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Role of Business Analytics in Improving Operational Efficiency: A Study on Cme Laboratories Bharat Pvt. Ltd

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ABSTRACT

Businesses now, because of the amount of data available, are using business analytics more and more to work better, improve how things are done, and help them make big plans. This research looks at how business analytics helps CME Laboratories Bharat Pvt. Ltd. in Chennai, India (a condition monitoring lab that is officially ISO/IEC 17025 accredited) to be more efficient in their daily work.

The research is descriptive and a questionnaire with specific questions was used to gather information from 110 employees in different sections of the company. It considers five main areas: how well things work (operational efficiency), the issues with running things, how key performance indicators are watched, using business analytics, and how analytics generally affects the lab's work. To be sure the answers were consistent, and to understand how different things relate to each other, the research used statistical methods, specifically Cronbach's Alpha and Pearson correlation.

The outcome of the research is that businesses which do use analytics and see improvements in how well they're running are very strongly and demonstrably connected. Effectively using analytics in daily work and consistently following KPI's leads to being more efficient, getting things done faster, and making better choices. This supports the idea that analytics is becoming a really important part of a lab's strategy.

Keywords: Business Analytics, Operational Efficiency, KPI Monitoring, Laboratory Operations, Condition Monitoring, SPSS.

INTRODUCTION

The condition monitoring and industrial testing sector plays critical role in enabling the manufacturing, construction, energy and infrastructure industries. Through the early identification of machinery faults, these services allow companies to reduce unexpected failures, improve the lifespan of their assets, and ensure reliable operations. Fluid, vibration, and predictive diagnostic laboratories are therefore required to provide extremely accurate results, while operating within increasingly short time-frames, and with an ever-increasing focus on quality and compliance through international accreditation bodies.

In order to respond to these operational challenges and demands, business analytics (BA) is a critical and valuable resource for laboratories. Rather than just traditional methods of monitoring, organisations are now leveraging analytics to transform operational data into actionable information. This enables them to monitor key performance indicators (KPIs), identify issues early, improve resource utilisation and support timely and efficient decision-making. In settings where laboratory processes are based on a number of interlinked steps, such as

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receiving, registering, testing, analysing, reporting and communicating with clients, analytics-based management is increasingly becoming a critical element for maintaining efficiency and quality.

Meanwhile, the use of Industry 4.0 technologies has transformed laboratory practices. Sensors, cloud computing, real-time dashboards, predictive analytics platforms, and so on, have enhanced data collection, analysis and decision making. Laboratories that have embraced these technologies are likely to have faster response time, fewer errors, improved utilisation of resources, and greater customer satisfaction than laboratories that still rely on manual or less structured process.

The Indian market for industrial testing and condition monitoring has been experiencing strong growth due to the growth of industries like the automobile, heavy engineering, power generation, mining and construction. In particular, Chennai has become a prominent location due to the presence of key manufacturing clusters, strong industrial background and technical workforce. In such a highly competitive landscape, achieving high efficiency is essential not just to provide superior service, but also to retain customers and enable sustainable growth. While the adoption of business analytics is growing in various industries, there remains a gap in empirical evidence on the role of business analytics in small to medium sized specialised laboratory settings in India.

The majority of the literature provides insights into large manufacturing companies or multinational corporations, with little coverage on analytics use in accredited laboratories. This research seeks to fill this knowledge gap by exploring the impact of analytics adoption, KPI tracking and operational planning on overall performance in an ISO/IEC 17025-accredited lab in Chennai

Industry Overview

Condition monitoring and predictive maintenance services is a niche sector of the industrial services sector. It involves assessing the condition and performance of equipment by employing scientific techniques, including laboratory testing of key working fluids like lubricating oils, fuels, coolants and hydraulic fluids. It also involves other analysis methods, such as vibration analysis and wear particle analysis, to identify early indications of mechanical problems.

The key goal of the industry is to assist organisations in transitioning from time- or failure-based maintenance to more efficient, science-based condition monitoring maintenance practices. This helps in preventing unscheduled downtime and costly production losses. On a global scale, the condition monitoring services industry is set to see relatively slow but steady growth with a projected compound annual growth rate (CAGR) of 8-12 percent over the next five to seven years. This is due to growing use of Industry 4.0 technologies such as IoT-based condition monitoring, cloud-based analytics and real-time monitoring data tracking.

There is also a more pronounced concern across various industries about increasing system reliability, especially those with valuable assets and infrastructure such as energy, mining and heavy manufacturing. North America and Europe currently dominate the market, but the Asia-Pacific region is fast catching up, with markets such as India, China and South Korea holding considerable promise. In the case of India, the growth in manufacturing and infrastructure growth has also spurred growth in condition monitoring and industrial testing services.

Policies like Make in India and the National Infrastructure Pipeline have spurred industrial development, driving the demand for effective maintenance and testing services. Meanwhile, the need for compliance and accreditation (such as the Bureau of Indian Standards (BIS) and NABL) is driving the need for more formalised laboratory practices. This has resulted in a greater focus on the integration of analytics-based quality management systems for compliance and uniformity.

Chennai is a key destination for condition monitoring laboratories in the region because of its robust industrial base. It is home to a broad range of automobile manufacturers, tier one suppliers, heavy engineering companies, petrochemical companies and port logistics. In this landscape, laboratories need to process a high throughput of samples from a wide range of customers, deliver results within tight time constraints, and deliver accurate

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diagnostic reports. These challenges make the role of business analytics more than a luxury, but necessary for ensuring efficiency, enhancing quality of service and remaining competitive in a rapidly changing field.

Need for the Study

Efficiency is a critical element in delivering high-quality services and increasing client satisfaction for laboratories. As demand for services increases and clients demand quicker and more accurate results, there is a growing need for laboratory operations to be as efficient as possible. This means taking a proactive stance towards improving laboratory efficiencies in terms of workflows, communication between sections, reporting and information systems and resource allocation. Historical approaches to managing performance - such as manual reviews, observations and reporting at the end of a shift - are insufficient to meet the demands of speed and accuracy in today's industrial service environment.

Business analytics offers a more formalised approach to performance monitoring and continuous improvement. But using analytics tools alone won't deliver the desired outcomes. If the analytics system is to be effective, staff must familiarise themselves with and have confidence in the system, KPI frameworks need to be applied appropriately and management needs to make decisions based on the information provided. Moreover, there should be a culture of transparency, accountability and data-informed decision-making throughout the organisation. In industrial diagnostic laboratories, inefficiencies can have a considerable impact. Slow turnaround times can affect clients' maintenance schedules and cause equipment downtime.

Analytical errors may lead to wrong maintenance actions, which may cause equipment breakdown and damage to reputation. Likewise, sample processing bottlenecks may result in wasted resources and reduced staff morale. These types of problems highlight the need to understand how business analytics can help such challenges to be organized, and the role of organisational factors in its adoption. This research is significant because it offers pragmatic and empirical evidence from laboratory operations, with verified statistical methodologies. It explores how the use of business analytics, KPI monitoring and operational efficiency management impact performance. The study's emphasis on the industrial laboratory setting provides valuable insights that managers, operations managers and analytic practitioners can use to enhance efficiency, decision-making and service delivery. What's more, increasing data-centric decision-making in industrial settings underlines the need to continually modernise information practices within laboratories.

Increasingly complex operations means that companies which successfully embed analytics at tactical, as well as strategic levels, will be well placed to meet the evolving needs of customers and industry. This not only drives short-term operational efficiency but also facilitates future growth and innovation. As a result, fostering an analytics culture that includes training, investment in technology and leadership support will be critical for laboratories to maintain a competitive edge in a data-driven industrial environment.

Objectives of the Study

The key aims of this study are:

- To map the existing workflow of CME Laboratories.
- To understand the critical factors that cause delays or inefficiencies in testing and reporting.
- To create efficiency performance measures using KPIs.
- To examine the role of analytics for efficiencies in turnaround time and productivity.
- To offer recommendations for improved decision-making and performance enhancement with business analytics

RESEARCH METHODOLOGY

Research Design

A descriptive approach was employed to understand employee perceptions and to examine the existing operational processes.

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Data Collection Methods

- **Primary data:** Obtained from a structured 30-question questionnaire with a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) sent to all employees using Google Forms. The questionnaire included questions related to: operational workflow, operational challenges, KPI use, analytics tool use, decision-making support and operational effectiveness.
- **Secondary Data**: Collected from peer-reviewed journals, research reports, industry reports, company reports and government and regulatory websites to support the primary data with relevant theoretical and contextual support.

Sample Size and Population

The convenience sampling method identified 110 employees from the test, quality control, administration and management divisions for the study. This represents a mix of laboratory technicians, analysts, quality control, supervisors, managers and administrators, capturing views from different levels of the organisation.

Constructs Measured:

Operational Efficiency (OE) - 6 items: Refers to perceptions of operational flow, coordination between departments, job clarity, communication and compliance with SOP.

Operational Challenges (OC) - 4 items: Measures perceptions of delays, bottlenecks, manual process interdependencies, and lack of automation.

KPI & Performance Monitoring (KPI) - 7 items: Measures the level of KPI measurement, turnaround time assessment, management review and monitoring using data.

Business Analytics Usage (BA) - 8 items: Measures adoption of analytics tools, predictive analytics, real-time analytics and data-driven decision-making and planning. Analytics'

Operational Impact (AI) - 5 items: Assesses improvements in service quality, efficiency, co-ordination and operational risk mitigation

Statistical Tools

Descriptive Analysis: Mean and standard deviations calculated for the 30 items to measure central tendency and dispersion

Cronbach's Alpha reliability analysis: Used to ensure reliability of constructs prior to inferential analysis.

Pearson correlation analysis: To test the presence and strength of the bivariate relationship between Business Analytics Adoption (BA) and Analytics Impact on Operations (AI).

Cross Tabulation Analysis: Cross tabulation analysis was used to display respondent's distribution across demographic categorical variables.

Multiple Linear Regression Analysis: A multiple linear regression was performed to examine the extent to which Operational Efficiency (OE), Operational Challenges (OC), KPI & Performance Monitoring (KPI) and Business Analytics Adoption (BA) are predictors of Analytics Impact on Operations (AI).

One Way ANOVA: ANOVA was used to test whether there are significant differences in average scores across demographic categories. Three ANOVA tests were performed. The Levene statistic was used to judge equality of variance. Post-hoc tests (Tukey's HSD) were carried out where appropriate

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Data Analysis and Interpretation

Demographic Analysis

The sample distribution suggests that this is a young workforce and at the beginning of their careers. Most (56.4%) are between the ages of 25-30, with 31.8% under 25 years old. A small percentage (10%) are in the 31-35 age group, and a very few are over 35. This age profile is in line with the company's formation in September 2024 and recruitment of young professionals to assist with its expansion.

As far as gender representation goes, 57.3% of the respondents are male, while 42.7% are female, indicating a slight male skew but otherwise an even gender representation. By designation, 32.7% are Laboratory Technicians and 27.3% are Laboratory Analysts. This is followed by Quality Control (14.5%), Supervisors (10.9%), Managers (8.2%) and Administrative personnel (6.4%)

This is significant, as it indicates most of responses are from the technical staff involved in laboratory workflows, testing and the use of analytics platforms. In terms of experience, over half (53.6%) of the sample has 1-3 years' experience, and 22.7% less than 1 year experience. This is consistent with the recent establishment of the organisation and suggests that many employees are still in the process of familiarising themselves with work processes and analytics tools.

This may in part explain the moderate neutral responses in some of the survey questions, as these may need more time and exposure to gain an understanding and become involved in performance monitoring approaches. In terms of department, the Testing department has the largest representation of respondents (44.5%), followed by Quality Control (25.5%), Management (20%) and Administration (10%).

This is a fair representation of the design of a condition monitoring laboratory where the bulk of the staff are involved in primary testing and analytical activities, which underpin its service.

Operational Efficiency Perceptions

In all six items of Operational Efficiency, respondents expressed agreement in the range of 53% to 72%, and neutrality in the range of 24% to 34%. This suggests that there is a general view of the workflow efficiency but not completely across the board. Respondents agreed that the process of receiving and registering samples is well organised ($M = 3.709$, $SD = 0.708$) with 57% of respondents agreeing that the early part of the workflow is quite well formalised.

The highest mean score in this construct was for the inter-departmental coordination process ($M = 3.855$, $SD = 0.776$), with 72% of respondents checking agreements or strongly agreeing, suggesting good coordination between different departments. Compliance with Standard Operating Procedures (SOP) scored the lowest among this category ($M = 3.645$, $SD = 0.724$).

While most employees reported that they adhere to procedures, the comparatively higher percentage of neutral responses implies that there may be a variance in the adherence to SOPs across different sections or levels of understanding among employees, especially new joiners. This highlights that better communication, reinforcement and training programs are required to ensure SOPs are consistently followed to enhance consistency and reliability in all testing and reporting processes.

Additionally, the differences in level of agreement and neutral responses indicate that while the fundamental operational processes are working well, there is an opportunity to increase the consistency of execution among teams and experience levels. Improving communication within the organisation, ensuring consistency in understanding of processes and reinforcing best practices through ongoing training can help address these. By bringing employee knowledge and practice closer to the established guidelines, the consistency of workflows and operational processes can be improved, resulting in more consistent and reliable results.

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Operational Challenges

The Operational Challenges construct presents employees' consistent identification of inefficiencies and bottlenecks in the laboratory processes. The absence of automation stood out as the most critical issue with 68% of respondents pointing to it as a source of operational inefficiency (M = 3.818, SD = 0.768).

This implies that manual procedures still constitute a significant constraint in present operational processes. In line with this, 67% of respondents identified bottlenecks in the operations that impact productivity (M = 3.800, SD = 0.764), while 73% acknowledged delays in sampling and testing processes (M = 3.773, SD = 0.738), confirming bottlenecks at the process level of the operation.

On the other hand, the high level of awareness of challenges among employees can be interpreted as a positive outcome. When they can identify and describe operational challenges, they will be well prepared to respond to solutions that address these challenges. In this regard, business analytics plays a crucial role, offering the methodologies to diagnose problems, track performance and implement changes to processes.

This willingness to embrace data-centred problem solving is also reinforced by the high levels of Business Analytics Adoption seen in Section 6.5; this shows that the organisation is ready to use analytics to improve its operations. Moreover, the uniformity in responses across the various challenges identified suggests that these are none of the problems are isolated, but instead reflect systemic process constraints.

They will need to be addressed through a holistic approach that integrates process redesign, automation and workflow streamlining. The organisation can improve productivity and eliminate bottlenecks by eliminating manual processes and streamlining key operational steps. This, in turn, will support the success of analytics projects, as these insights can be backed up by efficient operations at each step of the laboratory process.

KPI and Performance Monitoring

Attitudes towards the use of KPI and performance monitoring were overwhelmingly positive. This construct had the highest rating for the statement "monitoring operational data helps evaluate performance" (M = 3.845, SD = 0.732), with 72% agreeing with this statement.

This suggests employees understand the importance of monitoring data for measuring performance. Moreover, 76% of respondents rated KPI reviews by management as positive (M = 3.827, SD = 0.752), indicating that managers are highly engaged and committed to monitoring employee performance.

The notion that 65% of respondents recognised turnaround time (TAT) as a key performance indicator (M = 3.673, SD = 0.791) confirms that employees in a range of roles agree to the importance of TAT as one of the key indicators of quality service. Likewise, 67% of respondents agreed with the use of KPIs to identify improvement opportunities (M = 3.736, SD = 0.809).

Overall, these results suggest that formal KPI systems are well developed within the laboratory, and that both senior and junior staff perceive the use of KPIs as a valuable and beneficial approach to measure and assess how the laboratory operates, and identify opportunities for improvement.

Business Analytics Adoption

Business Analytics Adoption had the highest individual item mean of any construct measured in the study, specifically for the statement “data analysis reduces turnaround time” (M = 3.882, SD = 0.751); 73% of the respondents agreed. This is a critical perceived outcome, as turnaround time is one of the most visible and visible performance indicators to a client.

The high level of agreement indicates the association of employees between rapid turnaround and the use of data analysis, reflecting a tangible benefit resulting from investment in analytics for operational efficiency.

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Further, 67% of employees indicated support for using real-time analytics to speed up decision-making (M = 3.773, SD = 0.842) and 66% agreed that analytics facilitates planning and increases productivity (M = 3.709, SD = 0.734). Respondents indicated that predictive analytics for planning operations is recognised by management (68%, M = 3.727, SD = 0.728) and 66% agreed that management uses analytics for decision-making (M = 3.745, SD = 0.747).

Overall, these findings suggest that employees recognise the theoretical benefits of using analytics tools, and more importantly, are also gaining an appreciation of its application in practice in operational and managerial activities.

Analytics Impact on Operations

The Analytics Impact on Operations scale consistently demonstrated high agreement (between 52% and 69%) among respondents, suggesting that employees perceive various practical benefits associated with analytics in their workplace. 69% of respondents agreed that analytics enhances service quality (M = 3.764, SD = 0.765) - one of the highest perceived benefits. Likewise, 66% of respondents agreed that analytics identifies improvement opportunities (M = 3.673, SD = 0.718), indicating that employees perceive analytics as helping to improve processes.

Furthermore, 64% of respondents agreed that business analytics improves operational efficiency (M = 3.709, SD = 0.708), while 66% of respondents agreed that data-driven decision-making reduces risks (M = 3.764, SD = 0.765). Additionally, 66% of respondents felt that analytics improves inter-departmental coordination (M = 3.755, SD = 0.780), which suggests that it also has a positive effect on inter-departmental collaboration. These findings demonstrate the perceived value of analytics from an employee perspective as a source of many benefits, confirming its usefulness as a valuable operational resource.

The Pearson correlation coefficient (r = 0.921) between Business Analytics Adoption (BA) and Analytics Impact on Operations (AI) shows there is a strong positive association between the two.

Analysis

Correlations			
		Business Analytics Adoption (BA)	Analytics Impact on Operations (AI)
Business Analytics Adoption (BA)	Pearson Correlation	1	.921**
	Sig. (2-tailed)		.000
	N	110	110
Analytics Impact on Operations (AI)	Pearson Correlation	.921**	1
	Sig. (2-tailed)	.000	
	N	110	110

Interpretation

This means:

- The greater the degree to which business analytics is deployed and used within the laboratory, the more it will impact on operational performance (i.e., improve service quality, efficiency of work flow, co-ordination between departments and reduce risks associated with data-driven decision making) in a proportional way.
- Laboratory employees subjectively reporting a higher level of analytics usage also report better improvements across all dimensions of Analytics Impact, suggesting that the investment in analytics capabilities results in tangible improvements in operational performance.
- The correlation is statistically significant at the 0.01 level (Sig. = 0.000, two-tailed); this means that the results can be interpreted at 99% confidence, and this is one of the most robust findings in the analysis.

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- The sample size (N = 110) allows better statistical power than alternative studies with smaller sample sizes, which adds to the credibility and relevance of the results to organisational practice.

This is the highest correlation in the study (even higher than Operational Efficiency and KPI monitoring; r = 0.960 for OE-KPI; r = 0.921 for BA-AI), and demonstrates that the use of business analytics is a major source of operational impact. In contrast to the low significance reported in organisations with small sample sizes or low adoption of analytics, this finding (with a sample of 110) provides statistically strong support for the positive contribution of business analytics to operational performance in the laboratory service sector.

Analysis

Construct	No. of Items	Cronbach's Alpha (α)	Interpretation	Status
Business Analytics Adoption (BA)	8	0.903	Excellent	Excellent
Analytics Impact on Operations (AI)	5	0.840	Good	Good

Interpretation

All five constructs showed uniform internal steadiness because the numbers were high. A Cronbach's Alpha (α = 0.903) which represents "Excellent" dependability was gained by Business Analytics Adoption (BA). Good dependability was found in Operational Efficiency (α = 0.875), KPI & Performance Monitoring (α = 0.893), Analytics Impact on Operations (α = 0.840), and Operational Challenges (α = 0.817). It has been observed that the set of research questions is dependable and fits for statistical purposes.

- The five constructs demonstrate strong internal steadiness because the answers from the individuals taking the survey are uniform which means the items measure the same variables.
- Business Analytics Adoption (α = 0.903) shows excellent outcomes which suggests that the calculation of data analytics adoption is extremely dependable. Dependability in the "good" range was also measured for Operational Efficiency (α = 0.875), KPI & Performance Monitoring (α = 0.893), Analytics Impact on Operations (α = 0.840), and Operational Challenges (α = 0.817).
- Many people believe that the lack of low scores shows that the individuals taking the survey did not have misinterpretations of the questions when they were reading them.
- High dependability for these constructs causes more confidence because the collected information is valid and the relationships between variables are not false.
- Statistical validity was proven for the set of research questions used in this academic inquiry, and the tool can be used for correlation and hypothesis testing.
- Because the Cronbach Alpha (α) scores are high, the research outcomes are seen as valid and reflecting the real world.
- Dependability and stability of the measuring tool are established by the high internal steadiness shown in the five constructs.
- Business Analytics Adoption has the highest Cronbach's Alpha (α) value of 0.903, which is "excellent" dependability, while the other groups including Operational Efficiency (α = 0.875), KPI & Performance Monitoring (α = 0.893), Analytics Impact on Operations (α = 0.840), and Operational Challenges (α = 0.817) have "good" dependability.

Experts claim that the questions are closely related and capture the constructs without big errors because the dependability is high. This dependability allows for the investigation of relationships between variables using statistical methods when measurement error is not found. The set of research questions was found to be appropriate for the academic inquiry of business analytics impact on operations which gives assurance for the outcomes of this research.

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Hypotheses for the Study

H_1: The adoption of business analytics is positively related with Operational Efficiency. Tested via Pearson correlation ($r = 0.950$, $p < 0.01$)

H_2: There is a significant positive relationship between KPI & Performance Monitoring and Operational Efficiency. Tested via Pearson correlation ($r = 0.960$, $p < 0.01$)

H_3: KPI & Performance Monitoring and Operational Efficiency together significantly predict Analytics Impact on Operations. Tested via Pearson correlation ($r = 0.921$, $p < 0.01$)

H_4: Operational Efficiency, Operational Challenges, KPI & Performance Monitoring and Business Analytics Adoption predict Analytics Impact on Operations. Tested via multiple regression ($R^2 = 0.878$, $F(4,105) = 188.16$, $p < 0.001$)

H_5: Operational Efficiency significantly positively predicts Analytics Impact on Operations, controlling for other factors. Regression coefficient: $\beta = 0.332$, $t = 2.459$, $p = 0.016$

H_7: Operational Challenges (aware of bottlenecks/manual processes) is a significant positive predictor of Analytics Impact on Operations when controlling for other factors. Regression coefficient: $\beta = 0.342$, $t = 2.700$, $p = 0.008$

H_7: Business Analytics Adoption is a significant positive predictor of Analytics Impact on Operations when controlling for other factors. Regression coefficient: $\beta = 0.304$, $t = 2.339$, $p = 0.021$

H_8: There are significant differences in perceptions of Analytics Impact across departments (Quality Control, Testing, Administration, Management). One-way ANOVA ($F = 0.552$, $p = 0.648$) - did not reject null, no difference, therefore consistent.

DISCUSSION

This study offers a statistically significant view of the relationship between business analytics' adoption and operational efficiency in an industrial diagnostic laboratory. The descriptive statistics for the construct mean (all within a fairly tight range of 3.645 to 3.882 on a 5-point Likert scale) suggest a high level of agreement among respondents. This implies that the analytics adoption, the monitoring of key performance indicators (KPIs) and the design of operational processes together are having a positive impact on the operational outcomes.

The Pearson correlation between Business Analytics Adoption and Analytics Impact on Operations ($r = 0.921$, $p < 0.01$) is by far the most significant finding of this research. It shows analytics practices are not simply a complementing capability but also an enabler of operational performance. This result is consistent with previous research, such as Saleh et al. (2023), which demonstrate the use of predictive analytics in reducing process inefficiencies and improving planning and budget process accuracy, and Singh et al. (2024), who concluded that industrial testing organisations adopt structured analytics frameworks to gain stronger operational control and improved service quality.

The increased awareness of operational inefficiencies - such as lack of automation, consideration of process bottlenecks and execution of workflow in a timely manner - should not be seen as a signal of organisational lack of efficiency. Rather, in the context of this research, it suggests that employees are "analytics-aware" and able to accurately identify sources of operational discontent. A recognition of these concerns is a critical aspect of analytics adoption. A workforce that understands these issues is more likely to use analytics tools to provide solutions to problems as they arise, which in part explains the high correlation between Business Analytics Adoption and Analytics Impact.

The relative frequency of neutral responses in aspects such as SOP compliance ($M = 3.645$) and communication of performance metrics ($M = 3.645$) suggests that while the formal systems are in place, there could be

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inconsistencies in their daily practice. This is likely due to the organisation being in its early years and a workforce that is predominantly in the early years of their career, and still learning about operational processes and performance measurement systems. Overcoming this gap through targeted SOP communication and training programs in the use of analytics tools would likely improve consistency and further improve the success of existing analytics initiatives.

The strong correlations between all five of the constructs ($r = 0.911$ to 0.960) show that operational efficiency, KPI tracking, analytics support, dealing with operational problems and analytics impact are not individual variables, but are intricately linked and part of an analytics-driven system. This has a critical implication for organisations seeking to fully exploit the potential of analytics: they cannot completely benefit from analytics by addressing one aspect at a time. Rather, continuous improvements in operational performance require holistic improvements across these dimensions

CONCLUSION

This research offers valid, empirical evidence on the use of business analytics for enhancing operational efficiency in an ISO 17025-certified industrial diagnostic laboratory. The significant Pearson correlation ($r = 0.921$, $p < 0.01$) between Business Analytics Adoption and Analytics Impact on Operations using 110 employee responses provides statistically valid evidence that adoption of structured analytics delivers benefits in terms of improved service quality, turnaround time, co-ordination across departments, and operational risk.

The results suggest that CME Laboratories Bharat Pvt. Ltd. has a strong operational and analytics process. This is evident from the high awareness of KPIs ($M = 3.827$ for management KPI review), favourable attitudes of employees about the advantages of analytics, effective communication and coordination between departments, as well as management's interest in performance monitoring.

Interestingly, the highest item mean in the study, "data analysis reduces turnaround time" ($M = 3.882$), indicates that employees tend to link the use of analytics with turnaround time - the most important performance indicator in a laboratory from a client perspective. There are, however, some areas for improvement. Specifically, improving the communication of SOPs, higher levels of automation in manual processes, and a structured analytics training and onboarding process for new employees will be key in improving the way how analytics capabilities are used to consistently meet organisational performance objectives.

This is crucial to reinforce favourable views currently held by the workforce so that they are more consistently spread across various job roles, functions and hierarchical levels. In the future, as CME Laboratories serves more clients, and with increasing volumes of tests, the urgency to improve speed, accuracy, and reporting times will be elevated.

In this regard, the establishment of a well-developed, data-driven operational culture in which analytics is embedded across the entire process, from sample to information and strategic decisions, will be essential. This will be a differentiating factor, helping the organisation to maintain its high levels of performance and deliver positive outcomes in the challenging industrial testing market in Chennai.

Suggestions

This study suggests the following recommendations for improving the adoption of business analytics, and operational efficiency, at CME Laboratories Bharat Pvt. Ltd.

Implement real-time analytics dashboards and monitoring tools that provide real-time insights into key operational indicators including sample testing volumes and queues, turnaround time performance, and workload balance across departments. This real-time visibility will enable managers to identify and resolve bottlenecks as they arise, thereby preventing delays in servicing clients.

Enhance SOP communication and compliance by introducing onboarding programs, visual SOP guidelines at the workbench and regular SOP audits. Given that SOP compliance had the lowest mean in the Operational

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Efficiency construct, targeted improvements in this domain can go a long way towards improving the consistency and reliability of laboratory processes.

Prioritise the automation of manual processes in areas like sample registration, testing processes and reporting. Not only does automation reduce potential errors and processing times, but also allows technical staff to focus on more complex analysis activities. The high level of employee consensus on the need for more automation (M = 3.818 for "lack of automation contributes to inefficiencies") also emphasises this as a key investment area.

Create and roll out a company-wide analytics literacy initiative that trains all staff, from lab technicians to executives, in the analysis and interpretation of operational data and in the use of KPI dashboards, and engage them in data-driven improvement projects.

Adopt a formal KPI review cycle that includes documented review results, corrective actions and follow-up reviews. While the survey demonstrates the KPIs are already being tracked (M = 3.827), by providing more structure and accountability, KPI insights will be consistently translated into operational improvements.

Encourage inter-departmental data sharing and regular analytics discussions to capitalise on the close relationships identified among operational factors. Given that improvement in one factor has a positive impact on others, promoting structured discussions between departments will encourage more rapid improvement in the entire organisation's performance and improved analytics-driven decision-making in all areas.

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