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An evaluation of performance measurement system operational management: Case study ETO manufacturing company

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Abstract: This research evaluates the performance measurement system of PT. Hegarmanah (disguised), as a case study of an Engineer-to-Order (ETO) manufacturing company that supplies High Voltage Products and Services and has found inefficiencies in inventory workflows and its misaligned suppliers. Despite robust sales supported by centralized procurement's customers, PT. Hegarmanah faced internal issues that hindered the development of new Knowledge-based Performance Measurement Systems. This study conducted semi-structured interviews with operational and senior management representatives as part of a qualitative case study approach. The Knowledge-Based Performance Management System (KBPMS) framework was implemented, with an emphasis on specific resource capabilities, internal processes, and organizational output. The results indicated inefficiencies in inventory turnover that were caused by inadequate workflow management, insufficient supplier performance monitoring, and restricted operational cooperation. The suggested KBPMS system aims to improve team performance through smart-factory capabilities and workload optimization, expedite inventory workflows through ERP integration, and strengthen supplier data accuracy. The proposed IPMS framework addresses operational inefficiencies. Thus, a tailored performance management framework for engineer-to-order manufacturers, through the online implementation of performance measures and the enhancement of accountability, may enhance operational sustainability and align inventory practices with corporate objectives.

Keywords: *ETO(Engineer-to-order), Industry 4.0, ITO (Inventory turnover), PMS (Performance measurement systems), Smart factory, Sustainable business.*

1. Introduction

In an increasingly competitive and unpredictable manufacturing landscape (Tao, Liu, Zhou, & Mao, 2024) company utilizing the Engineer-to-Order (ETO) model has challenges that set them apart from mass production entities (Seth & Rastogi, 2019). In contrast with traditional production processes, ETO manufacturing company must accommodate to highly specific demands from the customer (Sjøbakk & Bakås, 2014) material flow and customization (Chopra, 2018) like changeable project parameters, and changing material requirements i.e variability (Chopra, 2018) frequently under tight lead times (Seth & Rastogi, 2019) and tight operating margins (Afrifa, Alshehabi, Tingbani, & Halabi, 2021). These dynamics need both operational flexibility (Afrifa et al., 2021) and a strong system for ongoing monitoring, and improvement of performance management of operational teams (Khurshid Khan & Wibisono, 2008). This study would focus on ETO manufacturing company that supply to the energy, utility company that required specific products but in moderate capacity volume's production especially on providing Indonesian Utility company.

The foundation of ETO manufacturing company success is the capacity to properly manage material flow and maintain the performance measurement system of the management team. However, considering of inventory management in maintaining profitability (Seth & Rastogi, 2019) and customer

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satisfaction (Sjøbakk, Bakås, Bondarenko, & Kamran, 2015), PT. Hegarmanah still had lacking of its operational performance measurement system (Sjøbakk et al., 2015; Wibisono, 2003). especially on its organizational operational team that they had sometime found delay and unpredictable (Soares et al., 2022) of decision-making processes from the manager because lacking of managing the information data from supplier (Johnson, 2024; Tao et al., 2024) the internal process and fragmented information flows (Manuj & Sahin, 2011). The difference between operational complexity and performance supervision (Fortes, Tenera, & Cunha, 2023) has been increasingly emphasized in academic research and industrial practices; thus this study would like to configure to performance measurement system framework of PT. Hegarmanah and assist it to solve the performance measurement gaps in inventory turnover and process integration.
According Knowledge-Based Performance Measurement System (KBPMS) (Wibisono, 2003) have introduced the as a flexible framework that aligns strategic objectives with operational conditions. In addition, research by Sjøbakk et al. (2015) emphasizes as well for the performance measurement systems of ETO material management that should be dynamic, integrated, and capable at facilitating decision-making in sophisticated production settings like ETO manufacturing (Sjøbakk et al., 2015). This project aims to integrate theoretical constructs with practical application by creating a PMS framework tailored to the operational division business unit of PT. Hegarmanah.
This research aims to offer a practical framework with KBPMS for ETO manufacturing company trying to balance customization and efficiency in a competitive market.

2. Theoretical Background

Conventional performance measurement system, which frequently prioritize static efficiency indicators (Lei, Li, & Deeprasert, 2024) are inadequate for accommodating the rapidly changing requirements of customized production settings (Sjøbakk et al., 2015). In this context, the organization must develop competencies that enable it to detect variations in customer requirements, capitalize on emerging possibilities, and adapt its internal operations accordingly. The concept of dynamic capacities, as articulated by Teece (1997) offers a significant foundation for comprehending how companies might adapt Irfani, Wibisono, and Basri (2020) and sustain competitiveness (Wibisono, 2003) in unpredictable (Soares et al., 2022) and sophisticated operating and inventory management by Accounting, Information & Communication Technology (ICT) (Puspitawati, Lhutfi, & Qudratov, 2024). The online report (Hanafi, 2009) of the managing of material or inventory should be indicated on single access platform website (Puspitawati et al., 2024) that to effectiveness and integration of accounting information systems that support cost analysis, forecasting and strategic decision making (Langfield-Smith, 2022).

Dynamic capabilities can usefully be broken down into three primary clusters (Teece, 2014): (1) identification, development, co-development, and assessment of technological opportunities in relationship to customer needs (sensing); (2) mobilization of resources to address needs and opportunities, and to capture value from doing so (seizing); and (3) continued renewal (transforming). Engagement in continuous or semicontinuous sensing, seizing, and transforming (Teece, 2014) is essential if the firm is to sustain itself as customers, competitors, and technologies change (Teece, 2014).

An engineer-to-order company will work with the customer to design the product (Fortes et al., 2023) and then make it from purchased materials, parts, and components (Seth & Rastogi, 2019). Of course, several ETO manufacturing company serve a combination of these environments, and a few will have all simultaneously (Sjøbakk et al., 2015). To make success of ETO material management, we would also maintain from supplier as important part (Yang, 2013) to supply the semifinished and raw product (Fortes et al., 2023). Fairness also associates with transparency: Hsu, Chen, and Wang (2008) propose that suppliers need to understand buyer needs and their decision-making processes (Johnson, 2024) to effectively respond to uncertainty in market behavior (Tao et al., 2024) production schedules, and inventory requirements (Johnson, 2024). activities such as process planning, material requirements planning, capacity planning, task sequencing and demand management are essential activities that companies should perform daily to meet customer demands and to be consistent and sustainable in their competitive environment (Fortes et al., 2023).

In terms of ETO material management, positioning of the customer order decoupling point is important in understanding production environments (Jacob, 2018) and had been studied by Børge Sjøbakk et al. (2015) shown on Table 1. ETO company had been characterized as manufacturing company that have not specific stock, since it will hold more inventory to the company and not good for the financial company (Hicks, McGovern, & Earl, 2000).

Table 1.
Simplifying the schematic CODP (Customer Order Decoupling Point (Børge Sjøbakk, Bondarenko, & Kamran, 2014).

	Manufacturing value chain			
Production situation	**Design/engineering**	**Procurement and fabrication**	**Final assembly**	**Shipment**
MTS				● CODP
ATO			● CODP	
MTO		● CODP		
ETO	● CODP			

Khurshid Khan and Wibisono (2008) could validate their hybrid PMS framework by applying in the manufacturing industry sector, including aircraft component manufacturing, electronics manufacturing, and telecommunication products manufacturing. The results of the validation exercise indicate that the proposed hybrid knowledge-based performance measurement system model is a suitable decision-making tool to assist the practitioners of PMS and provides consistent and detailed prioritized results for actions and improvements (Wibisono, 2003).

3. Methodology

Structure the study to facilitate the collection and analysis of necessary data to address your research questions, so enabling the resolution of the problem that initiated the study. According Sekaran and Bougie (2016) A research design is a blueprint or plan for the collection, measurement, and analysis of data, created to answer your research questions. This research paper would like to use Case studies, which refer to Sekaran and Bougie (2016) obtain a clear picture of a problem, one must examine the real-life situation from various angles and perspectives using multiple methods of data collection. Case studies focus on collecting information about a specific object, events, or activity, such as a particular business unit or organization.

The initiatives and firsthand experiences undertaken by the researcher to address the research problem for the first time are known as primary data. Data were collected primarily through qualitative research by face-to-face interviews as well as questionnaire survey. It has been collected from 10 expert from operational management from PT. Hegarmanah that also had been more than 15 years experiences on their role jobs as same industry on electrical manufacturer company. The interview process requires considerable time for respondents to reflect on and assess their personal experiences within the organizations.

The authors employed the Participatory Action Research (PAR) to seek the better focal point on contributing as part the team. In addition, researchers and problem holders interact to address real-life issues while sustaining a scientific focus. It differs from several other research methodologies in that the researchers actively engage in the setting of their study region.

The authors will collect the primary data using interview the SME (Subject Master Expert) on Operation manager and the managers, about the issue of inventory and its impact on improper factor of operation management. In addition, secondary data was also used on the research analysis to evaluate the business condition of the company. There are several steps starting from boundaries for this research, gathering information by means of unstructured or semi-structured observation, interviews, documents, visual material, and recorded information will be designed as protocols (Creswell, 2019).

4. Empirical Findings/Result

The organization is presently experiencing performance measurement gaps in inventory turnover and process integration. Based on the researchers conducted semi-structured focused interviews with many department managers to comprehend the company's current Performance-Management System (PMS) (Devi, Wibisono, Mulyono, & Fitriati, 2023). Subsequently, workshops with key departments in the organization facilitated conversations regarding the established performance metrics for materials management (Fatima & Wibisono, 2017). The researchers consolidated the conversations and disseminated them to management and other departments, including information and communications technology (ICT) support and finance. The researchers integrated a top-down cascade approach with a bottom-up design process, as indicated in the PMS framework (Sekaran & Bougie, 2016).

The interview method adhered to a systematic protocol, designed to correspond with the study objectives and the theoretical framework established from the literature review. This methodology served both as a checklist and to uphold the relevance and depth of the investigation. The data collection comprised audio recordings and researcher notes, subsequently transcribed for identifying important terms and topics highlighted by the respondents. These observations formed the basis for examining operational inefficiencies inside the organization (Sekaran & Bougie, 2016).

The operational process comprises the conversion of resources, energy, and information into goods or services at a designated scale to satisfy client requirements (Sjøbakk et al., 2015). A well-organized operational process consists of four fundamental elements: the cultivation and administration of supplier relationships, monitoring of products and services, management of distribution, and control of processes concerning social duties (Sulaiman, 2021).

Based on the operational insights obtained from the literature and stakeholder interviews, the subsequent phase of this research involved formulating a performance assessment framework that addressed the company's existing difficulties while aligning with its Engineer-to-Order (ETO) operating environment. This study determined that, although traditional frameworks like the Balanced Scorecard (Kaplan & Norton, 1996), Performance Prism (Neely, Adams, & Kennerley, 2002) and Integrated Performance Management System (Wibisono, 2003) present strong structures, the Knowledge-Based Performance Measurement System (KBPMS) (Khurshid Khan & Wibisono, 2008) offers a more flexible foundation for engineer-to-order (ETO) manufacturing.

4.1. Building Framework KBPMS of Operation Division Management

The Knowledge-Based Performance Management System (KBPMS) model (Wibisono, 2012) represents a significant advancement over previous Performance Management System (PMS) frameworks. It introduces innovative elements not previously explored, particularly the integration of a knowledge-based expert system and the combination of Group Analytic Practice (GAP) with the Analytical Hierarchy Process (AHP) into a unified decision-support model. The development of KBPMS involves three main stages: (1) Basic Information, (2) Core of Performance Management, and (3) Performance Management Mechanisms—each comprising critical components that contribute to the overall system.

Structurally, the KBPMS is divided into strategic and operational layers (Irfani et al., 2020). Strategically, it includes the Company Environment module, which identifies the firm's external context, and the Business Result Perspective module, which evaluates both financial and non-financial performance. Operationally, it features the Internal Process Perspective and Resource Capability Perspective modules (Fatima & Wibisono, 2017) each containing sub-modules and performance indicators discussed in detail.

KBPMS integrates GAP analysis, benchmarking, and the AHP method to create a comprehensive and precise performance evaluation framework. This hybrid model not only improves PMS in manufacturing settings but also enhances usability through an interactive (Fortes et al., 2023), knowledge-based software platform. This software facilitates user engagement, supports ongoing

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learning, and enables more informed decision-making by incorporating the latest performance management methodologies. The KBPMS framework present in Figure 1. KBPMS (D. Wibisono, 2012).

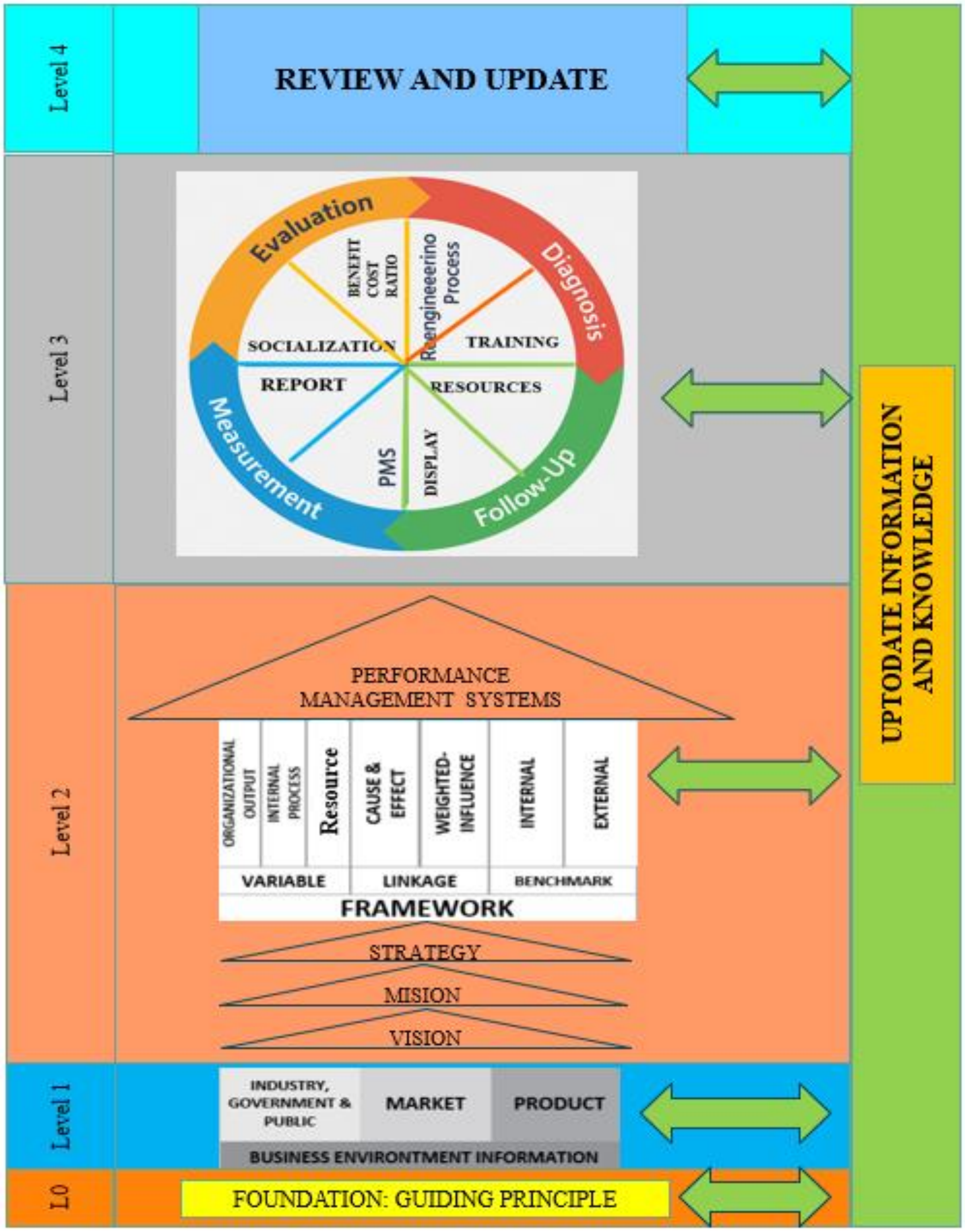

Figure 1.
Performance Management System Design Methodology (D. Wibisono, 2012).

Furthermore, based on Figures 1, KBPMS allows for continuous improvement through the integration of cutting-edge performance management methodologies, thereby supporting more effective

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and informed decision-making., Based on Wibisono (2012). In How to Create World Class Company 2016, Performance Management System Design divided into 4 (four) stages/level, that it will be described as follow;

4.1.1. Stage 0: Foundation

At this stage, building a foundation for the design of the performance management system is critical as it serves as the guiding concept for its development. Comprehension of the principles and regulations necessary for the construction of a suitable system. The Root of Problems identified four principles and five rules from the investigation results; the necessary changes to address the gap may be evaluated as guidelines for the next step, it is shown on Figure 2. Level 0 KBPMS.

Figure *2.*
Level 0 KBPMS (D. Wibisono, 2012).

Figure 2 As part of general KBPMS beside making Foundation; Guiding Principle it needs to be inter-connected to Update Information and Knowledge.

4.1.2. Stage 1: Basic Information

4.1.2.1. Internal Analysis

The following step to make essential data for the creation of a performance management system includes information regarding the business environment and details about the organization's output or products, it should be considered business information of the company's business. This context include the information of ETO Industry because understanding the ETO industry's complexity (Fortes et al., 2023) is essential before analyzing operational inefficiencies (Nasywa, 2024) as many challenges stem from the nature of customization (Sjøbakk et al., 2015), unpredictability, and cross-functional dependency (Devi et al., 2023). The products of the Operation Information System are generally categorized into two types: reports and dashboards (Sulaiman, 2021). In the context of PT Hegarmanah's development of the Smart Factory (Brodeur, Deschamps, & Pellerin, 2023) as internal platform that are essential for tracking and managing the execution of the daily operation management and its teams. These reports include Inventory (Material Management) that are generated during the implementation phase of the Smart Factory project (Sulaiman, 2021).

The customer of this research would be identified as the Project Manager as the external customer, as they presented as their customer to set value of delivery, specification, the scope of work of the order requirements Figure 3.

Figure *3.*
Level 1 KBPMS (D. Wibisono, 2012).

Figure 3. shows Level 1 of KBPMS include business environment information that should be updated information and knowledge. The business environment information would include information of Industry, government and public, Market share and capacity and its products.

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4.1.2.2. External Analysis

Complementing business environments, researcher conduct an in-depth exploration of both external and internal business environments to assess its competitive position in the manufacturing industry. A key analytical tool used during this process is Porter's Five Forces model. Exploration will be shown in Figure 4. Porter 5's forces PT. Hegarmanah.

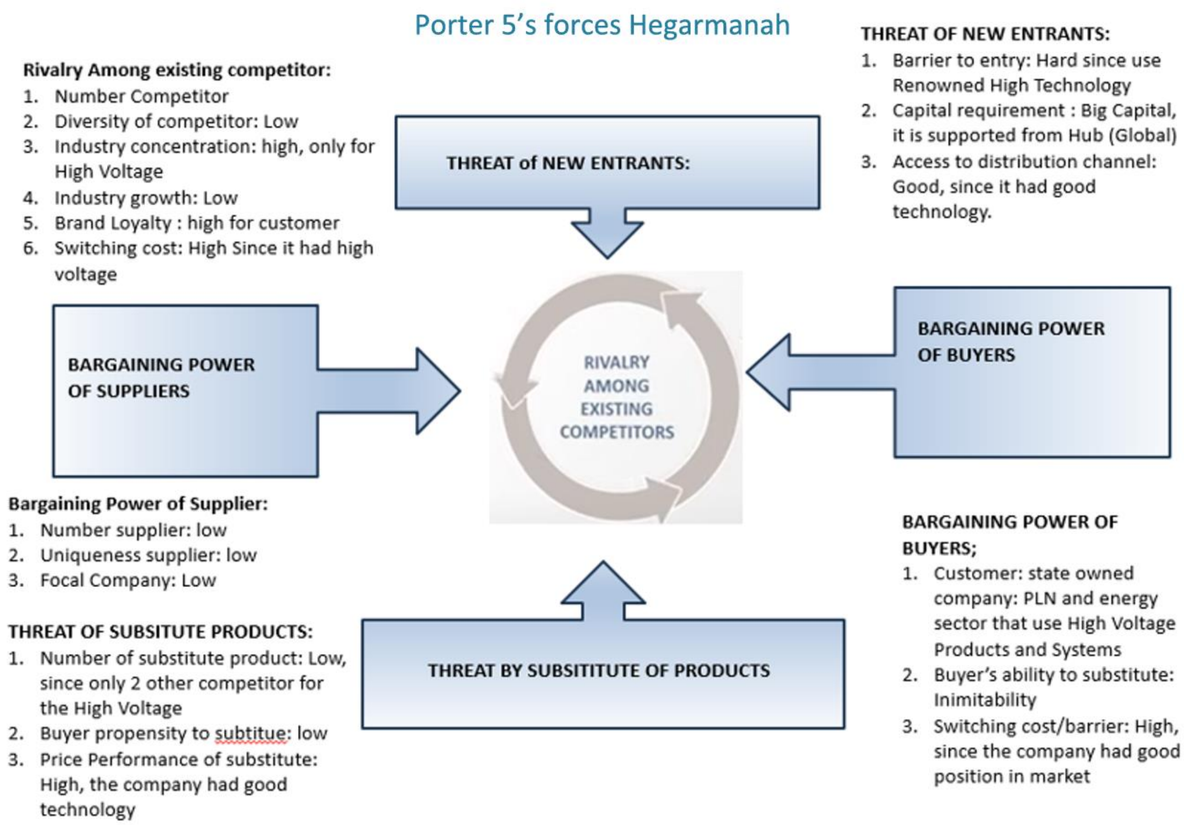

Figure 4.
Porter 5's forces PT.Hegarmanah.

4.1.3. Stage 2: Design of the performance management system

The next stage would be primary and main port of making the Performance Management Systems. It will consist of vision, mission, strategic, dan framework determination as the basis for performance variable, variable interrelationship, and benchmark selection (Wibisono, 2012). The second stage in the development KPBMS of PT Hegarmanah is the Design stage, which focuses on strategic formulation and comprehensive system planning. This phase employs various strategic approaches to ensure that the system design effectively addresses the complexities of the manufacturing industry and supports the company's digital transformation goals as per Figure 5.

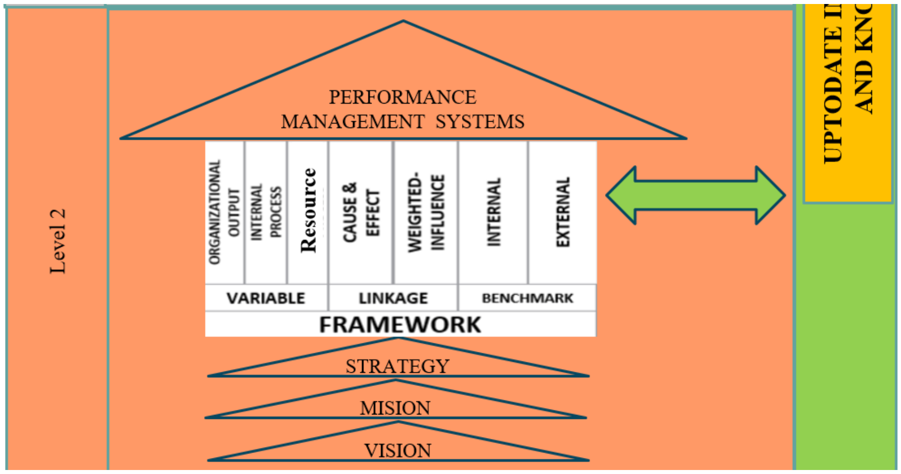

Figure 5.
Level 2 KBPMS (D. Wibisono, 2012).

Figure 5 shows Level 2 of KBPMS of D. Wibisono (2012) that had been divided two main part, the first part of Vision, Mision and Strategy and its Framework that consists; Variable of Organizational Output, Internal Process, Resources. The second of frame work woul consiste Cause and Effect and weighted influenced of the componets, and it need to be Benchmarking from Internal and External Group.

We can decompress a complex problem int multi-level hierarchical structure of objective, criteria, subcriteria, and alternative (Saaty, 1990). Respondents must compare the relative importance of the two variables using the Focus group discussion and interview of PT. Hegarmanah, which is responsible for evaluating key performance indicators at the corporate level. In the process AHP, it compares the scale 1 to 9 and the online AHP calculation developed by Klaus D Gospel of Business Performance Management Singapore from https://bpmsg.com/ (Goepel, 2018). Researcher use Analytical Hierarchy process (AHP) on decision making of the linkage variable based on the Figure 6. The summary result of variable linkage of research.

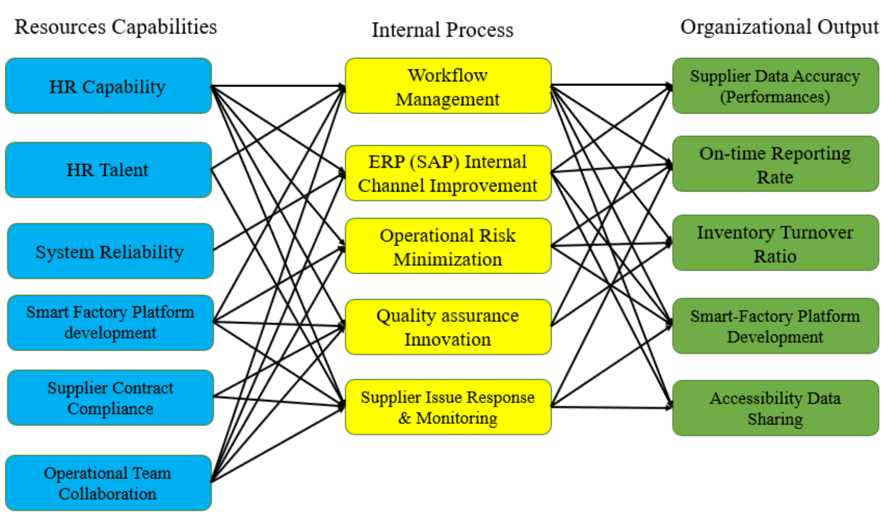

Figure 6.
The summary result of variable linkage of Research.

Figure 6 shows that there are five considerations for organizational output: Supplier Data Accuracy, On-time reporting rate, Accessibility data sharing, Inventory Turnover rate, and Smart-Factory Platform Development. There five aspects considered on Internal Process: Workflow Management of Inventory, ERP Internal Channel Improvement, Deliver Time Monitoring, Quality assurance innovation, supplier issue response and monitoring. In addition, the main aspects on resources capability consists of seven factors to be considered: Smart factory platform development, System reliability, Operational team collaboration, workload management, HR Talent Hub and Supplier contract Compliance.

Marketing and after-sales service aspects will not be analyzed since they pertain to external customers (Wibisono, 2012). Meanwhile, financial aspects will also not be analyzed, as inventory management processes do not involve financial output.

In the term of finding the KBPMS from (Wibisono, 2003) and the finding interview it could correlation with Performance Measurement System of ETO, refer to Sjøbakk et al. (2014) which still having little foundation on doing variable performances that research found as below Figure 7 Relationship Strategic Level Division and PMS Material Management.

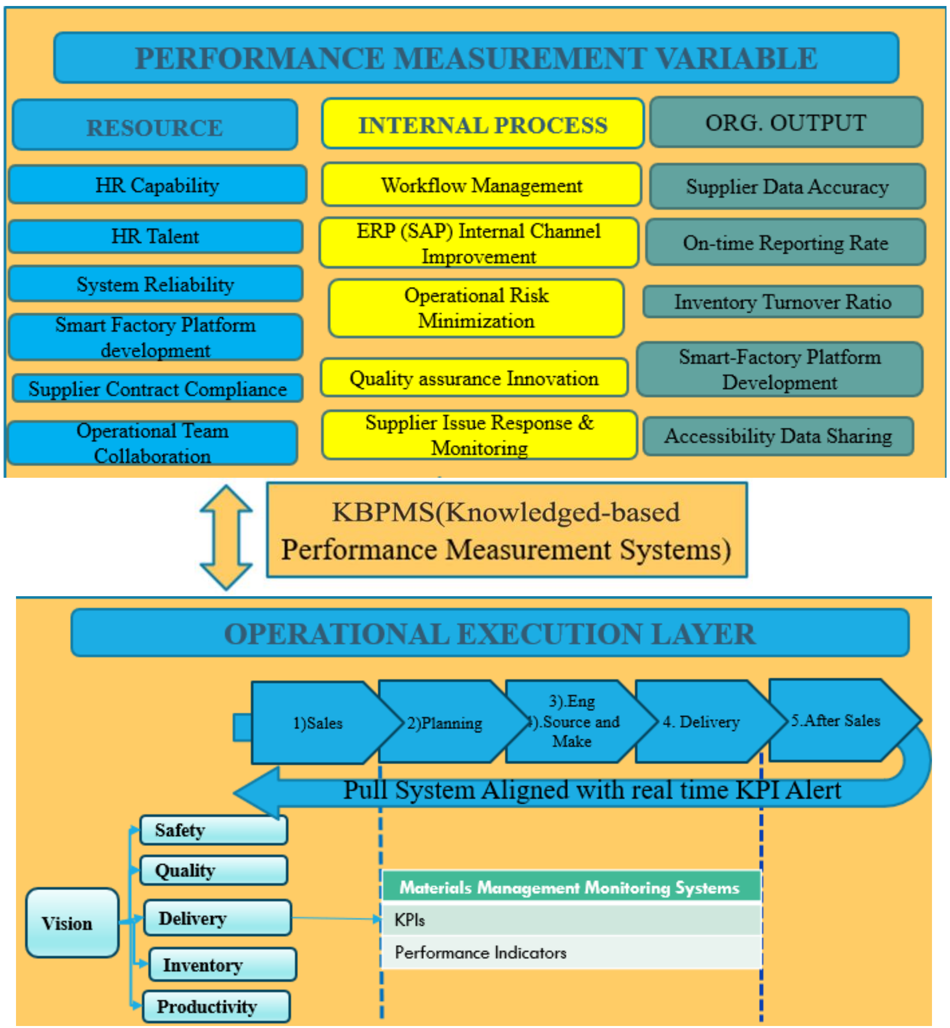

Figure 7.
Relationship the Strategic Level Vision and PMS Material Management.

In the Figure 7 there are 16 proposed indicators that seleccted on thre main persepectives and six-teen subpersepectives within the framework of KBPMS which are relevant to the ETO company (Sjøbakk et al., 2015). The organizational output consist of Supplier Data Accuracy (Performance), On-time reporting rate, Inventory Turnover Ratio, Smart-Factory Platform Development, and Accessibility data Sharing. The internal process that had become subpersectives that need to be measured are; workflow management, ERP (SAP) Internal Channel Improvement, Operational Risk Minimization, Quality assurance innovation, supplier issue responce and Monitoring. In addtion the resourcce capabilites with the HR Capability, Talent, System Reliability, smart factor platform development and supplier contract compliance.The variable linkages are important for determining causal effects among performance variables at different levels and for establishing improvement priorities among performance variables within the same level.

Based on the AHP that research conducted, we extract the level 2 of KBPMS as seen on Table 2. for Indicator researh finding of Perspective KBPMS using AHP.

Table 2.
Indicator Research Finding on Perspective KBPMS using AHP.

Perspectives	Indicators	Local Weigted	Perspective weighted	Global Weighted
BUSINESS OUTPUT	Inventory Turnover Ratio	13.45%	53.90%	7.25%
	Smart Factory Platform Development	12.70%	53.90%	6.85%
	On-Time Reporting Rate	20.11%	53.90%	10.84%
	Accessibility data sharing	15.32%	53.90%	8.26%
	Supplier data Accuracy	38.43%	53.90%	20.71%
INTERNAL PROCESS	Workflow Management (GR & GI Process)	21.00%	29.70%	6.24%
	ERP Internal Channel Improvement	18.00%	29.70%	5.35%
	Operational Risk Minimization	12.00%	29.70%	3.56%
	Delivery Time Monitoring	16.00%	29.70%	4.75%
	Quality Assurance Innovation	16.00%	29.70%	4.75%
	Supplier Issue Response & Monitoring	17.00%	29.70%	5.05%
RESOURCE CAPABILITIES	HR Capability	14.00%	16.40%	2.30%
	HR Talent	12.00%	16.40%	1.97%
	System Reliability	16.00%	16.40%	2.62%
	Smart Factory Platform Dev	21.00%	16.40%	3.29%
	Supplier Contract Compliance	15.00%	16.40%	2.80%
	Operational Team Collaboration	22.00%	18.00%	3.46%
SUMMARY				
OVERALL	Business Output	Internal Process	Resources Capabilities	
TOTAL WEIGHT	53.91%	29.70%	16.40%	

Validation and Benchmarking as part of Stage 2 of KBPMS on this study can also be used as a way of determining critical success factors or performance measures of a company. Benchmarking is the systematic and continuous process of measuring and comparing a company's business performance against leaders in the field and determining best adaptable improvement practices (Theodore, 2008). However, validation and benchmarking process have not been included in this paper.

4.1.4. Stage 3: Implementation

The design phase includes the presentation of the performance management system, reporting architecture, system socialization, cost-benefit analysis, potential process modifications, requisite training, necessary resources, and the status of the existing system post-implementation of the new system (Wibisono, 2012). During the implementation phase, the Smart Factory as a new system must be evaluated to ensure its capacity for measurement, assessment, diagnosis, and necessary intervention if

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the company or organization diverges from established standards. The implementation would refer to Figure 8 Level 3 KBPMS.

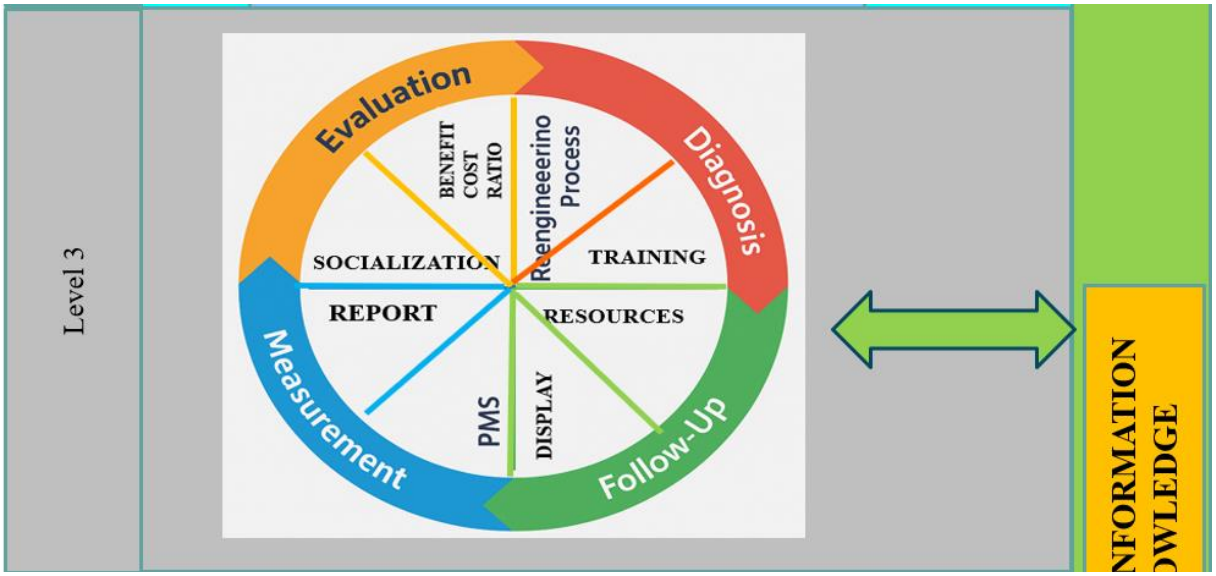

Figure 8.
Level 3 KBPMS. (D. Wibisono, 2012)

Figure 8 as Level Implementation would consist of evaluation, diagnosis, follow-up and Measurement as circle of operating daily of system and it is need be interconnected of Updated Information and knowledge. In the context of ETO manufacturer, PT Hegarmanah had implemented Smart factory to improve its operating operational especially on inventory management refer to Table 3

Table 3.
Foundation of Smart Factory KBPMS Design.

No	Root Cause	Existing System	Improvement Needs
1	No Integrated Platform to Manage Inventory	Inventory management system is not integrated	Implement an integrated inventory platform for real-time stock monitoring
2	Bad Data Management to Assess Supplier & Customer	Poor data management for suppliers and customers	Develop accurate and structured data management systems
3	No Strong Supplier-Customer Collaboration System	Lack of effective collaboration between suppliers and customers	Establish a strong collaboration system based on data and information technology
4	No Real-Time Inventory Visibility & Platform	No system for real-time inventory visibility	Implement technology to enable real-time inventory visibility
5	High Inventory Level	Excess inventory due to poor management	Optimize inventory levels through demand planning systems
6	Poor ITO (Inventory Turnover)	Low inventory turnover	Analyze and control stock rotation and adjust production lead time
7	Dependency on One Monopolist Customer	Heavy reliance on a single major customer	Diversify the customer base and strengthen relationships with other customers
8	Sales in Excess Due to Slow Disbursement	Excess sales due to slow order disbursement	Improve order processing and distribution systems
9	Inaccurate Forecasting and Delays	Inaccurate demand forecasting and delays	Improve forecasting accuracy using data analytics and AI
10	Volatile Demand	Unstable market demand	Increase production flexibility and adopt adaptive demand planning strategies

4.2. Smart Factory as Integrated Platform

A Smart Factory as an Integrated Dashboard Platform would be proposed and developed to PT.Hegarmanah that it might combine smart technologies Industry 4.0 (Tao et al., 2024) with a centralized dashboard system to provide real-time data visualization, control, and decision-making capabilities (Devi et al., 2023). This platform presented on Figure 9. would be integrated of various manufacturing processes, systems, and data sources into one cohesive interface, allowing operators, managers, and stakeholders to monitor, analyze, and manage all aspects of production from a single point of access.

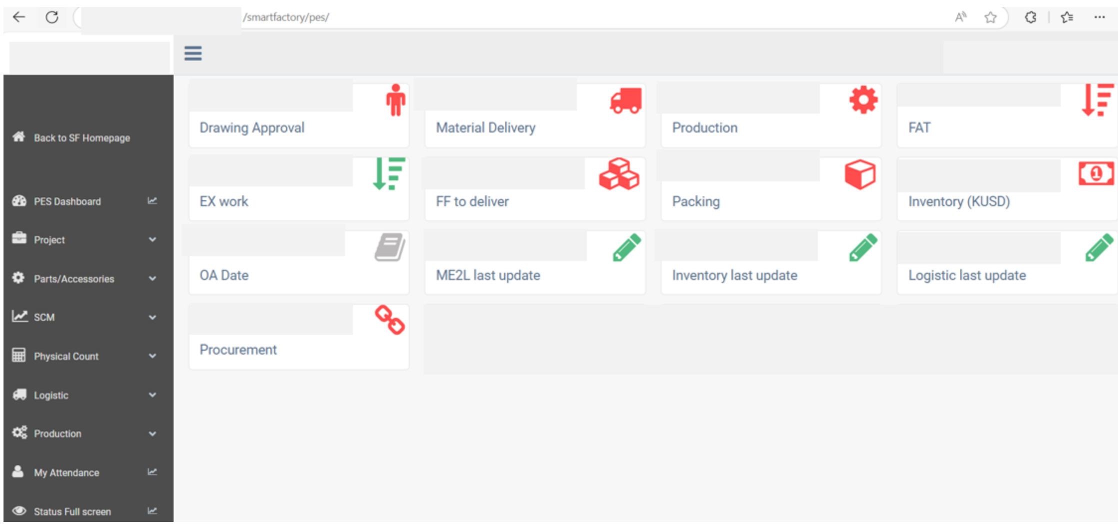

Figure 9.
Preview of Smart Factory.

4.2.1. Stage 4: Review and Update

Evaluation of the performance measurement system design would be relevant with the new business environment and latest technology and knowledge developments (Irfani et al., 2020). In this stage, establishing the foundation for the design of the performance management system is crucial, as it serves as the guiding principle for constructing the system. Based on the findings in Root of Problems, several root causes have been identified. These insights serve as a basis for assessing the changes required to bridge existing gaps, which will then guide the subsequent stages of the system's development as shown on Figures 10. Review and updated of KBPMS.

Figure 2.
Level 4 of KBPMS. (D. Wibisono, 2012)

5. Discussion

The findings of this study have found that ETO manufacturer company should have the high collaboration of each team, single platform to be accessed each member to make better communication and data sharing, supplier data accuracy, and controlled Inventory Turnover ratio. This aligns with the work of Sjøbakk et al. (2015) who established that performance management system of ETO manufacturing company.

The substantial impact of proposed Knowledge-Based Performance Management System by Wibisono (2012) that organization had been good performed that the management should have good framework measurement that profound on this study address to ETO manufacturing company dynamics especially on measured of making accuracy of supplier data, On-time reporting rate of inventory management, Inventory Turnover ratio, Smart Factory Development as platform of knowledge-based performance, and accessibility data sharing.

Moreover, this study highlights that both financial characteristics of ETO manufacturing company and experiences significantly impact on developing new platform system on the operational management team. This lead to make better proposed KBPMS refer to Wibisono (2012).

These results aligned on showing how important in understanding performance measurement system on effect of better financial management in managing inventory turnover on ETO manufacturing company, and strategic decisions on supply chain of ETO company (Tao et al., 2024)

6. Conclusions

The findings of this study are had been an important indicator for ETO-manufacturing companies like PT. Hegarmanah, which has been evaluated in this study. Based on the review of literature and performance indicators that had been shown 16 indicators to be consistently perceived as highly important and proven to build as model of performance measurement indicators in the operational management of an ETO manufacturing company. This had been accomplished through a qualitative study and by case-study of specific ETO manufacturing company.

This study is a first stage in the research direction aimed at creating a comprehensive and contextually tailored Performance Measurement System (PMS) for Engineer-to-Order (ETO) manufacturing Company in Indonesia. The study was executed as a singular case analysis at PT. Hegarmanah, concentrating on material management and its influence on inventory turnover. The findings provide a strong foundation for developing a Performance Measurement System (PMS) established on the Knowledge-Based Performance Measurement System (KBPMS) design, however the relevance of them may be restricted to certain contexts. Consequently, further investigations are recommended to examine multi-case studies across diverse ETO industries, including shipbuilding, aircraft, and energy-related manufacturing. Subsequent research should focus on creating standardized measuring tools, validating the established key performance indicators (KPIs) through comprehensive industry surveys, and establishing weighting priorities utilizing quantitative decision models such as ANP or DEMATEL. Future research should focus on establishing a national benchmarking platform that enables ETO enterprises to assess and compare performance according to best practices, facilitating strategic on industries that many types of products (high mix) but not too many quantities per type (low volume) on Indonesia manufacturing business for energy industry sectors.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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