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Implementation of the Least Square Method in Website-Based Product Sales Prediction

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Abstract

PT. Medan Bajaindo, a company engaged in the sales and production of various steel types, faces challenges in managing sales and inventory due to the use of manual and semi-digital systems, which often lead to delays in data processing and inaccurate forecasting. This research aims to design and implement a web-based product sales prediction system using the Least Squares method to improve forecasting accuracy and support more efficient inventory management. The study employed both field and literature research methods, including observation, interviews, and data collection of sales transactions from 2022 to 2024. The Least Squares method was applied to identify sales trends and generate predictive models, resulting in a linear equation Y'=175.19–0.96X that forecasted sales of approximately 140 units for January 2025. The implementation of this model into a web-based forecasting application enabled automatic calculation, visualization, and reporting of sales trends, thus overcoming previous data inefficiencies. The findings show that the system effectively enhances prediction accuracy, accelerates reporting, and supports data-driven decision-making, ultimately improving operational efficiency and reducing financial risks due to overstocking or stock shortages.

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1. Introduction

Forecasting is the systematic process of using historical data to estimate future events by applying statistical methods and scientific analysis. Through this process, organizations are able to identify patterns and trends that inform decision-making about the future. In the economic and business context, forecasting has become a crucial tool in enabling effective and efficient planning—especially when a company seeks to anticipate demand fluctuations, optimize production schedules, and manage inventory levels (Inbound Logistics, 2025; Goltsos, 2022). Accurate forecasts supply the foundational information required to align supply with demand while mitigating risk associated with uncertainty and variability (Babai, 2025; Chawla & Miceli, 2019). Indeed, forecasting is widely treated as an indispensable component of strategic and operational planning (Investopedia, 2003; systematic mapping study, 2023). Without a properly calibrated forecasting mechanism, businesses often respond reactively rather than proactively, thereby risking delayed actions or inefficient resource allocation. As

such, companies operating in competitive environments must rely on forecasting not simply to react to market changes, but to shape their strategic decisions in advance of them (Inbound Logistics, 2025). In summary, forecasting serves as a bridge from data to decision-making, enabling organizations to move beyond retrospective reporting to prospective planning.

PT. Medan Bajaindo is a company engaged in the production and sales of a wide array of steel products—such as carbon steel, alloy steel, stainless steel, tool steel, structural steel, galvanized steel, and spring steel—in Indonesia. Despite the breadth of its product portfolio and the complexity of its operations, the company continues to rely on largely manual or semi-digital methods for sales recording, including paper forms and spreadsheet-based data entry. This approach often leads to delays in the recapitulation of sales data and poses challenges for trend analysis and timely decision-making. In many organizations, manual or semi-digital systems create bottlenecks in capturing and transforming raw transactional data into actionable information (Tong et al., 2023; Garza Ramírez et al., 2021). Because of the slow pace of data processing, management at PT. Medan Bajaindo finds it difficult to estimate future sales volumes with confidence, which in turn complicates inventory planning and control. The lack of timely and accurate trend data prevents the company from aligning its production and sales strategy with actual market demand, which may lead to misalignment between supply and customer needs. Consequently, the company's operations are exposed to the risk of financial losses, operational inefficiencies, and deteriorated customer service when stock levels do not match demand.

The principal challenge faced by PT. Medan Bajaindo lies in the absence of a reliable forecasting mechanism capable of estimating the required quantity and type of products to be supplied in future periods. At present, data collection for the sales process is only semi-computerized, which means the process remains labor-intensive and time-consuming. Additionally, overlapping information between stock and sales records complicates the retrieval of valid and current data, reducing the transparency and accuracy of inventory status. Research shows that when sales and stock data are poorly integrated, organizations struggle with overstocking of slow-moving items or under-stocking of high-demand goods (Goltsos, 2022; Keith, 2023). These imbalances—either excess inventory or shortages—are detrimental: excess inventory ties up capital and space, leads to potential obsolescence, while shortages can result in lost sales and diminished customer satisfaction. In the manufacturing and sales domain, effective inventory management requires the ability to reconcile supply with forecasted demand (Kurawarwala, 1996; Berbain, 2011). Because PT. Medan Bajaindo cannot reliably predict future requirements, it experiences stock buildup for products that move slowly, inability to satisfy customer demand timely, and ultimately loss of competitiveness.

To address these issues, PT. Medan Bajaindo needs a system capable of forecasting future product stock levels and aligning inventory with expected sales demand. One of the quantitative methods suitable for this kind of forecasting is the least squares method—also known as the ordinary least squares (OLS) regression method. The least squares method uses a linear equation to determine the best-fit line through historical data in order to predict future values (Nasution et al., 2023; Landram, Abdullat & Shah, 2007). In practice, the method minimizes the sum of the squared residuals between actual past values and estimated values, yielding a model that can estimate future quantities with a known error margin (ResearchGate, 2018; Chawla & Miceli, 2019). Several studies applying least squares forecasting show its practicality and simplicity for businesses that rely on historical sales data to plan future production or inventory (IJERTE, 2018; Nasution et al., 2023). For example, the least squares method has been successfully used in multiple case studies to forecast raw material acquisitions and sales volumes (Nasution et al., 2023; IJRTE, 2018). By employing the least squares method, PT. Medan Bajaindo could quickly quantify sales volume trends and produce timely reporting, enabling more responsive and strategic inventory management.

This research aims to develop a sales forecasting system using the least squares method to assist PT. Medan Bajaindo in estimating future sales volumes and, by extension, optimizing inventory planning. Specifically, the study will identify the steps required to record product sales in such a way as to eliminate delays in inventory data processing, and then apply least squares forecasting to predict

future stock requirements. By doing so, the company is expected to overcome current constraints—such as delayed data input, irregular reporting, and inventory mismatches—and to gain decision-ready insights into production and inventory planning. The anticipated outcomes include improved efficiency in decision making, enhanced alignment between stock availability and customer demand, reduced losses due to overstock or stock-outs, and stronger competitive positioning in the steel market. The contributions of this study align with broader literature that links forecasting techniques to improved inventory control and supply chain performance (Goltsos, 2022; Babai, 2025; Keith, 2023). Ultimately, the study aims to provide both theoretical and practical contributions: theoretically, by applying and validating the least squares method in a steel industry context; practically, by delivering tangible improvements in the operational planning process for PT. Medan Bajaindo.

2. Research Methodolgy

In completing this research, the author used two research methods:

1. Field Study

   The field study was conducted by the author by conducting direct fieldwork to collect data, specifically by visiting the study location. The data collection techniques used by the author were:

   a. Observation

      The author observed product data and sales forecast data at PT. Medan Bajaindo, specifically in the sales department.

   b. Interview

      This technique involved direct face-to-face meetings with relevant parties to obtain clarification on previously unclear issues, specifically regarding the system mechanisms used at the company, and to ensure that the data collected was accurate. Questions were also posed to the sales department, specifically to Mrs. Cita Halawa. The interview was conducted as follows:

      1. How is the current product sales system operating at PT. Medan Bajaindo?

      Answer:

      Currently, the sales system is still semi-manual. Sales staff record customer orders using a form and then enter them into an Excel file. Afterward, the administration department creates invoices separately. There is no centralized system that can monitor sales data in real time.

      2. What obstacles are frequently encountered in the sales process?

      Answer:

      The main obstacle is delays in recapitulating sales data because it must be done manually. Furthermore, the accumulation of sales data often makes it difficult to analyze.

      3. Has the company ever conducted sales forecasts before? If so, how?

      Answer:

      Yes, but it is still done manually based on the sales team's experience. We roughly look at the previous year's sales data and then estimate targets for the following month or year.

      4. How important are sales forecasts to the company?

      Answer:

      Very important, because sales forecasts help determine the amount of stock to be maintained. Without accurate forecasts, overstocking or understocking can occur, impacting customer service.

2. Literature Research

   The author conducted a literature study to obtain data related to the writing of this thesis from various sources, such as guidebooks on creating PHP applications using HTML, data management, and books or journals on forecasting that discuss the concept of product sales forecasting at PT. Medan Bajaindo.

3. Sampling

Research and select available data relevant to the selected fields as attachments, namely sales documents from PT. Medan Bajaindo in 2023 and 2024.

In developing the system, the author used a fishbone framework or software life cycle model. The software life cycle has the following stages:

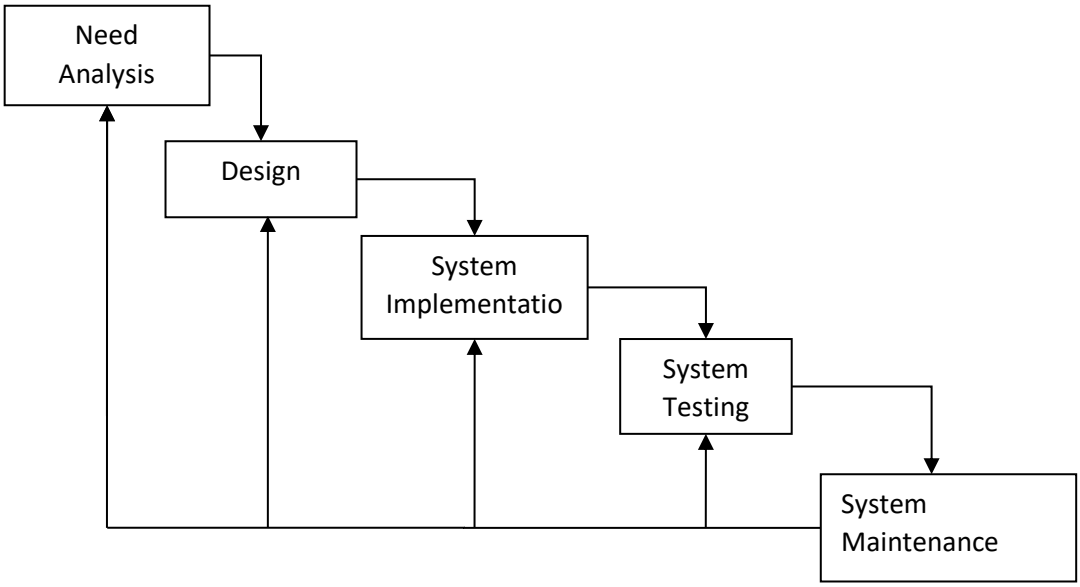

Figure 1. Waterfall Framework

Description:

1. Needs Analysis
   The researcher collected data containing the elements required for the design to be able to solve the existing problems according to the objectives. The data required for system design included product sales prediction data, user data, and the programming language used to create the application, PHP.
2. System Development
   In general, the product sales prediction information system using the Least Squares method at PT. Medan Bajaindo uses the Unified Modeling Language design model, namely use case diagrams, class diagrams, activity diagrams, and sequence diagrams.
3. Method
   The author chose the Least Squares method to design the product sales prediction system using the Least Squares method at PT. Medan Bajaindo.
4. Program Testing
   At this stage, comprehensive application testing was conducted, including functional testing and system robustness testing. Black box (interface) testing is software testing that tests the application's functionality against its internal structure or operation.
5. Results
   The researcher is a user of the product sales prediction information system designed using the Least Squares method at PT. Medan Bajaindo.

3. Results and Discussion

PT. Medan Bajaindo is a company engaged in the sales and production of steel. However, there are several obstacles faced by the company, in the sales process, of course, data collection is needed to

control annual revenue, and the existing data collection is still semi-computerized, so it will take a long time, and information about stock and sales is also overlapping, making it difficult to find it. Because the number and type of ceramic inventory does not match what consumers want, it ultimately causes its own losses for the company. There are several types of products that do not sell quickly, resulting in stock accumulation. Therefore, it is necessary to plan the appropriate number and type so that the company can sell goods before the 1 year deadline. And in obtaining greater profits, it takes quite a long time and the process of inputting product sales data often does not match the transactions that have occurred. The process of fulfilling purchases from customers cannot be fully fulfilled because the stock amount is often unstable so it cannot fulfill purchases from consumers.

The least squares forecasting method, commonly referred to as the least squares method, is a forecasting method that uses a linear equation to find the best-fit line for a set of past data to predict future data. Trend Equation Form: A sales trend is an upward or downward line that indicates the level of sales. The trend equation can take various forms, including: The straight-line equation is formulated as follows:

$$Y' = a + bX$$

Y' = Dependent variable value
X = Independent variable value in the trend analysis (time)
a = Y-intercept, which is the value of Y when X = 0
b = Slope of the trend line
This equation shows a straight or linear line.
Least Squares Method Calculation
Determining the equilibrium value of X2
Calculation of XY
Finding the value of a
Finding the value of b
Trend Equation Calculation

$$\text{I. } \sum Y = Na + b\sum X$$
$$\text{II. } \sum XY = a\sum X + b\sum X2$$

Note:
Y' = Trend
X = The independent variable in trend analysis is time (years)
Y = Sales Amount
N = Number of data
a, b = Constants
Since ∑X = 0 (the middle year = 0), the equation above becomes:

$$\sum Y = Na$$
$$a = \sum Y/N$$
$$N\sum XY = b\sum X2$$
$$b = \sum XY/\sum X2$$

1. Calculation of forecast results: Y' = a + bX [2]

Sales Data Case Study
The following is sales data for bolts and nuts in the carbon steel category from January 2022 to December 2024:

Table 1. Sales Data

No	Month	Year	Amount
1	Januari	2022	145
2	Februari	2022	450
3	Maret	2022	125
4	April	2022	240
5	Mei	2022	456
6	Juni	2022	214

No	Month	Year	Amount
7	Juli	2022	100
8	Agustus	2022	125
9	September	2022	126
10	Oktober	2022	200
11	November	2022	125
12	Desember	2022	125
13	Januari	2023	153
14	Februari	2023	145
15	Maret	2023	100
16	April	2023	300
17	Mei	2023	100
18	Juni	2023	178
19	Juli	2023	245
20	Agustus	2023	123
21	September	2023	89
22	Oktober	2023	145
23	November	2023	100
24	Desember	2023	205
25	Januari	2024	100
26	Februari	2024	123
27	Maret	2024	145
28	April	2024	160
29	Mei	2024	201
30	Juni	2024	239
31	Juli	2024	232
32	Agustus	2024	273
33	September	2024	137
34	Oktober	2024	140
35	November	2024	101
36	Desember	2024	142

In determining the X and Y values in determining the Least Squares Method, it is obtained from determining the X and Y coordinate points, where the X and Y values will be determined using the difference of 2 numbers and then the median value is 0, and can be proven from the image below:

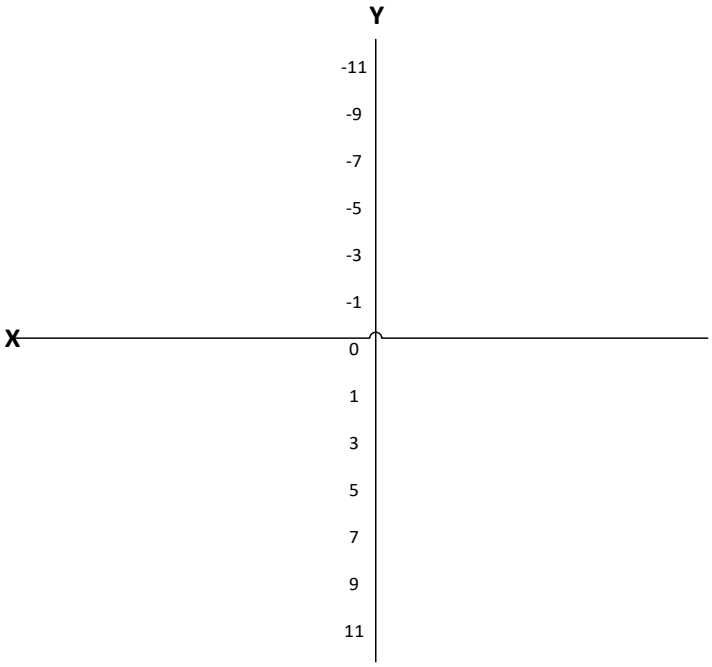

Figure 2. X and Y Coordinates

The following is actual sales data for the period January 2022-2024:

Table 2. Sales Forecast

No	Month	Year	Sale (y)	Periode (x)	x^2	xy
1	Januari	2022	145	-35	1225	-5075
2	Februari	2022	450	-33	1089	-14850
3	Maret	2022	125	-31	961	-3875
4	April	2022	240	-29	841	-6960
5	Mei	2022	456	-27	729	-12312
6	Juni	2022	214	-25	625	-5350
7	Juli	2022	100	-23	529	-2300
8	Agustus	2022	125	-21	441	-2625
9	September	2022	126	-19	361	-2394
10	Oktober	2022	200	-17	289	-3400
11	November	2022	125	-15	225	-1875
12	Desember	2022	125	-13	169	-1625
13	Januari	2023	153	-11	121	-1683
14	Februari	2023	145	-9	81	-1305
15	Maret	2023	100	-7	49	-700
16	April	2023	300	-5	25	-1500
17	Mei	2023	100	-3	9	-300
18	Juni	2023	178	-1	1	-178
19	Juli	2023	245	1	1	245
20	Agustus	2023	123	3	9	369
21	September	2023	89	5	25	445
22	Oktober	2023	145	7	49	1015
23	November	2023	100	9	81	900
24	Desember	2023	205	11	121	2255
25	Januari	2024	100	13	169	1300
26	Februari	2024	123	15	225	1845

No	Month	Year	Sale (y)	Periode (x)	x^2	xy
27	Maret	2024	145	17	289	2465
28	April	2024	160	19	361	3040
29	Mei	2024	201	21	441	4221
30	Juni	2024	239	23	529	5497
31	Juli	2024	232	25	625	5800
32	Agustus	2024	273	27	729	7371
33	September	2024	137	29	841	3973
34	Oktober	2024	140	31	961	4340
35	November	2024	101	33	1089	3333
36	Desember	2024	142	35	1225	4970
	Amount		6307	0	15540	-14923

$a = \sum y / n$
$a = 6307 / 36$
$a = 175.19$
$b = \sum xy / \sum x^2$
$b = -14923 / 15540$
$b = -0.96$
$y = a + b * x$
$y = 175.19 + -0.96 * 37$
$y = 139.67$
So the forecast result for January 2025 is 140.

Below, we will explain the results of the application we created, which is used to clarify the displays in the Website-Based Application of the Least Square Method in Product Sales Prediction at PT. Medan Bajaindo. This will allow the implementation results to be seen in accordance with the program's results. Below, we will explain each display in the program.

1. Forecast Data Form Display

This display is the forecast data input form used to display forecast data. The following image of the forecast data form is shown in 3:

Figure 3: Forecast Data Form Display

2. Forecast Result Data Form Display

This display is the forecast data input form used to display forecast data. The following image of the forecast data form is shown in 4:

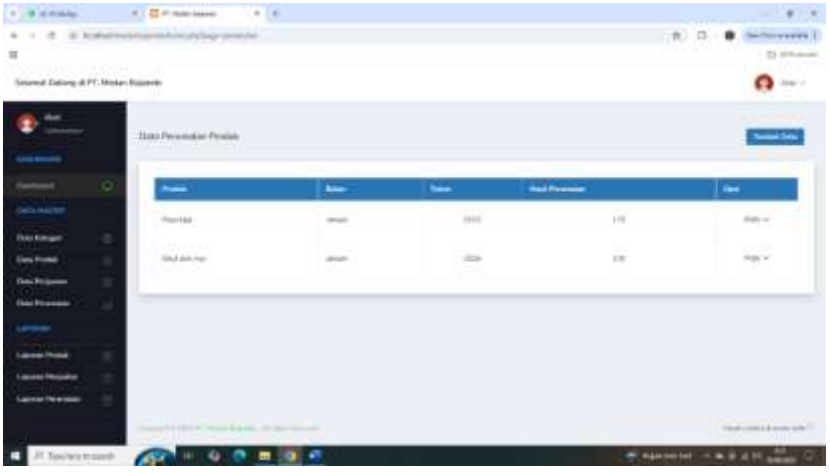

Figure 4. Forecast Result Data Form Display

3. Forecast Analysis Report Form Display

This form displays the forecast analysis data report. When the admin selects a report from the Forecast Analysis report option, the program will display the forecast analysis report. The display of the forecast analysis report form can be seen in Figure 5:

Figure 5. Forecast Analysis Report Form Display

4. Sales Report Form Display

This form displays the sales data report. When the admin selects a report from the Sales Report option, the program will display sales. An image of the sales form can be seen in Figure 6:

Figure 6. Sales Form Display

5. Product Report Form Display

This form displays product data reports. When the admin selects a report from the product report option, the program will display the product. An image of the product form can be seen in Figure 7:

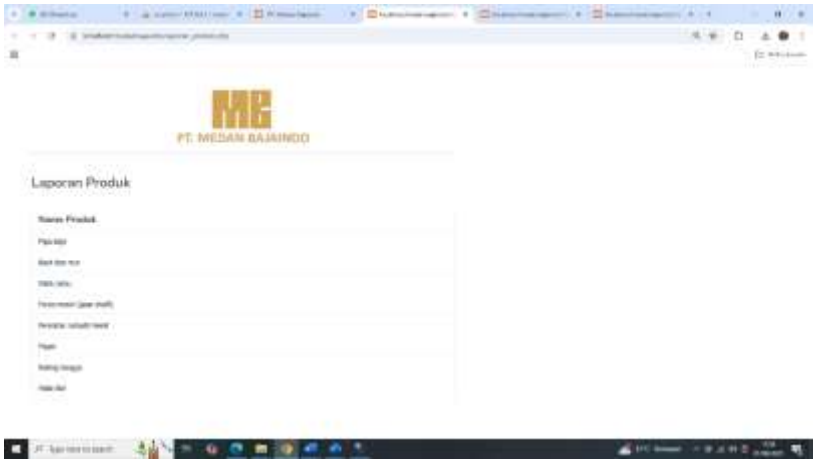

Figure 7. Product Form Display

Discussion

The research findings demonstrate that the application of the **Least Squares forecasting method** provides an effective and systematic approach for predicting product sales at PT. Medan Bajaindo. Through the integration of historical sales data from 2022 to 2024, the model successfully generated a predictive equation of $Y' = 175.19 - 0.96X$, resulting in an estimated sales volume of approximately **140 units for January 2025**. This result illustrates a declining sales trend over the observed period, implying that certain product categories—such as carbon steel bolts and nuts—may experience reduced demand if no corrective measures are implemented. The analysis also confirms that the Least Squares method offers a robust yet computationally simple model for trend estimation, aligning with prior studies emphasizing its reliability in linear forecasting applications (Nasution et al., 2023; Landram et al., 2007). The systematic computation of parameters $a$and $b$minimizes estimation

error and provides a stable reference for short-term sales planning. These findings are consistent with the theoretical framework of time-series forecasting, where linear trend models perform well in data contexts with moderate fluctuations (Babai & Chawla, 2021). Furthermore, the visualization of forecast results through the developed web-based application significantly improves managerial understanding, enabling PT. Medan Bajaindo's decision-makers to interpret patterns dynamically and to anticipate inventory requirements more accurately.

From an operational perspective, the implementation of this forecasting system represents a substantial advancement in the company's **data-driven decision-making process**. Previously, PT. Medan Bajaindo relied on manual and experience-based forecasting methods that were prone to delay, inconsistency, and inaccuracy. The introduction of an automated forecasting platform based on the Least Squares method not only streamlines data processing but also enhances data transparency and accessibility across departments. This transformation supports more **responsive inventory management**, reducing the likelihood of both overstock and stockouts, which have historically led to inefficiencies and financial losses. Moreover, the predictive insights provided by the system empower management to align procurement, production, and distribution strategies with anticipated demand trends. In broader managerial terms, this research highlights the strategic value of embedding quantitative forecasting models within enterprise systems to support continuous performance optimization (Goltsos, 2022; Keith, 2023; Kurawarwala & Berbain, 2011). Overall, the study validates that applying the Least Squares forecasting model not only enhances the precision of sales predictions but also strengthens operational efficiency and organizational adaptability in a competitive industrial environment.

4. Conclusion

This research concludes that the application of the Least Squares forecasting method in the development of a web-based sales prediction system at PT. Medan Bajaindo has been both effective and efficient in addressing the company's forecasting challenges. By utilizing historical sales data from 2022 to 2024, the system successfully produced accurate predictive results, with the model equation $Y'=175.19–0.96X$ indicating a downward trend in product demand. The developed application has resolved previous issues related to manual and fragmented data processing by introducing automation, real-time monitoring, and data visualization features. These enhancements significantly improve decision-making accuracy, inventory control, and operational responsiveness. Overall, the research demonstrates that implementing a quantitative forecasting model not only enhances sales prediction precision but also strengthens the company's capacity for data-driven decision-making and strategic planning in a dynamic industrial environment.

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