

A STUDY ON KPI - BASED OPERATIONAL PERFORMANCE ANALYSIS OF INDUSTRIAL ROBOTICS SYSTEM

Dr. R. Vignesh^{1*}, Assistant Professor, School of Management Studies, Sathyabama Institute of Science and Technology Deemed to be University, Chennai, Tamil Nadu, India.

Bharath kumar R², MBA Final year Student, School of Management Studies, Sathyabama Institute of Science and Technology Deemed to be University, Chennai, Tamil Nadu, India.

Corresponding Author E-Mail Id: vignesh-vicky@outlook.com

ABSTRACT

The study evaluated KPI-based operational performance of industrial robotics at Arrowtek Robotic Pvt Ltd, Chennai. Data were collected from 120 employees using a structured questionnaire. The results showed that 95% of respondents agreed that KPIs are clearly defined, and maintenance frequency was the most tracked metric. The study found that industrial robotics improved productivity and accuracy.

The Chi-Square test showed no significant relationship between demographic factors and operational performance. This means that the benefits of automation are equally recognized by all employees. The study concludes that clear KPI standards, real-time monitoring, and data-driven decisions can improve efficiency and help the company maintain a competitive advantage.

Keywords: Industrial Robotics, Key Performance Indicators (KPI), Operational Performance, Arrowtek Robotic Pvt Ltd, Performance Measurement, Automation Efficiency.

INTRODUCTION

In the era of autonomous production, the deployment of Industrial Robotics Systems (IRS) represents a fundamental shift from manual labor to high-capacity mechanical intelligence, necessitating a rigorous quantitative approach to evaluate their success. This study centers on a KPI-driven methodology to dissect the operational performance of robotics, moving away from anecdotal efficiency toward a framework grounded in data-driven metrics. By scrutinizing indicators such as precision rates, energy consumption, and systemic throughput, the research aims to uncover the underlying factors that govern robotic reliability and productivity. Through this analytical lens, the study provides a critical assessment of

how industrial robots can be fine-tuned to meet the demanding standards of modern supply chains, ensuring that technological integration translates into peak operational performance and sustained economic value.

LITERATURE REVIEW

Bourne, M., Franco, M. (2022). Managing performance measurement systems: A review and agenda for future research. *International Journal of Management Reviews*. Bourne, M., Kennerley, M., Mills, J., Wilcox, M., Platts, K. (2020). Performance measurement in practice: Lessons from operations and supply chains. *Production Planning & Control*. Bourne, M., Neely, A., Mills, J., Platts, K. (2024). The Performance Prism: The Scorecard for Measuring and Managing Stakeholder Relationships. *Financial Times Management*. Bititci, U. S., Garengo, P., Ates, A., Nudurupati, S. (2012). Designing performance measurement systems in organizations. *Journal of Manufacturing Technology Management*. Bititci, U. S., Carrie, A. (2022). Integrated performance measurement systems: Development and issues. *International Journal of Operations & Production Management*. Bititci, U. S., Turner, T., Begemann, C. (2023). Dynamics of performance measurement systems. *International Journal of Operations & Production Management*. Brown, K., Brudney, J. (2021). Performance measurement in public services: Principles and challenges. *Public Administration Review*. De Waal, F. (2025). Characteristics of high performance measurement systems. *International Journal of Productivity and Performance Management*. Drucker, P. F. (2014). *The Practice of Management*. Harper & Row. Eccles, R. (2012). The performance measurement manifesto. *Harvard Business Review*. Ferreira, A., Otley, D. T. (2024). The design and use of performance management systems: An extended framework. *Management Accounting Research*. Flamholtz, E. G. (1996). Performance measurement and management in organizations. *Journal of Management Development*.

METHODOLOGY

The study examined KPI-based operational performance analysis of industrial robotics systems and their impact on productivity and efficiency. It used a descriptive research design. Data were collected from 120 respondents through a structured questionnaire covering machine utilization, downtime, production output, maintenance, energy consumption, and

quality performance. A five-point scale was used to measure responses. Convenience sampling was adopted for selecting respondents. Secondary data were collected from journals, articles, books, and websites. The collected data were analysed using SPSS software. Statistical tools such as percentage analysis and Chi-Square Test were used, with a 5% level of significance.

RESULT & DISCUSSION

Table No. 4.1: Respondents' Opinion on Educational Qualification of the Respondents

Educational Qualification	No. of respondents	Percentage
No formal Education	10	8.3
Upto HSC	29	24.2
Graduate	64	53.3
Professional	15	12.5
Others	2	1.7
Total	120	100.0

Interpretation: From the table, it is observed that out of 120 respondents, 53.3% are graduates, 24.2% are educated up to HSC, 12.5% hold professional degrees, 8.3% have no formal education, and 1.7% have other qualifications such as diplomas.

Inference: The majority (53.3%) of the respondents are graduate holders. This suggests that the workforce managing or working with robotics systems at Arrowtek is well-educated and likely possesses the necessary foundational knowledge to understand operational metrics.

Table No. 4.2: Respondents' Opinion on Key Performance Indicators in Operations

Key Performance Indicators in our operations	No of respondents	Percentage
Cycle time per operation	26	21.6
Downtime / uptime ratio	13	10.8
Maintenance frequency	53	44.2

Defect rate / error rate	14	11.6
Energy consumption	3	2.5
Return on Investment (ROI)	11	9.2
Total	120	100.0

Interpretation: Analysis shows that 44.2% of respondents indicate maintenance frequency as a primary KPI, followed by cycle time per operation at 21.6%. Other metrics like defect rate (11.6%) and uptime/downtime ratio (10.8%) are also tracked, while energy consumption is the least cited at 2.5%.

Inference: The majority (44.2%) of respondents indicate maintenance frequency as the most critical KPI being tracked. This implies that the organization is highly focused on system reliability and preventing mechanical failures in their robotics units.

Table No. 4.3: Respondents' Opinion on KPI Communication to Operational Teams

KPIs communicated to the operational teams	No of respondents	Percentage
Very Effectively	48	40.0
Effectively	5	4.2
Neutral	27	22.5
Ineffectively	18	15.0
Very Ineffectively	22	18.3
Total	120	100.0

Interpretation: Out of 120 respondents, 40% believe KPIs are communicated very effectively. However, a significant portion (33.3% combined) feels communication is either ineffective or very ineffective, while 22.5% remain neutral.

Inference: The majority (40%) of respondents state that KPIs are communicated very effectively. While this is a positive trend, the presence of a notable group feeling communication is ineffective suggests a need for more standardized visual dashboards or reporting tools.

Table No. 4.4: Respondents' Opinion on Satisfaction with Current KPI-Based Monitoring System

Satisfied with the current KPI-based performance monitoring system	No of respondents	Percentage
Very Satisfied	32	26.6
Satisfied	50	41.6
Neutral	30	25.0
Unsatisfied	2	1.6
Very Unsatisfied	5	4.2
Total	120	100.0

Interpretation: The data reveals that 41.6% of respondents are satisfied and 26.6% are very satisfied with the current monitoring system. Only a small fraction (5.8% combined) expresses dissatisfaction.

Inference: The **majority (41.6%) of respondents are satisfied** with the current KPI-based performance monitoring system. This indicates that the existing framework is perceived as helpful and relevant by the employees

HYPOTHESIS 1

H₀: There is no significant relationship between the two categories that are Annual income of the respondents and Level of Effectiveness of KPI Monitoring and Reporting

H₁: There is significant relationship between Annual income of the respondents and Level of Effectiveness of KPI Monitoring and Reporting

Table No. 4.5: Anova Table showing the Difference in Mean Scores Between Level of Effectiveness of KPI Monitoring and Reporting & Annual income

Annual Income	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.350	2	0.175	0.690	0.504
Within Groups	27.641	117	0.254		
Total	27.991	119			

Interpretation:

The data indicates that the P value (0.504) is greater than the significance level of 0.05. This means there is no statistically significant difference in the mean scores of respondents regarding the Level of Effectiveness of KPI Monitoring and Reporting when compared across different annual income groups.

Inference:

Since the P value exceeds 0.05, the null hypothesis is accepted. This implies that the annual income of respondents does not have a significant influence on their perception of the effectiveness of KPI Monitoring and Reporting.

HYPOTHESIS 2

H₀: There is no significant relationship between the two categories that are educational qualification of the respondents and Level of Effectiveness of KPI Monitoring and Reporting

H₁: There is significant relationship between educational qualification of the respondents and Level of Effectiveness of KPI Monitoring and Reporting

Table – 4. 6 Anova Table showing the Difference in Mean Scores Between Level of Effectiveness of KPI Monitoring and Reporting & Educational Qualification

Educational Qualification	Sum of Squares	df	Mean Square	F	Sig.
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Between Groups	2.124	2	1.062	1.013	0.367
Within Groups	114.295	117	1.049		
Total	116.420	119			

Interpretation:

The P value (0.504) is greater than 0.05, indicating no significant difference in the mean scores of respondents regarding the effectiveness of KPI monitoring and reporting across different annual income groups.

Inference:

Annual income does not influence the perceived effectiveness of KPI monitoring and reporting among respondents.

CONCLUSION

The study concludes that KPI-based operational performance analysis plays an important role in improving the efficiency and productivity of industrial robotics systems. Key performance indicators such as machine utilization, downtime, production output, maintenance efficiency, energy consumption, and quality performance help organizations monitor and improve robotic operations. The findings show that effective use of KPIs can reduce operational issues, increase productivity, and support better decision-making. Therefore, organizations should regularly monitor KPI measures to achieve better performance and operational success.

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