

Optimizing Supply Chain Performance: A Performance Prism Analysis of Goods Receipt in Semiconductor Manufacturing

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Abstract

This study analyzes the goods receipt process performance at a semiconductor manufacturing company facing issues with process failures and inaccurate goods handovers, resulting in significant losses. Also, the company has never applied a comprehensive and structured performance measurement method to the goods receipt process. Using Performance Prism and Analytical Hierarchy Process (AHP) methods, 23 Key Performance Indicators (KPIs) were identified from three stakeholder groups: internal customers, receiving staff, and suppliers, categorized into five Performance Prism perspectives. Data collected through interviews was analyzed using Objective Matrix (OMAX) and Traffic Light System (TLS). Results show the current goods receipt process performance is in the yellow category, with a value of 3.66 and a score of 6, indicating adequate but improvable performance. The semiconductor manufacturing company needs to focus on enhancing KPIs in the yellow and red categories to achieve optimal performance. Recommendations include conducting periodic evaluations and improving communication systems between stakeholders to address these performance issues and minimize losses.

Keywords: Performance Measurement, Goods Receipt, Performance Prism, Multi-criteria Decision

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INTRODUCTION

In today's globalized and competitive business environment, effective supply chain management is crucial for success (Warastuti & Rahmaini, 2021). A company's success is determined not only by the quality of its products or services but also by its ability to optimize internal processes, particularly within the supply chain. One critical component of this is the "goods receipt" process, which is fundamental to supply chain and warehouse management. It lays the groundwork for subsequent activities (Rushton et al., 2014) and ensures smooth business operations (André Regis Oliveira & Maria Guerra Bezerra Chaves, 2018; Singgih et al., 2019). Accurate receipt of goods is necessary to prevent disruptions in subsequent phases (Hudori, 2016; Kulińska & Giera, 2019) and to satisfy internal stakeholders. This process involves several key steps, including delivery appointments, unloading, inventory updates, and quality inspections, all of which are crucial for efficient storage and overall operational effectiveness (Carel et al., 2024; de Oliveira et al., 2022).

A semiconductor manufacturing company, a key player in the industry since 1996, operates 17 production facilities across 19 global locations, including Batam. Recently, it encountered significant issues with the goods receipt process, particularly regarding staff contributions during the handover to internal customers. For instance, a delivery meant for a specific customer was mistakenly sent to the wrong one, resulting in a loss of high-value goods for over two months. This incident highlights failures in the goods handover process, which can lead to substantial losses in costs, time, and resources, thereby impacting overall company performance. In addition to these problems, the company has also never assessed the performance of the goods receipt process, so it cannot evaluate the overall performance of the process.

To address these issues, a thorough analysis of the goods receipt process is necessary, involving all stakeholders, including customers/internal (end users), employees (receiving staff) and suppliers, using Performance Prism framework. This method emphasizes stakeholder involvement and aims to foster reciprocal relationships (Legaretsa & Purnamawaty, 2021), enhancing synergy in goods receipt performance. In addition, in the research of Novita et al., (2021), it is stated that performance measurement using Performance Prism provides benefits that can pay maximum attention to various sides and stakeholders, provide a realistic picture of company performance, and show weaknesses in several performance indicators as a basis for setting improvement efforts. This analysis will be enhanced by employing an Analytical Hierarchy Process (AHP) for prioritizing indicators (Cahyadi & Aziz, 2022; Tarigan, et al., 2024), OMAX for specific performance evaluation (Ayusita Wardhani, 2022), and a Traffic Light System (TLS) for easy result interpretation (Afifah et al., 2022; Subhan et al., 2022).

RESEARCH METHOD

In this study, the researcher employed a qualitative approach using in-depth interviews with staff involved in the goods receipt process and observations to gain comprehensive insights. Non-probability sampling, specifically purposive sampling, was utilized due to the uncertain population size (Amin et al., 2023). Data collection methods combined observation and interview techniques to enhance research conduct, facilitate interpretation, and gather relevant data. The Analytical Hierarchy Process (AHP) was employed quantitatively to determine the relative importance of process aspects (Devano et al., 2023), while the Objective Matrix (OMAX) and Traffic Light System (TLS) were used to measure and visualize performance results (Subhan et al., 2022). This integrated approach provided a comprehensive understanding of the semiconductor manufacturing company's goods receipt process performance, supporting improvement recommendations and strategic decision-making to optimize company performance.

RESULTS AND DISCUSSION

Identification of Stakeholders

The Performance Prism method identifies 5 stakeholder groups, namely investors, owners, suppliers, customers, and employees (Kusuma & Sulindawati, 2023). However, in this study, the authors have identified the semiconductor manufacturing company's stakeholders involved in the goods receipt process there are 3 stakeholder groups by utilizing the Performance Prism method through a series of observations and interviews. Stakeholders identified include: Customers/ Internal (End Users), Employees (Receiving Staff) and Supplier.

Identification of Key Performance Indicator (KPI)

The results of KPI identification in each perspective in the Performance Prism framework can be seen in Table 1. The identification of Key Performance Indicators (KPIs) for the goods receipt process resulted in 23 tailored metrics across three stakeholder categories: customers/internal end users and receiving staff each received 8 KPIs, while suppliers were assigned 7 KPIs. These metrics were based on five criteria: satisfaction, strategy, process, capability, and contribution.

Table 1. Key Performance Indicator (KPI) of Each Stakeholder

Criteria	Stakeholder		
	Customers/ Internal (End Users)	Employee (Receiving Staff)	Supplier
Stakeholder Satisfaction	Level of conformity of received products (KPI 1)	Convenience at work (KPI 9)	Quality of ordered products (KPI 17)
	Quick handling of complaints (KPI 2)	Giving appreciation to employees (receiving staff) (KPI 10)	Sustainable partnership relationship (KPI 18)
Strategy	Communication between customers / internal (end users) and employees (receiving staff) (KPI 3)	Training and development of employees (receiving staff) (KPI 11)	Communication between suppliers and employees (receiving staff) (KPI 19)
	Responsiveness of the goods handover process (KPI 4)	Level of provision of supportive work facilities (KPI 12)	
Process	Openness of communication patterns (KPI 5)	Planning of training and development programs for employees (receiving staff) (KPI 13)	Probability of miss communication occurring between employees (receiving staff) and suppliers (KPI 20)
	Mechanism of goods handover process (KPI 6)	Coordination of equipment use that receiving staff need (KPI 14)	Accuracy of product specifications and delivery schedules from suppliers (KPI 21)
Capability	Number of customer/internal (end users) complaints resolved (KPI 7)	Provision of facilities for employee (receiving staff) training and equipment procurement (KPI 15)	Percentage of product accuracy and delivery time (KPI 22)
Stakeholder Contribution	Providing input for quality improvement of goods handover process (KPI 8)	More optimal in performing work and following applicable SOPs (KPI 16)	Supplier performance in product delivery accuracy (KPI 23)

Source: Authors

Weighting Analysis with Analytical Hierarchy Process (AHP)

The hierarchical structure presented in Figure 1 depicts the Goods Receipt Performance Measurement framework, consisting of three distinct levels. At the top is the overarching focus on goods receipt performance. The second level identifies three key stakeholder groups: Customers/Internal (End Users), Employee (Receiving Staff), and Supplier. The third level outlines five performance perspectives derived from the Performance Prism framework:

Stakeholder Satisfaction, Strategy, Process, Capability, and Stakeholder Contribution. These perspectives apply across all stakeholder groups, as indicated by the connecting lines. Each perspective is associated with Key Performance Indicators (KPIs) at the bottom level, providing a comprehensive structure for evaluating and improving the goods receipt process from multiple angles (Devano, 2023).

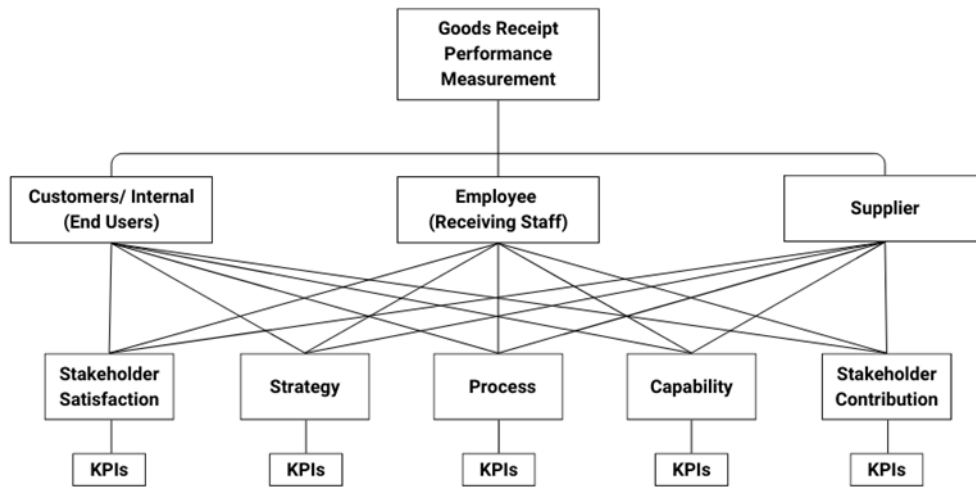


Figure 1. Hierarchical Structure
Source: Authors

Inter-Stakeholder Weighting

Table 2 presents the results of the Analytical Hierarchy Process (AHP) for weighing different stakeholders in the analysis. The stakeholders considered are Customers/Internal (End Users), Employees (Receiving Staff), and Suppliers. The table shows the pairwise comparison values between these stakeholders, along with the calculated Priority Vector, Eigen Value, and Consistency Vector. The Consistency Ratio (CR) of 0.05 indicates that the judgments are consistent (as it's below the generally accepted threshold of 0.1). The Priority Vector suggests that Employees (Receiving Staff) have the highest priority (0.42), followed by Customers/Internal (End Users) (0.32), and then Suppliers (0.26).

Table 2: Inter-stakeholder Weighting

	Customers/ Internal (End Users)	Employees (Receiving Staff)	Supplier	Priority Vector	Eigen Value	Consistency Vector	CR
Customers/ Internal (End Users)	1,00	2,29	0,14	0,32	1,31	4,04	0,05
Employees (Receiving Staff)	2,29	1,00	0,52	0,42	1,29	3,12	
Supplier	0,14	0,52	1,00	0,26	0,52	2,00	

Source: Authors

Weighting Between Five Performance Prism Perspectives

Table 3 shows the AHP results for weighting the five perspectives of the Performance Prism framework. The perspectives considered are Stakeholder Satisfaction, Strategy, Process, Capability, and Stakeholder Contribution. The pairwise comparisons, Priority Vector, eigenvalue, and Consistency Vector are presented. The Consistency Ratio (CR) of 0.06 indicates acceptable consistency in the judgments. The Priority Vector reveals that Stakeholder Satisfaction has the highest weight (0.30), followed by Process (0.20), Capability (0.19), Strategy (0.17), and Stakeholder Contribution (0.14).

Table 3. Weighting between the Five Perspectives of Performance Prism

	Stakeholder Satisfaction	Strategy	Process	Capability	Stakeholder Contribution	Priority Vector	Eigen Value	Consistency Vector	CR
Stakeholder Satisfaction	1,00	1,84	1,71	1,61	0,82	0,30	1,38	4,63	0,06
Strategy	1,84	1,00	0,79	0,35	0,46	0,17	1,01	5,83	
Process	1,71	0,79	1,00	1,59	0,24	0,20	1,18	5,80	
Capability	1,61	0,35	1,59	1,00	0,36	0,19	1,10	5,88	
Stakeholder Contribution	0,82	0,46	0,24	0,36	1,00	0,14	0,58	4,22	

Source: Authors

Weighting between KPIs

Table 4 presents the AHP results for weighting Key Performance Indicators (KPIs) related to Customers/Internal Stakeholders (End Users). Eight KPIs are compared, including factors like product conformity, complaint handling, communication, and process responsiveness. The Priority Vector shows the relative importance of each KPI, with "Providing input for quality improvement of goods handover process" and "Openness of communication patterns" having the highest weights (both at 0.15). The Consistency Ratio (CR) of 0.08 indicates acceptable consistency in the judgments.

Table 4. KPI Weighting Results Customers / Internal Stakeholders (End Users)

	KPIs								Priority Vector	Eigen Value	Consistency Vector	CR
	1	2	3	4	5	6	7	8				
1	1,00	0,63	0,69	0,29	1,31	0,63	0,63	1,65	0,10	0,90	9,19	0,08
2	0,63	1,00	1,65	0,20	1,65	0,20	1,26	3,78	0,14	1,41	10,03	
3	0,69	1,65	1,00	0,28	1,26	1,34	0,93	1,34	0,12	1,11	9,29	
4	0,29	0,20	0,28	1,00	2,15	1,44	0,74	0,79	0,10	0,90	8,89	
5	1,31	1,65	1,26	2,15	1,00	1,06	1,00	0,32	0,15	1,17	7,80	
6	0,63	0,20	1,34	1,44	1,06	1,00	1,49	0,93	0,12	0,99	8,00	
7	0,63	1,26	0,93	0,74	1,00	1,49	1,00	0,74	0,11	0,99	8,62	
8	1,65	3,78	1,34	0,79	0,32	0,93	0,74	1,00	0,15	1,33	8,77	

Source: Authors

Table 5 shows the AHP results for weighting KPIs related to Employee Stakeholders (Receiving Staff). Eight KPIs are compared, covering aspects such as work convenience, employee appreciation, training and development, and facility provision. The Priority Vector indicates that the "Level of provision of supportive work facilities" has the highest weight (0.20), followed closely by "Planning of training and development programs for employees" (0.19). The Consistency Ratio (CR) of 0.10 is at the upper limit of acceptable consistency, suggesting that the judgments are just within the acceptable range of consistency.

Table 5. KPI Weighting Results Employee Stakeholders (Receiving Staff)

	KPIs								Priority Vector	Eigen Value	Consistency Vector	CR
	9	10	11	12	13	14	15	16				
9	1	0,42	0,54	1,82	0,63	1,98	0,42	0,42	0,12	1,04	8,92	0,1
10	0,42	1	0,85	0,38	0,57	1,47	0,37	0,15	0,09	0,66	7,09	
11	0,54	0,85	1	0,15	2,08	0,69	0,16	0,16	0,09	0,78	8,44	
12	1,82	0,38	0,15	1	6,07	1,59	3,17	0,33	0,2	2,15	10,75	
13	0,63	0,57	2,08	6,07	1	1,39	1,75	0,15	0,19	2,1	11,11	
14	1,98	1,47	0,69	1,59	1,39	1	0,41	0,21	0,14	1,21	8,47	
15	0,42	0,37	0,16	3,17	1,75	0,41	1	0,15	0,09	1,23	13,17	
16	0,42	0,15	0,16	0,33	0,15	0,21	0,15	1	0,07	0,29	3,98	

Source: Authors

Table 6 presents the AHP results for weighting KPIs related to Supplier Stakeholders. Seven KPIs are compared, including product quality, partnership relationships, communication, and delivery accuracy. The Priority Vector shows that "Probability of miss communication occurring between employees and suppliers" has the highest weight (0.21), followed by "Sustainable partnership relationship" (0.17). The Consistency Ratio (CR) of 0.02 indicates high consistency in the judgments for this set of comparisons.

Table 6. Supplier Stakeholder KPI Weighting Results

	KPIs							Priority Vector	Eigen Value	Consistency Vector	CR
	17	18	19	20	21	22	23				
17	1,00	1,59	0,51	1,36	1,21	0,46	0,30	0,13	0,99	7,41	0,02
18	1,59	1,00	1,67	3,11	0,29	1,26	0,21	0,17	1,49	8,59	
19	0,51	1,67	1,00	2,62	0,22	0,79	0,30	0,13	1,21	9,30	
20	1,36	3,11	2,62	1,00	0,87	1,00	0,48	0,21	1,55	7,32	
21	1,21	0,29	0,22	0,87	1,00	0,48	0,67	0,11	0,67	5,94	
22	0,46	1,26	0,79	1,00	0,48	1,00	1,04	0,13	0,89	6,61	
23	0,30	0,21	0,30	0,48	0,67	1,04	1,00	0,10	0,54	5,20	

Source: Authors

Scoring System Using Objective Matrix (OMAX) and Traffic Light System (TLS) Customers / Internal Stakeholders (End Users) Scoring System

Table 7. Stakeholder Performance Measurement Customers / Internal (End Users)

KPI	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8
Performance	4,00	4,00	3,67	4,00	3,33	3,67	4,33	3,67
10	5	5	5	5	5	5	5	5
9	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6
8	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2
7	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8
6	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4
5	3	3	3	3	3	3	3	3
4	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
3	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2
2	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
1	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
0	1	1	1	1	1	1	1	1
Score	7	7	7	7	5	6	8	6
Weight	0,10	0,14	0,12	0,10	0,15	0,12	0,11	0,15
Value	0,68	0,99	0,84	0,71	0,75	0,74	0,92	0,91

Source: Authors

Table 8. KPI Value and Total Performance Index of Customers

	KPI								Average Current Performance	Total Index
	1	2	3	4	5	6	7	8		
Current Performance	4,00	4,00	3,67	4,00	3,33	3,67	4,33	3,67	3,83	7
Weight	0,10	0,14	0,12	0,10	0,15	0,12	0,11	0,15		
Value	0,68	0,99	0,84	0,71	0,75	0,74	0,92	0,91		

Source: Authors

OMAX analysis of customer/internal stakeholder (end users) performance shows 1 KPI in the green category and 7 in the yellow category out of 8 KPIs. Overall, the stakeholder group scores 7, placing it in the yellow category, indicating satisfactory performance with room for improvement in most areas.

Employee Stakeholder Scoring System (Receiving Staff)

Table 9. Employee Stakeholder Performance Measurement (Receiving Staff)

Conclusion								
KPI	KPI 9	KPI 10	KPI 11	KPI 12	KPI 13	KPI 14	KPI 15	KPI 16
Performance	4,00	3,67	3,67	3,33	3,00	3,33	3,33	4,33
10	5	5	5	5	5	5	5	5
9	4,6	4,6	4,6	4,6	4,6	4,6	4,6	4,6
8	4,2	4,2	4,2	4,2	4,2	4,2	4,2	4,2
7	3,8	3,8	3,8	3,8	3,8	3,8	3,8	3,8
6	3,4	3,4	3,4	3,4	3,4	3,4	3,4	3,4
5	3	3	3	3	3	3	3	3
4	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
3	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2
2	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
1	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4
0	1	1	1	1	1	1	1	1
Score	7	6	6	5	5	5	5	8
Weight	0,12	0,09	0,09	0,20	0,19	0,14	0,09	0,07
Value	0,82	0,56	0,56	1,00	0,94	0,71	0,47	0,58

Source: Authors

Table 10. KPI Value and Total Performance Index of Employee Stakeholder

	KPI								Average Current Performance	Total Index
	1	2	3	4	5	6	7	8		
Current Performance	4,00	3,67	3,67	3,33	3,00	3,33	3,33	4,33	3,58	7
Weight	0,12	0,09	0,09	0,20	0,19	0,14	0,09	0,07		
Value	0,82	0,56	0,56	1,00	0,94	0,71	0,47	0,58		

Source: Authors

Using the OMAX method, calculations reveal that among 8 Key Performance Indicators (KPIs) assessed for employee stakeholders (receiving staff), 1 KPI is in the green category and 7 are in the yellow category. Overall, the stakeholder group achieves a score of 6, placing it in the yellow category according to the Traffic Light System.

Supplier Stakeholder Scoring System

Table 11. Supplier Stakeholder Performance Measurement

KPI	KPI 17	KPI 18	KPI 19	KPI 20	KPI 21	KPI 22	KPI 23
PERFORMANCE	4,67	4,00	3,00	2,33	3,67	3,00	4,33
10	5	5	5	5	5	5	5
9	4,6	4,6	4,6	4,6	4,6	4,6	4,6
8	4,2	4,2	4,2	4,2	4,2	4,2	4,2
7	3,8	3,8	3,8	3,8	3,8	3,8	3,8
6	3,4	3,4	3,4	3,4	3,4	3,4	3,4
5	3	3	3	3	3	3	3

KPI	KPI 17	KPI 18	KPI 19	KPI 20	KPI 21	KPI 22	KPI 23
PERFORMANCE	4,67	4,00	3,00	2,33	3,67	3,00	4,33
4	2,6	2,6	2,6	2,6	2,6	2,6	2,6
3	2,2	2,2	2,2	2,2	2,2	2,2	2,2
2	1,8	1,8	1,8	1,8	1,8	1,8	1,8
1	1,4	1,4	1,4	1,4	1,4	1,4	1,4
0	1	1	1	1	1	1	1
Score	9	7	5	3	6	5	8
Weight	0,13	0,17	0,13	0,21	0,11	0,13	0,10
Value	1,21	1,21	0,65	0,64	0,68	0,67	0,82

Source: Authors

Table 12. KPI Value and Total Performance Index of Supplier Stakeholders

	KPI 17	KPI 18	KPI 19	KPI 20	KPI 21	KPI 22	KPI 23	Avg Current Performance	Total Index
Current performance	4,67	4,00	3,00	2,33	3,67	3,00	4,33	3,57	6
Weight	0,13	0,17	0,13	0,21	0,11	0,13	0,10		
Value	1,21	1,21	0,65	0,64	0,68	0,67	0,82		

Source: Authors

Using the OMAX method, the analysis shows that among 7 Key Performance Indicators (KPIs) for supplier stakeholders, 1 KPI is in the red category, indicating a critical need for immediate improvement. Additionally, 2 KPIs are in the green category, while 4 KPIs fall into the yellow category. Overall, the score for supplier stakeholder performance is 6, placing it in the yellow category according to the Traffic Light System.

Discussion

Previous research by Legaretsa and Purnamawaty (2021) focused on measuring overall performance with 16 KPIs for employees and 12 for suppliers to assess both stakeholders' performance in company operations. In contrast, the current study specifically measures the receiving process performance while still using the Performance Prism framework, ensuring methodological consistency. This approach allows for a comprehensive view of various stakeholder perspectives (Cahyadi & Aziz, 2022; Farisy et al., 2023), and highlights performance weaknesses for improvement (Novita et al., 2021).

This study identified 23 KPIs across five Performance Prism perspectives, distributed among three stakeholder groups: 8 for customers/internal users, 8 for employees (receiving staff), and 7 for suppliers. In-depth interviews highlighted that while most stakeholders were satisfied with the goods receipt process, improvements were needed in communication, complaint response speed, and supplier recognition. Receiving staff requested more training and better coordination, while suppliers stressed lead time efficiency. This aligns with Palinoan et al., (2024), who identified 24 similar KPIs using comparable methods. The performance measurement results for each stakeholder group are presented in Tables 13 through 16, offering a detailed analysis of the goods receipt process performance across various dimensions and stakeholder perspectives.

CONCLUSION

The research on the semiconductor manufacturing company's goods receipt process identified 23 Key Performance Indicators (KPIs) across various perspectives, with stakeholder satisfaction, strategy, process, capability, and stakeholder contribution each having its own set of KPIs. The Analytical Hierarchy Process (AHP) highlighted the importance of employees (receiving staff) with the highest weight of 0.42. Performance measurement using the Objective

Matrix (OMAX) and Traffic Light System (TLS) revealed that out of 23 KPIs, 4 are in the green category, 18 in the yellow, and 1 in the red. Overall, the performance is good but needs improvement in some areas. To enhance performance, the company should focus on KPIs in the yellow and red categories, such as improving communication between employees and suppliers through training, better communication systems, and regular monitoring. This will boost the efficiency and effectiveness of the goods receipt process and strengthen relationships with stakeholders.

Future studies utilizing the Performance Prism technique should broaden the references for stakeholder selection and tailor them to the specific context of the research subject to enhance the quality of the findings. Furthermore, it is encouraged to integrate this method with the Integrated Performance Measurement System (IPMS), a holistic strategy that addresses the requirements of all stakeholders while assessing the company's standing relative to its competitors (external monitor). Therefore, the integration of these two methodologies can yield a more comprehensive and effective performance evaluation.

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