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Advanced forecasting techniques in operations management

Abstract

Currently, conducting business has become increasingly complicated due to rapid technical advancements in production processes, which also impact the management of these processes and pose a threat to the survival of firms. Various external influences affecting the internal working environment of companies have compelled organizations to become more adaptable and responsive to change. This research focuses on a key issue for organizations, both private and public, by providing necessary information for making business decisions and analyzing potential events. Forecasting is essential for all businesses, regardless of their industry or the nature of their operations. This paper discusses forecasting, including its significance, stages, methodology, and recent advancements in the area.This article utilized the qualitative technique to gather information by accessing libraries and numerous online resources to obtain data. They draw conclusions about the importance of forecasting for decision-making in businesses based on data from the case study, research literature, and various sources.

Keywords: *Menagment, Business, forecasting, technology, production processes*

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1. Introduction

Operations management is the discipline that focuses on overseeing the conversion of inputs into outputs. Inputs consist of resources that can be transformed (such as materials, information, and customers) and resources that facilitate transformation (like staff and assets). Outputs include products, services, and outcomes. Operations management is a key job in organizations that produce goods or services, whether they are in the private, public, or public-private sector.

Advanced operations management involves overseeing and organizing the resources of organizations and businesses to handle input-output processes effectively. MAO is an essential and ongoing development process that guarantees increased productivity and profitability in every business or organization. All functions and operations should align with the company or organization's strategic goals, following a thorough examination and measurement of present processes, referred to as performance in the context of MAO.

1.2 Content of the research

This research focuses on a key issue for organizations, both private and public, by providing necessary information for making business decisions and analyzing potential events. Forecasting is essential for all businesses, irrespective of their industry, whether they produce things, offer services, or sell products. This paper presents forecasting, its role, stages, methodologies, and achievements in the subject. Moreover, they derive conclusions about the topic through the case study and its analysis.

1.3 Resources used

We utilized material gathered from literature and scholarly journals for the research's development and compilation.

1.4 Research method

This paper utilized the qualitative method to gather information by accessing libraries and online resources.

1.5 Results from the research

The research results indicate that forecasting and its methods are valuable tools for decision-making and selecting appropriate strategies for corporate operations. Forecasting software uses advanced methods to analyze historical data, assess present conditions, and predict future business activity. They commonly execute reporting, analytical processing, data mining, knowledge extraction, business performance management, and data analysis for forecasting. According to research data and analyses from various sources, forecasting is a crucial step for businesses aiming for success and longevity in the market.

2. Materials and Methods

We have divided this chapter into several parts that help to create the theoretical framework of the entire paper in a clear and logical way, where the literature with a large number of definitions, meanings, analyses, writings, etc. has been examined.

Every day, human beings make decisions that have a positive or negative impact on their future. In the business world as well, managers make decisions that have impacts on the future of their respective organizations. These decisions can be positive or negative. The basic nature of forecasting, then, is to make a good and reliable prediction about a future event. Therefore, forecasting can be defined as the art and science of predicting future events. Its purpose is to provide the most objective and essential prerequisites for making business decisions and analyzing events that may occur.

The need for forecasting is inherent in every enterprise, regardless of whether they manufacture, provide services, or sell goods. Enterprises are established to meet the specific needs of their customers, using for capital purposes tangible and human resources and taking actions so that the owners, managers, and other employees in the enterprise earn income while the enterprise is equipped with opportunities for development. (McIntyre, 1987)

Forecasting can find application in:

Inventory control and production planning: forecasting the demand for a product allows us to control the stock of raw materials and finished products, plan the production schedule, etc.

Investment policy: forecasting financial information such as interest rates, stock prices, gold prices, etc. This is

an area in which no one has yet developed a reliable (consistently accurate) forecasting technique.

Economic Policy: Forecasting economic information such as economic growth, unemployment, inflation rate, etc. is essential for both government and business in planning for the future.

Forecasting is a relevant issue in many different areas of management, as it profoundly affects overall performance. Organizations invest large sums based on forecasts for new products, factories, retail outlets, and contracts. In fact, poor forecasting can lead to disastrous decisions.

Since the 1960s, both researchers and practitioners have identified that forecasting is an important issue and have devoted much attention to this topic; indeed, contributions have been made from many different research fields, from econometrics to operations management. (Armstrong, 1987)

The importance of forecasting

Forecasting can play a major role in driving the success or failure of an enterprise. At the basic level, an accurate forecast keeps prices low by optimizing business operations such as cash flow, production, staffing, and financial management. It helps reduce uncertainty and predict changes in the market, as well as improve internal communication and communication between a business and its customers. It also helps increase market recognition for businesses. Moreover, a promising forecast is compelling for investors who may be interested in investing money, i.e., in a business.

For a business to run efficiently, it needs to have an idea of what the future will look like.

A forecast provides this insight as a basis on which to plan. Every functional group within a business benefits from forecasting.

For sales managers, the forecast numbers influence how the sales function is managed. Forecasts also help to understand customer engagement and, therefore, shape marketing efforts. Since forecasts estimate a projected sales volume over a certain period of time, salespeople can use them to set their goals and activities, and subsequent adjustments can be made to achieve those goals. Marketers can use forecasting to evaluate the effectiveness of their campaigns, decide which markets to enter and exit, and determine the life cycle of their products.

Middle managers and finance teams use forecasts to prepare and evaluate financial plans, capitalize production, and estimate needs and logistics. A forecast can help inform critical decisions about how to allocate resources and set overheads within a business. (Carol, 1988)

The importance of forecasting in the field of management

The importance of forecasting lies in its ability to help managers and planners take better actions regarding the future and also help them discharge their functions more effectively.

Figure 1 The steps of the forecasting process

When a manager has access to the anticipated information, he is able to:

The manager is generally better informed in order to clearly define his objectives.

Thinking, generating, and choosing alternatives becomes more focused.

Due to sufficient time, he is able to organize and implement his actions effectively. (Adam & Ebert)

Forecasting methods

There are two methods of predicting based on the type of data collected.

1. Qualitative forecasting approaches rely on subjective opinions rather than statistical models. They enable the description and prediction of events that are not always verifiable through historical evidence. They rely on intuition and previous knowledge regarding how a specific variable evolves. Qualitative methods, also known as intuitive methods, are considered subjective because the outcomes are influenced by the deliberate interpretation of previous experiences. They are: **1. Executive Prespective. 2. Conducting mark research. 3. Delphi method.**

2. Quantitative forecasting methods rely on forecasting models constructed using time series data. The models mentioned are trend models, linear regression, econometric models, and analog models. Forecasting the future involves utilizing statistical and economic models, mathematical models, and models of optimism. The utilization of quantitative methods depends on the presence of certain data. Collecting and processing historical data is essential.

3. Quantitative approaches are generally viewed as more objective than qualitative methods; however, they are most suitable for short-term forecasts. Quantitative methods include time series models analyzing data every 3 months during the past 5 years.
   • Causal models

   Classification prediction

   Forecasts are categorized based on the future time frame they typically depict. Three of these classifications are:
   1. Short-term forecasting typically spans up to one year but is usually shorter than three months. It is utilized for coordinating planning, procurement, task allocation, workforce capacity, and production volume. The medium-term projection, also known as an intermediate forecast, spans from three months to three years. It is beneficial for sales planning, production planning, budgeting, and analyzing different operational strategies.

Long-term forecasting, spanning at least three years, is utilized for strategizing new goods, capital investments, site selection for facilities, business growth, and research and development initiatives. The source is Peterson's work from 1998. Sophisticated forecasting techniques in operations management With the increasing prevalence of computer technology, the use of computer systems for forecasting has become essential. Business intelligence (BI) is the result of combining technology with economic laws and tactics utilized by firms for data analysis.

IB utilizes software to convert data into actionable intelligence for informing a business's behavior and strategic decisions. The advancement of automated techniques in the field of economics has significantly expanded, now encompassing sophisticated approaches that are part of artificial intelligence. Business forecasting is now increasingly being done using artificial intelligence techniques, specifically computer software.

The advancements have rendered the forecasting process and expenses feasible and economical for small and medium-sized enterprises. What is the use of utilizing forecasting software when Excel can serve the same function? This software's primary purpose is to alleviate the need for manual mathematical calculations. Not all businessmen or managers have accounting skills. Forecasting software can assist in analyzing complex data efficiently and streamline the process of drawing up future financial plans.

Forecasting software offers historical analysis, current status, and predictions of corporate operations. They usually conduct tasks such as reporting, analytical processing, data mining, knowledge extraction, business performance management, and data analysis for forecasting. These software applications can process substantial volumes of organized and sometimes disorganized data to identify, generate, and cultivate novel strategic possibilities derived from information. It can provide firms with a competitive edge in the market and ensure long-term stability.

SAS software support

"SAS" means "Statistical Analysis System." It is a type of software that allows us to generate a visual output that can help with business intelligence. In simple terms, SAS is a combination of several programs that help introduce business intelligence. The software used in the integrated SAS system is managed by an organization known as SAS Institute Inc.

The raison d'être of the statistical analysis system is to work with data that is obtained from multiple sources. Data from various sources is collected together and used to perform some kind of statistical analysis to get the expected result.

SAS provides us with a platform to work with specific, complex data to assess the current trend. Raw data is processed to turn it into information that can lead to business benefits.

With SAS, it is possible to store, retrieve, and modify data with the help of a powerful programming language, to use built-in procedures to perform statistical analysis or to produce reports in a standard format, and to perform customized analyses and reports using software technology.

Today's manufacturing leaders are visionaries, seeking ever more efficient methods to produce and move physical goods while thinking beyond productivity, cost savings, and risk reduction. Future survival will require manufacturers to become agile, AI-driven organizations that minimize risk and seize opportunity through deep operational insights and confident decision-making. Manufacturing analytics solutions from SAS allow businesses to tune manufacturing operations for minimal cost and risk while capitalizing on data as an asset that helps you deliver innovative services and the highest quality products possible. (SAS Support)

The significance of SAS software in advanced operations management

- Enhancing quality, productivity, and reliability through the use of analytics integrated with artificial intelligence. Analyzing existing data to uncover more profound insights, identifying any data deficiencies, and transitioning from a reactive to a proactive strategy by implementing scalable data integration and sophisticated analytics.
- Implement a decision framework to direct the company's strategy for analytics. Implementing robust data management and analytics solutions to ensure the success of technology and industry-related initiatives. 4.0

3. Results

This chapter will analyze the findings derived from the literature review.

Case study: Nestle Company

Overview of the company's business and operational management.

Henri Nestle established "Nestle" in 1866, with its main office located in Vevey, Switzerland. In 1990, it amalgamated with the Anglo-Swiss condensed milk firm. Today, it is the largest and most varied food corporation globally, being double the size of its competitors in the food and beverage industry. Nestle has over 323,000 employees across 469 production sites in 86 countries worldwide.

Nestle operates on the philosophy of decentralization, where each country is accountable for managing its own operations, including worker recruiting.
Company name: Nestle
Owner: Paul Bulcke
CEO: Mark Schneider
Total employees: around 323,000

Over the years, the company has undergone changes related to its development and growth in various markets, the expansion of its workforce, the formation of numerous partnerships, modifications to its logo, and the broadening of its product range to include over 2000 brands available in nearly all countries worldwide.

The changes have positioned the company as a leader in the food industry. The organizational structure has shifted from a director and employee hierarchy to one that includes the chairman of the board (CEO), executive board, and board of directors. The "Nestle" company's organizational structure consists of three divisions: global hierarchy, geographic division, and product-based division, which aid in the effective management of operations.

Figure 2 displays the organizational structure according to operations.

The advanced method of forecasting in the company "Nestle"

Accurate forecasting at Nestle enhances customer service, reduces inventory bottlenecks, and lays the groundwork for efficient marketing. Nestle's production lines manufacture around one billion units daily. This statistic represents the vast quantity of commodities manufactured by the world's biggest food corporation. Nestle has introduced 10,000 items to enhance consumers' lives with improved and healthier food and beverages, in line with its commitment to "Good Food, Good Life.".

Nestle relies on forecasting to guarantee the appropriate quantities of items are stocked in their inventory and reach consumers. Even the most exceptional marketing campaigns may fail if Nestle cannot answer consumer requests promptly.

Nestlé's focus on tightly overseeing its supply chain and maintaining minimal stocks is proportional to the scale of its activities. Planning on a global scale is highly complex due to its immense size. Product categories, sales regions, and several participating departments intertwine to form a complex network.

The nature of the food and beverage business presents challenges for operational planning. Seasonal factors, weather dependency for optimal harvest, demand changes, retail trends, and perishable product nature create challenges in production planning and logistical coordination.

Marcel Baumgartner, who oversees worldwide demand planning and statistical forecasting at Nestle's corporate headquarters, describes supply chain management as a well-established and acknowledged procedure within the company. Professionals manage transportation systems, oversee warehouses effectively, and serve as the primary interface for clients. One specific concentration is on planning, particularly demand and supply planning.

Baumgartner states that this approach focuses on two key metrics: customer service levels and inventory levels. One should increase stocks in order to improve customer service levels, which are based on the proportion of deliveries that are complete and on time. Tying up funds and finding storage space might be challenging due to concerns about the freshness of the products.

In this industry, products are processed in large batches to maintain low unit prices, ensure quality, and utilize raw ingredients efficiently. The "make-to-stock" manufacturing method contradicts the "make-to-order" principle commonly found in areas like the automotive industry.

Nestle strongly relies on properly predicting consumer orders to ensure the correct amount of items are available at the right place and time.

Additional commercial concerns, such as budgets and sales objectives, are also significant considerations. The primary objective is for the organization to be proactive rather than reactive. Nestlé does this by emphasizing robust alignment procedures, enhanced cooperation with customers, and utilizing appropriate forecasting software and methodology.

Statistics versus intuition

There are two primary methods for creating forecasts. The subjective method relies mostly on evaluating planners based on the experience they possess. Statistical methodology addresses the prediction issue using data.

Prior to implementing SAS forecasting software, Nestle primarily relied on rudimentary

forecasting methods in conjunction with integrated systems. Nestlé's demand planners analyzed and approved these projections using SAS forecasting software. Nestle found that statistical forecasting is more dependable with ample historical data. They understood that predicting the future solely based on the past is not effective. The key factor in this intricate setting is the ability to evaluate forecast reliability. This is why Nestle decided to utilize SAS software.

Forecasting the demand for a product heavily relies on demand volatility, particularly for items with significant demand changes. The selection and integration of methodologies are crucial. The SAS Prediction Server streamlines this extensive undertaking.

Enhance knowledge, reduce speculation

Nestle uses SAS software due to its scalability, which enables a team of specialists to cover vast geographical areas effectively.

SAS's strength lies in its automated selection of suitable statistical models.

The comparison between the conventional forecasting approach and SAS methods revealed that Nestle is able to equalize and enhance its existing performance for the predictable portion of demand, providing demand planners with valuable space and time.

Kia Motors America Company

Overview of the company's business and operations management

Kia Motors America (KMA) is the American division responsible for sales, marketing, and distribution of Kia vehicles, which is headquartered in Seoul, South Korea. KMA is situated in Irvine, California, and provides a comprehensive range of vehicles through over 755 dealers in the United States. KMA has shown consistent improvement throughout the years. In 2013, Kia Motors America achieved its 18th consecutive year of U.S. market share increase. J.D. Power recognized it as the top mass market brand in entry-level quality for five years running from 2015 to 2019. Kia commenced production at their inaugural US Kia Motors facility in Georgia in November 2009.

The plant currently has a production capacity of 340,000 automobiles per year and handles distribution to several dealers in the US and Canada, as well as fulfilling shipments across North America and internationally.

Company Name: Kia Motors America

Owner: Hyoung-Keun (Hank) Lee General Manager/Chief Executive Officer: Han Woo-Park Employee count: about 55,000

Advanced forecasting method used by Kia Motors America

Kia Motors America utilizes sophisticated analytics and artificial intelligence solutions provided by SAS software to enhance goods, services, and customer happiness.

Advancements like autonomous emergency braking have contributed to the increased safety of vehicles over time. The American Automobile Association (AAA) states that these advanced systems might potentially avert about 9,500 traffic fatalities per year in the United States. Kia, as an automaker, is utilizing advanced analytics and artificial intelligence to enhance safety and quality in its vehicles as engineers explore new technologies for safer driving. Kia Motors has been ranked as the top brand in the mass market for the sixth consecutive year, as per the J.D. Initial Power Quality Study.

A better maintenance experience

John Thornton holds a managerial position in Kia's Legal Division.

Upon joining Kia ten years ago, Thornton quickly identified a chance to enhance performance through improved data. Kia invested in a portfolio of SAS solutions with Thornton's backing and now utilizes sophisticated analytics for various initiatives focused on enhancing Kia's products and services.

Kia Tech is an excellent illustration. If a Kia dealer technician encounters a new issue or struggles to diagnose a car problem, they have the option to contact the helpline. Kia viewed this as a chance to collect data and compile

a report on the primary issues faced by the cars. The Techline report was created as a result.

Before the use of SAS software, personnel spent two days creating the Techline report by merging data from a CRM system, phone logs, and survey replies. By utilizing SAS Visual Analytics software, employees automated the report and decreased the creation time to only 30 minutes. Quicker access to information benefits Techline agents by enhancing the experience for Kia technicians and customers, while also allowing management to monitor agent performance effectively, enabling guidance and enhancing the entire service experience.

Predicting part failures improves safety

The Kia firm places significant emphasis on quality. Kia, like other car manufacturers, aims to enhance quality and minimize warranty expenses by predicting part malfunctions. Manufacturers frequently use weibull analysis to forecast these rates over time and predict the failure rate of each product.

Because of the abundance of components in numerous models and model years, manual computation of this kind is unfeasible. This startup uses sophisticated analytics to automatically do Weibull analysis on each item. The technique starts by summarizing warranty and sales data, then graphs failure rates over time versus mileage, which linearizes part failures and predicts them into the future using a regression line.

Kia uses this data to forecast failure rates and maintenance costs for each vehicle's warranty period, allowing them to reduce costs by making design changes, implementing less expensive repairs, and introducing new service techniques. It also assists the organization in selecting its warranty strategies. Utilizing SAS software provides a significant benefit by allowing the organization to promptly identify durability issues in car parts and assess their effects on customer satisfaction and warranty expenses, which would otherwise take years to uncover. The software allows for the quick generation of a summary report and a "Weibull" analysis for all sections with just a few clicks.

Artificial Intelligence determines meaning in customer insights

Customer input is a valuable resource that manufacturers may use to enhance their products. Kia receives input on its production growth and customer perceptions of its vehicles by analyzing questionnaire responses gathered by the National Highway Traffic Safety Administration. Decoding the responses from this group of individuals might be challenging. Responses vary in clarity and may involve comments on several subjects (various cars), necessitating modern technologies to derive insights from survey responses.

Kia utilizes sophisticated analytics provided by SAS to interpret the significance of consumer feedback. The model categorizes and infers the type of complaint in each response, allowing Kia to spot quality concerns and fix them in the design and production process of current and upcoming vehicles. Kia enhances its service efficiency and provides clients with a good experience by utilizing this forecast.

The projects shown provide insight into Kia's new high standard of excellence, a constant transformation elevating the vehicle from a budget brand to a symbol of quality.

4. Conclusions

This chapter provides a concise overview of the key aspects of the study to enhance the understanding of the research question.

Advanced operations management is a crucial job in organizations that produce goods or services, whether they are in the private, public, or public-private sector. Advanced operations management focuses on designing, planning, controlling, and enhancing complex organizational systems that produce products or services. The method involves making essential and ongoing enhancements to guarantee increased productivity and profitability in every business or organization.

Based on our knowledge and practical experience, including investigated case studies, we can conclude that the principles of operations management presented in lectures align with those implemented in many multinational companies. A corporation focused on growth and longevity prioritizes efficient management of input resources, including design, information, technology, and output resources such as products, services, or outcomes.

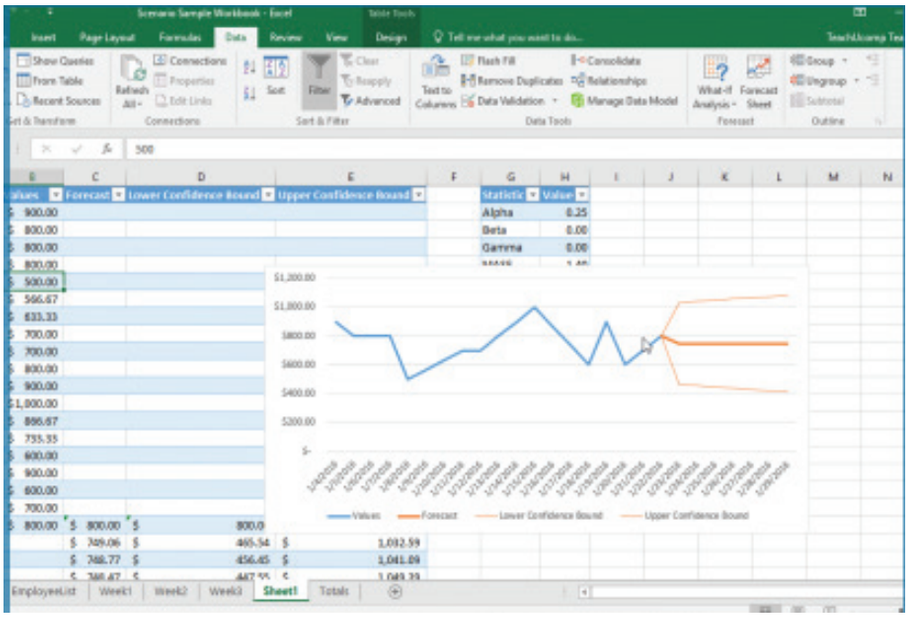

Figure 3 depicts the conventional forecasting approach.

Figure 4 Advanced forecasting method

Operations management and investment in it are more valued in foreign businesses compared to businesses in our country, where the role of an operations manager is not widely recognized or necessary. From my study, most publications and studies on forecasting focus on the significance of forecasting, its various types, and approaches primarily via traditional methods, often through Excel. To discover literature on advanced forecasting methods, research was conducted on international companies' websites. These companies have implemented more advanced business forecasting techniques by utilizing technology, specifically computer software.

How are choices determined in the company you examined in the case study? Both Nestle and Kia Motors are globally expansive companies that operate on a decentralized principle, where each country manages its own operations, including staff recruitment. Are strategic decisions made through consensus or by the company's leadership?

The progress of these two companies, their expansion, the establishment of a positive reputation globally through the provision of secure, top-notch products, and the consistent enhancement of efficiency and productivity are key goals accomplished through effective management, collaboration, dedication, and fostering relationships among employees, executives, and the board of directors. Considering the number of products and brands developed and sold in the international market by these companies, along with the credibility established among consumers and customers, it can be concluded that these two companies have sufficient consensus in strategic decision-making.

How precise is the measurement of productivity in this business? Elaborate!

Nestle is a multinational corporation, which makes it easier to manage the inputs and outputs of the transformation process. Productivity is a key performance indicator in the company, calculated by comparing the number of products produced (outputs) to the input resources used for production, such as energy, employees, raw material costs, and other inputs. Due to the fact that responsible individuals make decisions at each stage rather than a single person in charge of everything, decentralization is a significant factor in evaluating Nestle's production. Similarly, at Kia Motors, productivity is defined as the disparity between outputs and inputs. Productivity will be assessed correctly in the two organizations used as a case study because they create physical items, not provide services.

Can the outcomes of management interventions in the organizational structure and transformation process be anticipated?

The primary focus of this study is forecasting, and it is evident that forecasting and its advanced approaches hold significant importance in both case studies.

Both firms utilize soft forecasting software for various purposes such as demand forecasting, inventory control, financial forecasting, and marketing, in addition to consulting forecasting experts.

Any management involvement in the organizational structure, transformation process, or supplier network of both organizations is foreseeable.

There is a bullet point. Are the business activities you examined characterized by simplicity and repeatability, or complexity and discreteness?

Both case studies involve multinational organizations with a wide global presence, a substantial workforce, and diverse business operations.

Both companies have a geographical division that is further subdivided depending on products due to the complicated nature of the activity.

No further information was provided. To what extent is the company you researched vulnerable to fluctuations?

Nestle Company and Kia Motors are engaged in mass production processes characterized by high volume and limited product variation, resulting in a low degree of variability.

Irrespective of the company's excellence, variability is unavoidable in any process. Operations managers must design processes with consideration of potential hazards and provide management alternatives.

5. Recommendations for the studied companies

After reviewing the literature and publications, it is evident that companies like "Nestle" and "Kia Motors America" have successfully built the necessary software and technology for accurate forecasting. However, we have identified several areas for improvement that we propose addressing.

Nestle should invest in its research and development department to create new products tailored for the elderly, such as protein milk and nutritious cereals, to cater to their daily dietary needs.

Both firms need to ensure that all workers and members at every level have adequate knowledge and expertise about the significance of forecasting to address information asymmetry.

Specifying actions to connect the development team with the planning specialists should establish collaboration between teams.

Utilizing a human resources management platform is essential for both organizations to centralize data, receive email notifications on reports and activities connected to product production, and access detailed visualizations of forecasts and research.

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