overall product quality.
3. It analyzes impacts on defects, efficiency, satisfaction, and quality-related decisions, specifically.

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Limitations of Study

1. The research was restricted to N.M. Zackriah & Co., limiting generalizability of findings.
2. The respondent selection was based on convenience, potentially affecting sample representation and reliability.
3. Respondent bias and limited questionnaire completion time may have affected information accuracy.

II. REVIEW OF LITERATURE

From the study made by **Antony, Sony, and Gutierrez**, **(2022),** titled "An Empirical Study on Quality 4.0 Readiness in Manufacturing Organizations", published in The TQM Journal, (Vol. 34, Issue 6), pages (1452–1470), it was concluded that digital quality tools and analytics improve operational control and support continuous improvement.

In a study made by **Sadikin, (2023),** titled Defect Reduction in the Manufacturing Industry: Systematic Literature Review, published in the International Journal of Industrial Engineering and Engineering Management (Vol. 5, Issue 2), pages (Not specified), it was concluded that defect reduction directly improves product quality, customer satisfaction, and operational efficiency..

Another study made by **Patel and Mehta (2023),** titled Data Analytics for Quality Control: Applications and Future Opportunities, published in the International Journal of Quality & Reliability Management (Vol. 40, Issue 5), pages (1125–1143), it was concluded that data analytics improves quality control accuracy and supports faster corrective actions.

Further study made by **Liu, Liu, Gu and Yang**, (2023), titled From Total Quality Management to Quality 4.0: A Systematic Literature Review and Future Research Agenda, published in Frontiers of Engineering Management, (Vol. 10, Issue 2), pages (191–205), it was concluded that traditional quality management practices are evolving into Quality 4.0 through the integration of AI, IoT, and analytics.

Company Profile

Established in 1972 by Mr. N.M. Zackriah, NMZ Group is a leading leather manufacturer and exporter. The company produces finished cow leather, footwear components, shoe uppers, and shoes. Its Ambur facilities feature modern machinery, stringent quality control, and effluent treatment systems. Recognized as a Golden Export House, NMZ serves international markets and employs approximately 750 skilled workers.

World Scenario

The global leather industry is a major manufacturing and export sector producing footwear, garments, bags, accessories, and upholstery. Major producers include China, Brazil, Italy, India, Vietnam, Turkey, and Pakistan. Rising incomes, fashion trends, and global retail expansion drive demand, while synthetic alternatives and environmental regulations remain challenges.

India – National Level

India is a major leather producer, exporter, and employment generator, supporting around 4.4 million workers. Key segments include tanning, footwear, garments, leather goods, and accessories. Major export markets include the USA, Germany, UK, Italy, France, and UAE. Government programmes support infrastructure, skills, and exports.

State Level

Tamil Nadu is India's leading leather hub, with major centres including Chennai, Ambur, Ranipet, Vaniyambadi, and Vellore. Uttar Pradesh, West Bengal, Maharashtra, Punjab, and Karnataka are other important clusters.

Future Outlook

Future growth will be driven by automation, quality analytics, predictive analytics, sustainability, digital transformation, and efficient supply chains. Eco-friendly production, data-driven quality management, and skilled employees will strengthen competitiveness, reduce defects, improve productivity, and support long-term global growth.

Research Design:

The study adopts a descriptive research design to collect, analyze, interpret, and report data systematically.

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Source of Data:
Primary data were collected through a structured questionnaire from employees. Secondary data were obtained from the company website, journals, internet sources, and other relevant records.

Research Approach and Instrument:
A survey method was used, with a questionnaire serving as the primary research instrument.

Sample Plan:
The sample unit comprised employees of N.M. Zackriah and Co., Ambur. A sample of 120 respondents was selected from a population of 750 employees using simple random sampling.

Tools Used:
Collected data were analyzed using Percentage Analysis, Chi-Square Test, and Correlation Analysis to evaluate quality-related practices, relationships, and organizational performance.

Percentage Analysis: Percentage analysis was used to compare data and express relationships between different categories in percentage terms.

$$\textbf{Percentage} = \frac{\textit{No.of Respondents in a Category}}{\textit{Total No.of Respondents}} \textbf{ x 100}$$

Chi-Square Test: Chi-square determines whether variables are associated, including analytics usage, performance, awareness, decision-making, and departmental usage.

$$\chi^2 = \frac{\sum (\mathbf{0i} - \mathbf{Ei})^2}{\mathbf{Ei}}$$

Correlation Analysis: Correlation analysis is a statistical tool used to measure the relationship between two variables. It is denoted by "r" and shows the strength and direction of the relationship. It helps to identify whether variables such as business analytics usage and organizational performance are related

$$\mathbf{r} = \frac{n\,(\sum xy) - (\sum x)\,(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2\,[n\sum y^2 - (\sum y)^2}}$$

Data Analysis and Interpretation
Data analysis involves systematically organizing and examining data to answer research questions, often using visual tools like tables and charts. Data, collected through various methods, is meaningless until analyzed. Analysis identifies patterns and insights through techniques like classification and comparison. Interpretation gives meaning to findings, aligns them with research goals, and generates insights for informed decision-making and future studies.

Table: 1 Age of the Respondents

Age	No. of Respondents	%
Below 25	19	16
25-35	29	24
35-45	45	38
Above 45	27	22
Total	**120**	**100**

From the above table, it is interpreted that, 16 % of the respondents belong to below 25 age group, 25 % to 25 – 35 Age group, 38 % to 35 – 45 age group, 22 % to above 45 age group.

Table: 2 Gender

Gender	No. of Respondents	%
Male	89	74
Female	31	26
Total	**120**	**100**

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From the above table, it is interpreted that 74 % of respondents are male and 26 % are female.

Table: 3 Experience

Experience	No. of Respondents	%
Below 2 years	21	17
2-5 years	35	29
5-10 years	42	36
Above 10 years	22	18
Total	**120**	**100**

It is interpreted that 17 % of respondents have less than 2 years of experience, 29 % have 2 – 5 years, 36% have 5 – 10 years and 18 % have more than 10 years of experience.

Table: 4 Department working

Department working	No. of Respondents	%
Production	36	30
Operation	19	16
Logistics	28	23
Quality control	27	23
Quality assurance	10	8
Total	**120**	**100**

It is interpreted that 30 % of respondents belong to production department, 16 % to Operation, 23 % to Logistics, 23 % to quality control and 8 % to Quality Assurance department.

Table: 5 Awareness on QMS

Awareness on QMS	No. of Respondents	%
Yes	81	67
No	39	33
Total	**120**	**100**

It is interpreted that 67 % of respondents aware of Quality Management System and 33 % are unaware of quality management system.

Table: 6 Frequency of Quality Checks

Frequency of Quality Checks	No. of Respondents	%
Daily	24	20
Weekly	70	58
Monthly	15	12
Half yearly	2	2
Annually	9	8
Total	**120**	**100**

It is interpreted that 20 % of respondents agree that Quality check is done daily, 58 % agree the quality check is done weekly, 12 % as monthly, 2 % as half yearly and 8 % as annually.

Table:8 Major Quality Issue faced

Major Quality Issue faced	No. of Respondents	%
Quality in raw material	12	10
Production defects	10	8
Supply delays	9	8

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Shorter shelf transit	7	6
Damage during transit	10	8
No issues	72	60
Total	**120**	**100**

It is interpreted that 10 % of respondents faced quality issues with raw material, 8 % each with production defects, supply delays and damage during transit, 6 % with shorter shelf transit and 60 % agreed that they never had any quality issues during their work.

Table: 9 Awareness on usage of Quality Analytical Tools

Awareness on usage of Quality Analytical Tools	No. of Respondents	%
Yes	71	59
No	49	41
Total	**120**	**100**

It is interpreted that 59 % of respondents aware of quality analytical tools and 41 % are unaware of usage of quality analytical tools.

Table: 10 Respondents Opinion with QMS Implementation

Opinion with usage of Marketing Operations Analytics	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	Res*	%	Res*	%	Res*	%	Res*	%	Res*	%
Standard Quality parameters	28	23	78	65	2	1	8	8	4	3
Effectiveness of Quality Practices	9	7	69	58	10	8	27	23	5	4
QMS identifies defects at early stage	23	19	54	45	14	12	23	19	6	5
Accurate collection of Quality Data	18	15	65	54	17	14	9	8	11	9
Deficiency in Worker's skills	4	3	12	10	25	21	73	61	6	5
Poor Internal Communication in QMS	7	6	5	4	32	26	67	56	9	8
Lack of Quality Culture awareness	8	7	28	23	46	38	26	22	12	10
Poor Employee loyalty	5	4	5	4	28	23	74	62	8	7
Process shut down due to raw material	24	20	42	35	22	18	20	17	12	10
Defects due to low lighting	8	7	24	20	44	37	28	23	16	13
Repetitive power failure in QMS	16	13	34	28	36	30	22	19	12	10
Poor Maintenance in QMS	8	7	17	14	23	19	62	52	10	8
QMS reduces Defects and Rework	28	24	76	63	10	8	4	3	2	2
QMS Improves process efficiency	22	18	79	66	12	10	2	2	5	4
QMS supports better decision making	12	10	95	79	4	3	2	2	7	6

Res* Respondents

Interpretation

The table presents the opinions of 120 respondents regarding various Quality Management System (QMS) factors. The highest response category and value for each factor are interpreted below:

Standard Quality Parameters: The highest response is Agree, with 78 respondents (65%). This indicates that a substantial majority of employees agree that standard quality parameters are properly followed in the organization.

Effectiveness of Quality Practices: 69 respondents (58%) agree that the existing quality practices are effective. This suggests that employees generally perceive the organization's quality practices as satisfactory and beneficial.

QMS Identifies Defects at Early Stage: 54 respondents (45%) agree that QMS helps identify defects at an early stage. This indicates that the quality system contributes to timely detection and prevention of quality problems.

Accurate Collection of Quality Data: The highest response is Agree, with 65 respondents (54%). This shows that most employees believe quality-related data are collected accurately for monitoring and analysis.

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Deficiency in Workers' Skills: 73 respondents (61%) disagree with the statement. This indicates that the majority do not consider workers' skills to be a significant deficiency affecting quality performance.

Poor Internal Communication in QMS: The highest response is Disagree, with 67 respondents (56%). This suggests that most employees do not perceive poor internal communication as a major problem within the QMS.

Lack of Quality Culture Awareness: 46 respondents (38%) selected Neutral, representing the highest response. This indicates uncertainty among employees regarding the level of quality culture awareness in the organization.

Poor Employee Loyalty: 74 respondents (62%) disagree with this statement. This indicates that most respondents do not perceive poor employee loyalty as a significant organizational issue.

Process Shutdown Due to Raw Material: The highest response is Agree, with 42 respondents (35%). This suggests that raw-material-related issues may sometimes contribute to production interruptions.

Defects Due to Low Lighting: 44 respondents (37%) selected Neutral, which is the highest response. This indicates that employees are uncertain about whether inadequate lighting significantly contributes to defects.

Repetitive Power Failure in QMS: The highest response is Neutral, with 36 respondents (30%). This reflects mixed opinions regarding the impact of repeated power failures on QMS and production activities.

Poor Maintenance in QMS: 62 respondents (52%) disagree with the statement. This indicates that most employees do not consider poor maintenance to be a major weakness in the QMS.

QMS Reduces Defects and Rework: 76 respondents (63%) agree that QMS reduces defects and rework. This demonstrates strong employee confidence in the effectiveness of QMS in minimizing quality problems and unnecessary rework.

QMS Improves Process Efficiency: The highest response is Agree, with 79 respondents (66%). This indicates that employees strongly recognize the contribution of QMS toward improving operational and process efficiency.

QMS Supports Better Decision-Making: 95 respondents (79%) agree that QMS supports better decision-making. This is the highest value in the entire table, indicating very strong employee confidence in QMS as a tool for improving managerial and operational decisions.

III. CHI SQUARE TEST–I

Relationship Between Years of Experience and Usage of Quality Analytics Tools

Null Hypothesis: H0: There is no significant relationship between years of experience and usage of quality analytics tools

Alternative Hypothesis: H1: There is a significant relationship between years of experience and usage of quality analytics tools.

Observed Frequency: The observed frequency for Chi Square Test is given in the table below:

Table 11: Observed Frequency

Experience	Usage of Quality Analytical Tools		
	Yes	No	Total
Below 2 years	12	9	**21**
2-5 years	22	13	**35**
5-10 years	25	17	**42**
Above 10 years	12	10	**22**
Total	**71**	**49**	**120**

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Source: Primary Data

$$\text{Expected Frequency} = \frac{Row\ Total\ x\ Coloum\ Total}{Grand\ Total}$$

The Calculation is as follows

1. Row1 Total × Column1 Total / Grand Total = 21 x 71 / 120 = **12.43**
2. Row1 Total × Column2 Total / Grand Total = 21 x 49 / 120 = **8.58**
3. Row2 Total × Column1 Total / Grand Total = 35 x 71 / 120 = **20.71**
4. Row2 Total × Column2 Total / Grand Total = 35 x 49 / 120 = **14.29**
5. Row3 Total × Column1 Total / Grand Total = 42 x 71 / 120 = **24.85**
6. Row3 Total × Column2 Total / Grand Total = 42 x 49 / 120 = **17.15**
7. Row4 Total × Column1 Total / Grand Total = 22 x 71 / 120 = **13.02**
8. Row4 Total × Column2 Total / Grand Total = 22 x 49 / 120 = **8.98**

Table 12: Expected Frequency

Experience	Usage of Quality Analytical Tools		
	Yes	No	Total
Below 2 years	12.42	8.58	**21**
2-5 years	20.71	14.29	**35**
5-10 years	24.85	17.15	**42**
Above 10 years	13.02	8.98	**22**
Total	**71**	**49**	**120**

$$\chi^2 = \frac{\sum (0i - Ei)^2}{Ei}$$

Table 13: Calculation of Chi Square

Observed frequency	Expected frequency	Oi–Ei	$(Oi–Ei)^2$	$(Oi–Ei)^2/Ei$
12	12.42	-0.43	0.1849	0.0149
9	8.58	0.43	0.1849	0.0216
22	20.71	1.29	1.6641	0.0804
13	14.29	-1.29	1.6641	0.1165
25	24.85	0.15	0.0225	0.0009
17	17.15	-0.15	0.0225	0.0013
12	13.02	-1.02	1.0404	0.0799
10	8.98	1.02	1.0404	0.1159
120			**Total**	**0.4314**

$\sum[(Oi–Ei)^2 / Ei] = 0.4314$

Degrees of freedom = (No. of Rows – 1) (No. of Columns – 1) = (4-1) x (1-1) = 3

At 5% level of significance the value is **7.815**. Calculated value = **0.4314**

Table value >Calculate value, H0 is accepted.

Inference

Hence there is no significant relationship between years of Experience and the proper use of quality analytics tools in the organization.

Coefficient of Correlation

Correlation coefficient is the statistical tools used to measures the degree to which two variables are linearly related to each other. Correlation measures the degree of association between two variables.

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Table 14: Relationship between Identifying Defects at an Early Stage and Reduction in Defects and Rework

Early Detection of Defects (X)	Reduced Defects and Rework (Y)	X^2	Y^2	XY
23	28	529	784	644
54	76	2916	5776	4104
14	10	196	100	140
23	4	529	16	92
6	2	36	4	12
$\sum X = 120$	**$\sum Y = 120$**	**$\sum X^2 = 4206$**	**$\sum Y^2 = 6680$**	**$\sum XY = 4992$**

Source: Primary Data

Formula:

$$\mathbf{r} = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2}}$$

$$r = \frac{5 \times (4992) - (120) \times (120)}{\sqrt{(5 \times (4206) - (120)^2 \times 5 \times (6680) - (120)^2}}$$

r = 0.9408

Calculated value = **0.9408**

Interpretation

It is inferred that the correlation value **r = 0.9408** is **positive**, therefore there is a positive relationship Identifying Defects at an Early Stage and Reduction in Defects and Rework

Suggestions for Better Prospects

The organization should strengthen Quality Analytics awareness, employee training, and skill development. Data collection and reporting systems should be improved for accurate analysis. Employee participation, interdepartmental communication, and quality culture should be encouraged. Investment in advanced digital analytics can enable real-time monitoring and faster corrective action. Regular audits should evaluate effectiveness, support early defect identification, reduce rework, and ensure continuous improvement.

IV. CONCLUSION

The study concludes that Quality Analytics significantly improves quality performance and operational efficiency at N.M. Zackriah & Co., Ambur. Findings highlight effective QMS practices, early defect identification, defect reduction, process efficiency, and better decision-making. Chi-Square analysis shows no significant relationship between experience and analytics usage, while correlation indicates a strong positive relationship (r = 0.9408) between early defect identification and reduced defects and rework. Continuous training, accurate data management, advanced tools, and employee involvement are recommended.

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