JPB REVIEW
INTERNATIONAL JOURNAL OF PROFESSIONAL BUSINESS REVIEW
ISSN: 2525-3654
OPEN ACCESS

ENHANCING SUPPLY CHAIN DECISION-MAKING THROUGH FORECAST FIT: A QUALITATIVE AND QUANTITATIVE ANALYSIS

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ARTICLE INFO

Article history:

Received: May, 15th 2024

Accepted: July, 15th 2024

Keywords:

Data-Driven Decision Making;
Demand Forecasting;
Forecast Accuracy;
Inventory Management;
Organisational Practices;
Qualitative Analysis;
Quantitative Analysis;
Supply Chain Management.

ABSTRACT

Objective: This study investigates the development and relationships between the goodness of fit of demand forecasts and supply chain decision-making within organisations.

Theoretical Framework: Emphasising both qualitative and quantitative perspectives, we explore how accurate demand forecasting is integrated into organisational practices and how it influences evidence-based cultures.

Method: The study employs an empirical case study from a Chilean public health organisation to demonstrate the practical application of advanced forecasting models.

Results and Discussion: Our analysis reveals that precise forecasting methods significantly enhance inventory management, resource allocation, and cost efficiency, while fostering a data-driven decision-making culture.

Research Implications: The findings underscore the importance of integrating accurate demand forecasting into organisational practices to improve supply chain performance and decision-making.

Originality/Value: This study contributes to the literature by illustrating the effectiveness of advanced forecasting models in optimising lot-sizing decisions and achieving substantial cost savings.

Doi: https://doi.org/10.26668/businessreview/2024.v9i8.4880

MELHORANDO A TOMADA DE DECISÕES NA CADEIA DE SUPRIMENTOS ATRAVÉS DO AJUSTE DE PREVISÕES: UMA ANÁLISE QUALITATIVA E QUANTITATIVA

RESUMO

Objetivo: Este estudo investiga o desenvolvimento e as relações entre a bondade do ajuste das previsões de demanda e a tomada de decisões na cadeia de suprimentos dentro das organizações.

Referencial Teórico: Enfatizando tanto as perspectivas qualitativas quanto quantitativas, exploramos como a previsão de demanda precisa é integrada nas práticas organizacionais e como influencia as culturas baseadas em evidências.

Método: O estudo utiliza um estudo de caso empírico de uma organização de saúde pública chilena para demonstrar a aplicação prática de modelos avançados de previsão.

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Resultados e Discussão: Nossa análise revela que métodos precisos de previsão melhoram significativamente a gestão de inventário, alocação de recursos e eficiência de custos, ao mesmo tempo que promovem uma cultura de tomada de decisão baseada em dados.
Implicações da Pesquisa: Os achados destacam a importância de integrar a previsão de demanda precisa nas práticas organizacionais para melhorar o desempenho da cadeia de suprimentos e a tomada de decisões.
Originalidade/Valor: Este estudo contribui para a literatura ao ilustrar a eficácia dos modelos avançados de previsão na otimização das decisões de dimensionamento de lotes e na obtenção de economias substanciais de custos.

Palavras-chave: Tomada de Decisões Baseada em Dados, Previsão de Demanda, Precisão da Previsão, Gestão de Inventário, Práticas Organizacionais, Análise Qualitativa, Análise Quantitativa, Gestão da Cadeia de Suprimentos.

MEJORANDO LA TOMA DE DECISIONES EN LA CADENA DE SUMINISTRO A TRAVÉS DEL AJUSTE DE PREVISIONES: UN ANÁLISIS CUALITATIVO Y CUANTITATIVO

RESUMEN
Objetivo: Este estudio investiga el desarrollo y las relaciones entre el ajuste de la bondad de las previsiones de demanda y la toma de decisiones en la cadena de suministro dentro de las organizaciones.
Marco Teórico: Enfatizando tanto las perspectivas cualitativas como cuantitativas, exploramos cómo se integra la previsión de demanda precisa en las prácticas organizacionales y cómo influye en las culturas basadas en la evidencia.
Método: El estudio emplea un estudio de caso empírico de una organización de salud pública chilena para demostrar la aplicación práctica de modelos de previsión avanzados.
Resultados y Discusión: Nuestro análisis revela que los métodos de previsión precisos mejoran significativamente la gestión de inventarios, la asignación de recursos y la eficiencia de costos, al tiempo que fomentan una cultura de toma de decisiones basada en datos.
Implicaciones de la Investigación: Los hallazgos subrayan la importancia de integrar la previsión de demanda precisa en las prácticas organizacionales para mejorar el rendimiento de la cadena de suministro y la toma de decisiones.
Originalidad/Valor: Este estudio contribuye a la literatura al ilustrar la efectividad de los modelos de previsión avanzados en la optimización de decisiones de tamaño de lote y en el logro de ahorros de costos sustanciales.

Palabras clave: Toma de Decisiones Basada en Datos, Pronóstico de Demanda, Precisión del Pronóstico, Gestión de Inventarios, Prácticas Organizacionales, Análisis Cualitativo, Análisis Cuantitativo, Gestión de la Cadena de Suministro.

1 INTRODUCTION

In this paper, we examine the development and relationships between the goodness of fit of demand forecasts and supply chain decision-making in organisations. We focus on how these relationships have been integrated into organisational practices and how the evidence cultures used for supply chain decision-making within these organisations have changed.

2 THEORETICAL FRAMEWORK

2.1 INTEGRATION OF FORECAST FIT INTO ORGANISATIONAL PRACTICES

The studies on the importance of forecast fit in supply chain decision making consistently highlight the critical role that accurate demand forecasting plays in enhancing organisational practices. For instance, Forslund and Jonsson (2007) and Pekgün et al. (2019) illustrate that improved forecast accuracy directly impacts inventory management and resource allocation. By integrating precise forecasting methods, organisations can better align their inventory levels with actual demand, thus minimising both overstock and stockout situations, which ultimately leads to cost savings and improved service quality.

Badulescu et al (2021) and Rajesh (2016) emphasize the need for robust frameworks to evaluate forecast models. These frameworks ensure that the chosen models are consistently producing reliable and accurate forecasts, which are crucial for making informed supply chain decisions. The integration of such frameworks into organisational practices has led to a more systematic approach to evaluating and selecting forecasting models, thereby improving overall supply chain efficiency.

2.2 CHANGES IN ORGANISATIONAL EVIDENCE CULTURES

The incorporation of accurate demand forecasts into supply chain decision making has also brought about significant changes in the organisational cultures of evidence used for these decisions. Bousdekis et al (2021) and Baginski et al (2017) highlight that organisations are increasingly relying on data-driven decision making. This shift towards a culture that values empirical evidence and robust data analysis over intuition or anecdotal evidence has enhanced the reliability and effectiveness of supply chain decisions.

Moreover, studies such as those by Moon (2018) and Babai et al (2022) show that accurate demand forecasting fosters a culture of continuous improvement. Organisations that prioritise forecast accuracy are more likely to invest in training and development to enhance their forecasting capabilities, leading to ongoing improvements in their supply chain processes. This commitment to continuous improvement not only boosts forecast accuracy but also drives innovation and efficiency across the supply chain.

2.3 IMPACT ON STRATEGIC PLANNING AND RISK MANAGEMENT

Accurate demand forecasts are not only crucial for operational decisions but also play a vital role in strategic planning and risk management. Feddersen and Cleophas (2024) note that organisations with accurate demand forecasts are better positioned to develop strategic plans that align with market realities. This alignment helps organisations to anticipate and respond to market changes more effectively, thereby gaining a competitive advantage. Ultimately, accurate demand forecasts derived from business intelligence systems and machine learning can lead to up to 9238% accuracy in intelligent demand forecasts, positively impacting organisational positioning and decision-making processes, see Khan et al (2020).

Furthermore, Rosienkiewicz (2021) demonstrate that accurate forecasting reduces the risk of overstocking and stockouts, which are common sources of financial loss and inefficiency in supply chains. By mitigating these risks, organisations can ensure more stable and predictable operations, which is essential for long-term strategic planning.

2.4 EVOLUTION OF FORECASTING PRACTICES

The evolution of forecasting practices within organisations, as highlighted by these studies, indicates a shift towards more sophisticated and data-driven approaches. For example, Sanders and Graman (2016) show that advanced forecasting models and technologies are being adopted to improve forecast accuracy. These models leverage large datasets and advanced analytics to produce more accurate and reliable forecasts, which are crucial for effective supply chain management.

Additionally, the studies reveal that there is a growing recognition of the need for collaboration and information sharing within the supply chain to enhance forecast accuracy. Badulescu et al (2021) and Moon (2018) emphasize the importance of integrating supplier and customer data into forecasting models to achieve a more holistic view of demand. This integration fosters greater transparency and collaboration across the supply chain, leading to more accurate forecasts and better decision making.

The studies analysed underscore the importance of forecast fit in supply chain decision making. Accurate demand forecasts enhance organisational practices, foster a data-driven culture of evidence, improve strategic planning and risk management, and drive the adoption of advanced forecasting practices. These developments collectively contribute to

more efficient and resilient supply chains, highlighting the critical role of forecast accuracy in modern supply chain management.

3 METHODOLOGY

3.1 QUALITATIVE ANALYSIS

Qualitative Studies on the Importance of Forecast Fit in Supply Chain Decision Making Up to this point, and without attempting to be exhaustive, it is possible to verify that a large part of the studies have addressed the topic from a quantitative perspective, where there seems to be little questioning, given the substantial evidence that accurate demand forecasts would improve supply chain management in organisations. We will now focus on qualitative studies on the importance of forecast fit in supply chain decision making.

3.2 DATA COLLECTION

Historical data from the organization were collected, including clinical analysis determinations, setup costs, purchasing costs, storage costs, and stockout costs.

3.3 FORECASTING METHODOLOGY

Generalized Autoregressive Moving Average (GARMA) models were used to simulate time series of demand. The best-fitting model was selected using the Akaike Information Criterion (AIC). The accuracy of the forecast was evaluated using the Mean Absolute Percentage Error (MAPE).

3.4 SUPPLY CHAIN OPTIMIZATION

The organization employs a two-stage stochastic programming framework with temporal dependence to optimize lot-sizing decisions in inventory systems with time-dependent random demands.

3.5 CORRELATION ANALYSIS

The relationships between MAPE, AIC, and percentage cost savings were analyzed using Pearson correlation coefficients.

4 RESULTS AND DISCUSSIONS

Table 1 summarises several studies with a qualitative focus, where the importance of forecast fit in supply chain decision making in organisations, their contributions, methods, and main findings can be analysed.

Table 1

Studies with qualitative focus on importance of forecast fit in supply chain decision making in organisations, their contributions, methods, and main findings.

Reference	Contributions	Method	Results
Menon et al (2022)	Develops theory for service supply chain fit	Qualitative study based on service-dominant logic	Service supply chain impacts operant resources and firm performance.
	Validates model with survey data	Validation through survey data	Strategic view and investment needed for service supply chain fit.
Sabri, Y (2019)	Bridging gap in supply chain fit literature	Case study	Organisational structure moderates supply chain fit and firm performance relationship.
	Developing a conceptual framework for future testing	Data collection from key respondents	Decision-making centralisation and coordination are critical internal uncertainty factors.
Avci (2018)	Factors influencing forecast accuracy: production, information, human, technology	Qualitative and quantitative data collection	Forecast accuracy influenced by production, information, human factors, technology and tools.
	New factors: organizational culture, new product development, supplier delivery performance	Case study analysis at an FMCG company	New factors: organizational culture, new product development, supplier delivery performance.
Wu and Chen (2018)	Improved grey models for accurate small sample system analysis.	GM (,), GDES, GMC (,N) models discussed	Proposed models outperform traditional grey models in prediction precision.
	Incorporation of human judgment for enhanced supply chain forecasting.	Incorporate human judgment for future trend forecasting.	GIM provides more information with predictive values in forecasting interval.
Park(2016)	Investigate capacity allocation policies on human behavior in forecasting decisions	Forecast-accuracy based allocation	Improved order forecast accuracy with forecast-accuracy based allocation.

	Address forecast sharing and ordering behavior for supply chain management	Information disclosure on allocation policy	Supplier's information disclosure enhances order forecast accuracy under uniform allocation.
Sanders and Graman (2016)	Study impact of forecast sharing on two-stage service supply chain.	Simulation of distribution-storage facility based on realistic cost data.	Forecast bias magnification impacts supply chain costs significantly.
	Highlight detrimental effects of bias and standard deviation magnification.	Corroboration of findings through survey data.	Forecast sharing mitigates impact, especially at higher forecast standard deviation levels.
Alexander and Walker (2016)	Elaboration of theory around SSCM and DT.	Cross-sector qualitative case studies	Elaboration of theory around sustainable supply chain management (SSCM) and decision theory (DT)
	Distinction between efficiency measures and effectiveness in SSCM outcomes.	Analysis of internal and external factors	Distinction between efficiency measures and effectiveness in organizational resource and SSCM outcomes
Albarune, and Habib (2015)	Reveals limitations and practical solutions on forecasting practices.	Secondary data analysis	Demonstrates forecasting practices in SCM in Pharmaceuticals, Retail, and FMCG.
	Proposes a forecast management model for organizations.	Case studies highlighted	Reveals limitations, practical solutions, recommendations, and proposes a model.
Babai et al (2022)	Identify how forecasters respond to countervailing events influencing sales.	Statistical forecasting	The participants responded to the quantity of information made available.
	Examine statistical characteristics of supply chain forecasts for potential improvement.	Qualitative information through a forecasting support system	There was a consistent bias towards underestimating the effect of promotions.
Balachandra et al (2020)	Connects judgmental inputs to forecasts and inventory decisions	System dynamics theory	Connecting judgmental inputs into forecasts and inventory decisions improves supply chain performance.
	Improves forecast accuracy and enhances supply chain performance	Connecting judgmental inputs into forecasts and inventory decisions	Adjusting final output based on contextual information leads to better forecast accuracy.
Ashfaq et al (2012)	Analyzing integration of supply chain functions and customer satisfaction	Analyzing supply chain functions and customer satisfaction	Supply chain integration leads to customer satisfaction
	Emphasizing strategic fit of supply chain in Pakistan's environment	Collecting data through questionnaires from big stores	Big stores manage demand forecast effectively for customer satisfaction
Fildes et al (2006)	Identify design features of FSSs to improve forecasting accuracy.	Decomposition facilities for accurate forecasts	FSS design features to improve forecasting effectiveness
	Learn about decision support and enhance forecasting practice.	Menu structures to guide users towards appropriate strategies	Users often make poor quantitative method choices

Source: Own elaboration

Figure 1 shows a word cloud generated from the previously described qualitative studies.

Figure 1

Word cloud generated from the previously described qualitative studies

Source: Own elaboration

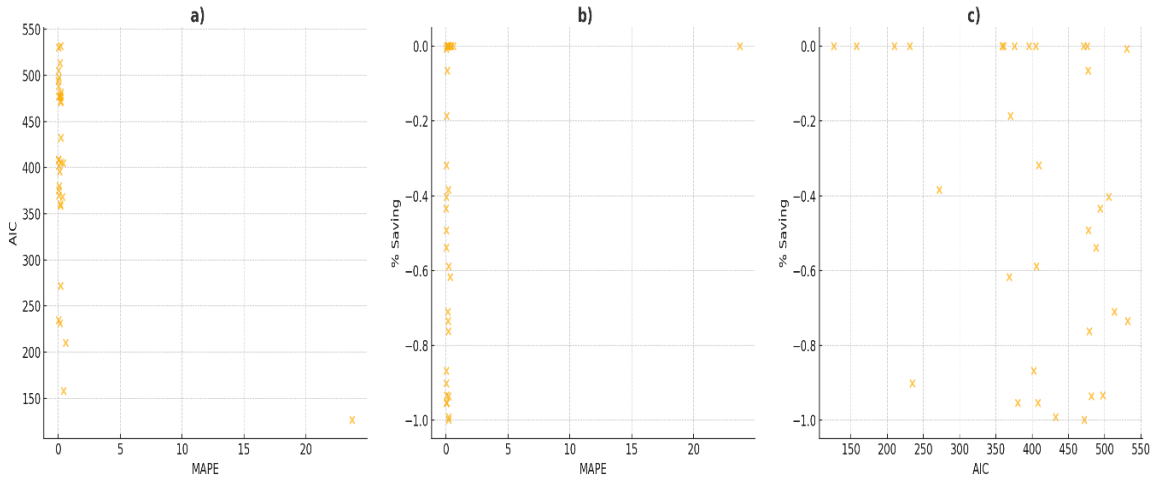
The word cloud generated from the qualitative studies highlights key themes such as "forecasting," "supply chain," "performance," and "information," indicating the crucial role that accurate demand forecasts play in enhancing supply chain management within organisations. The term "forecast accuracy" appears prominently, underscoring its importance in aligning organisational practices with market demands.

An illustrative example: as a way to empirically demonstrate the relationships between the goodness of fit of demand forecasts and supply chain decision-making in organisations, we have gathered qualitative and quantitative data from an anonymous Chilean public health organisation, where clinical analysis determinations are conducted. These data have been made available for this study and can be requested from the author. It is well known that one of the most relevant ways to measure the performance of supply chain decision-making models is by evaluating the total costs involved in this process, namely: setup costs, purchasing costs, storage costs, and/or stockout costs. The illustrative organisation bases its supply chain decisions on a two-stage stochastic programming framework with a temporal dependence context, given the nature of the items comprising its inventories. This is an advanced approach for optimising lot-sizing decisions in inventory systems with time-dependent random demands. According to

Rojas et al. (2019), this methodology involves simulating demand time-series using generalised autoregressive moving average (GARMA) structures to capture temporal patterns in demand data, and subsequently using it in purchase lot-sizing. The Akaike Information Criterion (AIC) is employed to select the best-fitting GARMA model, ensuring that the Mean Absolute Percentage Error (MAPE) of the demand forecast is accurate and thus theoretically improving inventory management decisions. However, according to our qualitative findings, the use of these advanced decision-making models should have a strong correlation with achieving truly minimal total supply chain costs for the organisation, leading to a percentage of savings when comparing the total cost (TC) result against a non-optimal inventory policy. Figure 2 shows scatter plots between a) MAPE and AIC, b) MAPE and Saving, and c) Saving and AIC. Table 2 shows the Pearson correlation coefficient and their statistical significances for the same pairs of relationships.

Figure 2

Scatter plots between a) MAPE and AIC, b) MAPE and Saving, and c) Saving and AIC.



Source: Own elaboration

Table 2

Matrix correlation between MAPE and AIC, MAPE and Saving, and Saving and AIC.

Variable	Pearson Correlation	p-Value
MAPE/AIC	-0.467	<0.005
MAPE/Saving	-0.097	0.589
AIC/Saving	0.374	<0.05

Source: Own elaboration

The recent analysis provided insights into the relationships between MAPE, AIC, and percentage savings.

1. relationship between MAPE and AIC: The Pearson correlation coefficient is -0.467 with a p-value of 0.0062, indicating a moderate negative correlation that is statistically significant. This suggests that as AIC increases, MAPE tends to decrease, implying that models with higher AIC values generally have lower prediction errors;
2. relationship between MAPE and Percentage Savings: The Pearson correlation coefficient is 0.200 with a p-value of 0.263. This weak correlation is not statistically significant, indicating no clear relationship between the mean absolute percentage error and the percentage of savings. Thus, prediction accuracy does not appear to directly influence the savings achieved;
3. relationship between AIC and Percentage Savings: The Pearson correlation coefficient is -0.338 with a p-value of 0.054, suggesting a moderate negative correlation that is close to being statistically significant. This implies that higher AIC values tend to be associated with lower percentage savings, leading to a percentage of savings when comparing the total cost (TC) result against a non-optimal inventory policy.

In summary, the analysis highlights significant correlations between AIC and MAPE, but not between MAPE and percentage savings. The near-significant correlation between AIC and percentage savings suggests that the selection criteria of the model (as indicated by AIC) may have an impact on the savings achieved, though further investigation would be needed to confirm this relationship.

5 CONCLUSION

The findings of this study highlight the crucial importance of accurate demand forecasting in supply chain management. Accurate forecasts enable organisations to align inventory levels with actual demand, minimising overstock and stockout situations, and leading to significant cost savings and improved service quality. The integration of robust forecasting frameworks into organisational practices ensures consistent production of reliable forecasts, facilitating informed decision-making processes.

Furthermore, the shift towards data-driven decision-making cultures within organisations has enhanced the reliability and effectiveness of supply chain decisions. Organisations that prioritise forecast accuracy are more likely to invest in training and development to enhance their forecasting capabilities, fostering a culture of continuous

improvement. This commitment to data-driven decision-making not only boosts forecast accuracy but also drives innovation and efficiency across the supply chain.

The empirical evidence from the Chilean public health organisation demonstrates the practical benefits of advanced forecasting models in real-world settings. The use of sophisticated decision-making models, such as the two-stage stochastic programming framework with temporal dependence, leads to more accurate inventory management decisions and substantial cost savings. The analysis of the relationships between Mean Absolute Percentage Error (MAPE), Akaike Information Criterion (AIC), and percentage savings underscores the significance of selecting appropriate forecasting models to optimise supply chain performance.

In conclusion, this study provides valuable insights into the critical role of forecast fit in modern supply chain management. By integrating accurate demand forecasting methods and fostering data-driven decision-making cultures, organisations can achieve more efficient, resilient, and competitive supply chains. These findings offer practical guidance for organisations seeking to enhance their supply chain management practices through improved forecast accuracy and advanced analytical techniques.

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