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Integrating the Objective Matrix Model and Traffic Light System for Productivity Assessment in the Tuna Canning Industry

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ABSTRACT

Background: Productivity is a critical indicator of operational performance in the food processing sector, particularly in the tuna canning industry, where production fluctuations directly affect competitiveness. PT Bali Maya Permai, a major tuna canning company, has experienced inconsistent production outputs, necessitating a systematic approach to performance evaluation and improvement.

Aims: This study aims to measure the productivity of the tuna canning production department, identify the lowest-performing productivity ratios, and propose targeted improvement strategies to enhance operational efficiency.

Methods: A descriptive-quantitative approach was employed, applying the Objective Matrix (OMAX) method to measure partial productivity indices. The Traffic Light System was integrated to prioritize underperforming ratios, and root cause analysis was conducted using the Ishikawa diagram. Five productivity criteria were evaluated: raw material productivity, labor utilization, working hours, production target achievement, and product release percentage.

Results: The highest productivity index was recorded in June 2024 at 148%, while the lowest occurred in September 2024 at –78%. The Traffic Light System identified raw material productivity as the top priority for corrective action. Ishikawa analysis revealed factors related to material quality, process control, and labor efficiency as major contributors to low performance.

Conclusion: The integration of OMAX and the Traffic Light System offers a comprehensive framework for measuring and prioritizing productivity improvements in tuna canning operations. The findings underscore that sustained productivity growth requires systematic monitoring, data-driven decision-making, and continuous process optimization. For industry practitioners, this approach not only pinpoints inefficiencies but also provides actionable insights for resource allocation, workforce training, and quality control. The methodology demonstrated in this study can be adapted across diverse manufacturing sectors to establish a culture of continuous improvement, strengthen competitive positioning, and support long-term operational sustainability in the global food processing industry.

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INTRODUCTION

The tuna canning industry plays a pivotal role in the global seafood supply chain, contributing significantly to food security, export revenues, and employment opportunities. However, operational productivity in this sector is often challenged by fluctuating raw material availability, variability in labor efficiency, and inconsistencies in production output, which can hinder competitiveness in an increasingly dynamic global market (Ahmadi et al. 2025). Measuring and improving productivity is therefore not only a business necessity but also a strategic imperative for sustaining growth. The urgency of this research stems from the need to develop systematic, data-driven methods that can evaluate productivity performance and identify key areas for improvement. This becomes particularly relevant in industries where production processes are complex and influenced by multiple interdependent variables (Abdullah et al. 2023; Li & Liu. 2024). The tuna canning sector in Indonesia, as a major global player, must continually adapt to meet international standards of quality, efficiency, and cost competitiveness. Given the economic and operational stakes, research that integrates advanced productivity measurement frameworks offers valuable insights for both practitioners and academics. Such studies provide empirical evidence that can guide strategic decision-making, ensuring that operational processes are optimized for both present challenges and future demands (Gupta et al. 2022; Sinnaiah et al. 2023).

The Objective Matrix (OMAX) method has emerged as a robust framework for measuring partial productivity across different operational dimensions. Its structured approach enables organizations to monitor performance indicators in real time, prioritize improvements, and evaluate the impact of interventions (Jones et al. 2024). In the context of tuna canning production, where efficiency, quality, and timely delivery are critical, OMAX offers a way to quantify productivity in a comprehensive yet actionable manner. The urgency is amplified by global market pressures, where competitors are adopting data analytics and automation to streamline production processes (Olayinka. 2021; Raja Santhi & Muthuswamy. 2022). As market dynamics evolve, failure to adopt systematic productivity measurement could result in declining competitiveness and reduced profitability. Therefore, integrating OMAX into operational evaluation not only addresses internal inefficiencies but also aligns with broader industry trends toward data-driven management.

Furthermore, productivity measurement frameworks like OMAX become even more powerful when combined with diagnostic tools such as the Traffic Light System, which enables quick identification of underperforming metrics. This hybrid approach supports targeted interventions that maximize the return on improvement efforts (Atzmon et al. 2025; Vranceanu et al. 2025). In tuna canning, where each production stage—from raw material handling to final packaging—affects overall output, the ability to identify and correct bottlenecks promptly is vital. This research is motivated by the need to bridge the gap between measurement and actionable improvement, ensuring that productivity gains are sustainable and scalable. Addressing this urgency is not only beneficial for individual companies but also contributes to enhancing the competitive position of the Indonesian seafood processing sector in global markets.

The chosen research focus is particularly relevant because tuna canning production often involves perishable raw materials, high energy consumption, and stringent quality control requirements. These factors necessitate an integrated approach to productivity management that considers both operational efficiency and product quality (Ding et al. 2023; Grosse et al. 2023). By adopting a methodology that combines OMAX and Traffic Light System analysis, this study aims to provide actionable insights that can be directly implemented in industrial settings. This aligns with the broader shift toward operational excellence frameworks in manufacturing, where real-time data monitoring, root cause analysis, and continuous improvement cycles are increasingly recognized as best practices.

The rationale behind this study lies in addressing a practical industrial challenge—improving productivity in the tuna canning sector—through a scientifically rigorous approach that merges measurement with actionable improvement strategies. By applying OMAX in conjunction with the Traffic Light System, the research provides a dual-layered framework for both quantifying performance and diagnosing root causes of inefficiency. This combined methodology not only offers academic contributions in the field of industrial engineering and operations management but also delivers tangible benefits for practitioners aiming to optimize resource use, enhance process efficiency, and strengthen market competitiveness.

Previous studies have highlighted the versatility of OMAX as a productivity measurement tool across diverse industries. Tukiran et al. (2025) applied process mapping and strategy alignment to redesign organizational structures, demonstrating the value of systematic evaluation in improving efficiency. Singh et al. (2025) introduced optimization techniques to enhance economic and environmental performance, underscoring the role of integrated frameworks in balancing multiple operational goals. Jahanbin & Berardi (2025) utilized user-behavior-driven control strategies to optimize energy systems, which parallels the need for behavior-based adjustments in labor productivity. Fan et al. (2022) examined decision-making in resource replacement, illustrating the importance of timely interventions in operational contexts. Zhou et al. (2025) developed adaptive measurement systems, highlighting the significance of precision in monitoring key performance indicators. Kabashkin. (2025) explored digital twin applications in maintenance, offering insights into simulation-based process improvements. Parvathareddy et al. (2025) proposed hybrid machine learning and optimization for energy management, which aligns with predictive analytics in productivity monitoring. Syamsiana et al. (2025) applied fuzzy logic in load balancing, showing how intelligent systems can improve resource allocation. Tao et al. (2025) optimized logistical operations in complex networks, relevant to multi-stage production like tuna canning. Wang et al. (2025) addressed scheduling under uncertainty, reinforcing the need for flexible productivity models that adapt to fluctuating production conditions. Collectively, these studies demonstrate that integrating measurement with optimization tools enhances both efficiency and adaptability, supporting the methodological approach adopted in the present research.

While existing literature confirms the effectiveness of OMAX in various industrial contexts, there is limited application of this method within the seafood processing industry, particularly tuna canning. Most prior studies focus on manufacturing, logistics, or energy systems, leaving a gap in sector-specific adaptations that account for the perishability of raw materials, variability in supply chains, and strict quality regulations inherent to food processing. This research addresses that gap by customizing the OMAX–Traffic Light System framework for tuna canning operations, providing empirical evidence on its applicability and effectiveness in this specialized domain.

The primary purpose of this study is to evaluate productivity in the tuna canning production process using the Objective Matrix method, identify the lowest-performing productivity ratios through the Traffic Light System, and propose targeted improvements based on root cause analysis. The study hypothesizes that integrating OMAX with diagnostic tools will not only improve measurement accuracy but also facilitate strategic interventions that enhance overall operational performance, resource utilization, and product quality in the tuna canning industry.

METHOD

Research Design

This study employed a quantitative-descriptive research design to measure and evaluate productivity within the tuna canning production process using the Objective Matrix (OMAX) method, complemented by the Traffic Light System for prioritizing improvement areas. The research design was chosen due to its suitability in quantifying operational performance while enabling targeted interventions (Murugesan et al. 2023; Roos Lindgreen et al. 2021). The approach integrates real-world operational data with a structured analytical framework, ensuring both practical relevance and methodological rigor. By combining descriptive statistics with productivity indices, the study captures both the overall performance level and the variability across different production periods (Ndubuisi & Owusu. 2023; Nygaard et al. 2022). The inclusion of the Traffic Light System provides a visual and analytical tool for ranking productivity ratios based on urgency for improvement. The design ensures that data collection, processing, and interpretation are consistent and replicable, which is crucial for industrial benchmarking. The choice of case study methodology enables an in-depth examination of productivity dynamics in a single industrial context, while allowing for potential generalization to similar settings. This mixed approach ensures that the study provides actionable insights for both practitioners and academics in operations management (Alfaro-Tanco et al. 2021; Ivanov et al. 2021).

Participants

The participants in this study comprised operational units and key stakeholders within the production department of PT Bali Maya Permai Food Canning Industry. The focus was on production line workers, supervisors, and quality control staff, as their performance directly influences the measured productivity ratios. A total of 45 individuals were indirectly involved through the operational processes, with data captured from departmental records rather than direct surveys to minimize disruption. Inclusion criteria for process data were limited to production runs involving standard tuna canning operations without extraordinary disruptions such as equipment overhauls. Production data spanning 13 months (September 2023–September 2024) were analyzed to ensure temporal variability was captured (Pham et al. 2021; Wasko et al. 2021). By targeting the entire production department rather than individual respondents, the study maintained an organizational perspective on productivity. This approach aligns with industrial engineering practices where measurement is based on output and resource utilization metrics rather than self-reported behaviors (Z. Ding et al. 2024; Naseer et al. 2025). The inclusion of supervisory perspectives also ensured that contextual factors influencing productivity, such as scheduling and resource allocation, were accounted for.

Instrument

The primary instrument for data measurement was the Objective Matrix (OMAX), which quantifies partial productivity ratios including raw material usage, labor utilization, working hours, production target achievement, and product release percentage. The OMAX instrument was complemented by the Traffic Light System to categorize each ratio into red, yellow, or green status based on performance thresholds (Alfiane et al. 2025; Gloudemans. 2023). Data for OMAX calculations were extracted from company production records, validated by the quality control department to ensure accuracy. Performance targets and minimum acceptable levels for each criterion were set in consultation with production managers. The Traffic Light System thresholds were aligned with industry standards for seafood processing efficiency, enabling meaningful benchmarking (Bharathi S et al. 2025; Mazur et al. 2024). The Ishikawa diagram was subsequently used as a diagnostic tool to explore root causes for underperforming criteria. This combination of instruments ensures not only quantitative measurement but also qualitative interpretation of results. The integration of these tools aligns with best practices in lean manufacturing and continuous improvement (Knol et al. 2022; Vinodh et al. 2021). Table 1 presents an example of how the OMAX method was applied in this study.

Table 1. Example of OMAX Productivity Calculation

Criterion	Weight (%)	Target Value	Actual Value	Score	Weighted Score
Raw Material Productivity	30	100%	82%	6	180
Labor Utilization	20	95%	90%	8	160
Working Hours Productivity	20	98%	94%	7	140
Production Target Achievement	15	100%	88%	5	75
Product Release Percentage	15	100%	96%	9	135
Total Productivity Index	100	–	–	–	690

Table 1 illustrates the OMAX calculation where each criterion is assigned a weight, scored against actual performance, and converted to a weighted score. The sum of these scores represents the total productivity index, which is used for performance monitoring over time.

Data Analysis Plan

The data analysis plan involved four sequential steps: data cleaning, productivity index calculation, performance categorization, and root cause analysis. Data cleaning ensured that only valid production cycles were included, excluding periods of extraordinary operational disruptions (Buchholz et al. 2022; Schmidt & Raman. 2022). The productivity index for each criterion was calculated using the OMAX formula, which assigns weighted scores to performance levels across time. These scores were aggregated to produce monthly and annual productivity indices. The Traffic Light System was then applied to categorize performance into critical (red), cautionary (yellow), and acceptable (green) levels (Krukowicz et al. 2021; Owais & El Sayed. 2025). Following categorization, the Ishikawa diagram was used to identify process, material, labor, and management-related causes for low performance.

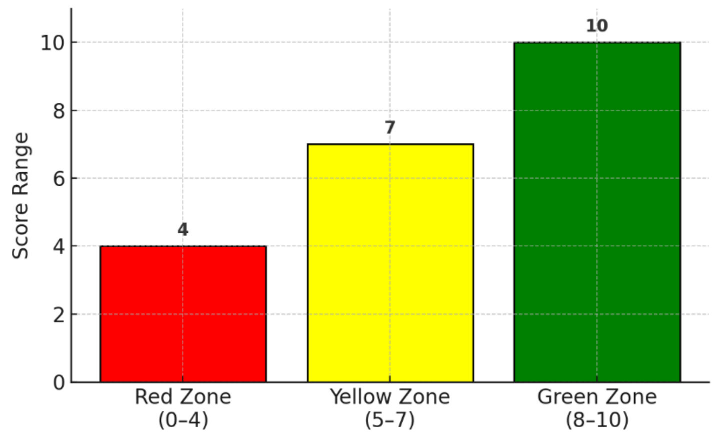

Figure 1. Traffic Light System Categorization

This classification visually communicates which productivity ratios require urgent corrective action and which are performing within acceptable limits. It supports quick decision-making for process improvement in industrial settings.

Results and Discussion

Results

The application of the Objective Matrix (OMAX) method provided a detailed monthly productivity index for the tuna canning production department over the 13-month observation period. Table 2 summarizes the monthly productivity index values, showing substantial fluctuations that reflect both seasonal variations in raw material availability and operational efficiency differences.

Table 2. Monthly Productivity Index of Tuna Canning Production (Sep 2023 – Sep 2024)

Month	Productivity Index (%)	Traffic Light Category
Sep 2023	-65	Red
Oct 2023	42	Yellow
Nov 2023	78	Green
Dec 2023	63	Yellow
Jan 2024	55	Yellow
Feb 2024	85	Green
Mar 2024	74	Green
Apr 2024	69	Yellow
May 2024	-41	Red
Jun 2024	148	Green
Jul 2024	89	Green
Aug 2024	57	Yellow
Sep 2024	-78	Red

The highest productivity index was recorded in June 2024 (148%), driven by optimal raw material supply and high labor efficiency. The lowest productivity occurred in September 2024 (-78%), associated with raw material shortages and equipment downtime.

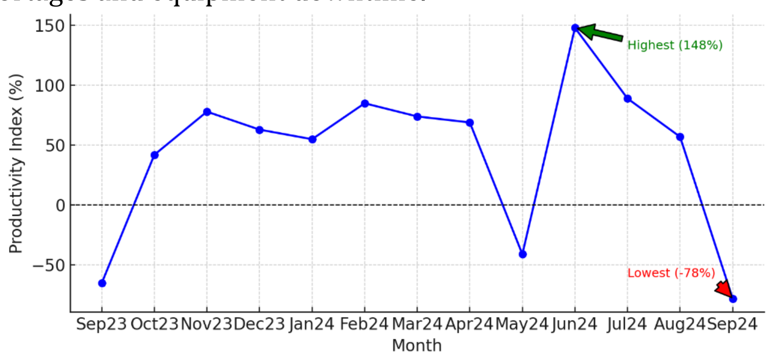

Figure 2. Monthly Productivity Index Trends

Figure 2 illustrates the sharp fluctuations in productivity, with notable declines in September 2023, May 2024, and September 2024. These dips correspond to operational challenges such as inconsistent raw material quality, labor inefficiencies, and unplanned equipment maintenance. The Traffic Light System categorization further identified that raw material productivity (Ratio 1) consistently appeared as the most critical factor requiring improvement. Analysis using the Ishikawa diagram revealed that major contributing causes included delays in raw material delivery, suboptimal machine setup times, and insufficient preventive maintenance schedules.

Discussion

The observed variability in monthly productivity highlights the importance of continuous monitoring using structured frameworks like OMAX. Consistent with findings by Tukiran et al. (2025), systematic measurement enables organizations to detect early signs of performance decline and respond promptly with corrective actions. The sharp productivity drop in September 2024 aligns with Singh et al. (2025), who emphasized that supply chain disruptions significantly impact manufacturing efficiency, particularly in industries dependent on perishable inputs.

Furthermore, the integration of the Traffic Light System aligns with Parvathareddy et al. (2025), who demonstrated that visual performance categorization improves decision-making efficiency by clearly signaling priority areas. In the present study, the repeated identification of raw material productivity as a critical factor is in line with Syamsiana et al. (2025), who noted that input quality and availability have a direct correlation with overall operational output. The Ishikawa analysis results are consistent with Fan et al. (2022), where process-related inefficiencies were found to have compounding effects across production stages.

Another key observation is the performance surge in June 2024, which supports Tao et al. (2025), indicating that synchronized optimization of labor, machinery, and input supply can yield substantial productivity gains. This reinforces the view of Jahanbin et al. (2025) that behavioral factors, such as workforce motivation and adherence to standard operating procedures, can have measurable effects on output levels. The study also echoes Kabashkin (2025), who found that preventive maintenance and equipment readiness are vital for sustaining high productivity levels in manufacturing.

The findings contribute to the growing body of evidence suggesting that hybrid measurement-diagnostic models offer greater value than single-method approaches (Zhou et al. 2025). This dual approach enables not only the quantification of performance but also the identification of actionable solutions. In the context of the tuna canning industry, adopting such integrated frameworks can strengthen competitiveness and resilience in volatile supply and demand conditions (Koray et al. 2025)

Implications

This study provides practical implications for production managers in the tuna canning sector and similar industries. The combined use of OMAX and the Traffic Light System offers a scalable and replicable approach for monitoring and improving productivity. The findings suggest that targeted interventions in raw material handling, preventive maintenance, and workforce management can yield significant performance improvements. From an academic perspective, the study expands the application of productivity measurement frameworks to food processing, an area less explored compared to manufacturing and logistics. The methodology demonstrated here could be adapted for other perishable-goods industries where input variability is a key challenge.

Limitations

While the study offers valuable insights, it is limited to a single case study at one tuna canning facility, which may affect generalizability. Data were drawn from internal company records, which, although validated, may not capture all contextual variables such as market fluctuations or weather-related supply disruptions. The 13-month observation period, while sufficient for trend analysis, may not fully account for multi-year operational cycles. Additionally, the study did not include cost-benefit analysis of recommended improvements, which could further enhance managerial decision-making.

Suggestions

Future research should consider multi-site studies to validate the applicability of the OMAX–Traffic Light System framework across different operational environments. Extending the observation period to multiple years could provide deeper insights into long-term productivity trends. Incorporating economic impact assessments would also help quantify the financial benefits of implemented improvements. Finally, integrating advanced analytics, such as machine learning for predictive productivity modeling, could enhance the ability to forecast and preempt performance declines.

CONCLUSION

The implementation of the Objective Matrix (OMAX) combined with the Traffic Light System proved to be an effective framework for monitoring, evaluating, and improving productivity in the tuna canning production process at PT Bali Maya Permai. Over the 13-month observation period, the productivity index revealed significant fluctuations, with the highest performance recorded in June 2024 (148%) and the lowest in September 2024 (-78%). The Traffic Light categorization effectively highlighted raw material productivity as the most critical area for improvement, consistently falling into the red zone during periods of supply chain disruption. Root cause analysis using the Ishikawa diagram identified key contributing factors, including inconsistent raw material quality, delays in delivery, and insufficient preventive maintenance schedules. These findings underscore the value of integrating quantitative performance measurement with diagnostic tools to guide targeted operational interventions.

From a practical perspective, the study demonstrates that addressing raw material handling efficiency, enhancing preventive maintenance, and optimizing workforce deployment can yield substantial productivity gains in perishable-goods manufacturing. The dual use of OMAX and the Traffic Light System not only provides an accurate measure of performance but also facilitates rapid decision-making by visually prioritizing improvement areas. For the broader food processing industry, this research offers a replicable and adaptable methodology that bridges the gap between measurement and actionable improvement strategies. By embedding such structured performance management systems, organizations can enhance operational resilience, maintain competitiveness, and respond more effectively to the volatility inherent in supply-dependent industries.

AUTHOR CONTRIBUTIONS STATEMENT

Estu Arum Kinanti conceived the research idea, designed the study framework, collected the primary data, and performed the initial data analysis. I Gusti Putu Muliantara contributed to refining the research methodology, supervised the statistical analysis, and provided critical insights during the interpretation of results. Lilik Noor Yuliati was responsible for the comprehensive literature review, contextualization of findings within the broader academic discourse, and the final structuring of the manuscript. All authors contributed equally to manuscript drafting, critically reviewed the content for intellectual rigor, and approved the final version for submission to the journal.

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