3º LUGAR

The forecasting process as a planning tool in cost accounting of a military organization providing services to the Brazilian Navy

O processo de previsão como ferramenta de planejamento na contabilidade de custos de uma organização military prestadora de serviços da marinha do Brasil

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Luiz Sérgio Carvalho de Mello
Rio de Janeiro – RJ
Master's Degree in Accounting from UERJ[1]
luiznvufrj@yahoo.com.br

Isabelle Leal da Silva Cardoso
Rio de Janeiro – RJ
Master's Degree in Accounting from UERJ
isabellelscardoso@gmail.com

Mauro Tavares dos Santos Junior
Rio de Janeiro – RJ
Master's Degree in Accounting from UERJ
maurotavares2@yahoo.com.br

José Francisco Moreira Pessanha
Rio de Janeiro – RJ
PhD in Electrical Engineering from UERJ
professorjfmp@hotmail.com

ABSTRACT

The use of Cost Accounting in the public sector makes it possible to analyze the application of public resources by institutions in favor of delivering better goods and services to society. In this sense, planning is an essential element for successful results and achieving greater efficiency in public spending. In this way, the forecasting process, through modern statistical tools, presents itself as a tool capable of providing greater precision and robustness to public managers' decision-making. In this context, the Brazilian Navy has in its structure the Military Service Provider Organizations (OMPS) which, among its activities, carry out industrial ship repair and maintenance services and in its accounting structure it uses costs as a planning parameter for its expenses. Therefore, the study in question aimed to evaluate how the forecasting process, based on the Holt-Winters method, can contribute to the planning of OMPS cost accounting. After executing the process, it was possible to obtain management information such as seasonal periods and trends, in addition to an estimated annual cost, which was 98.99% closer to the result of the annual cost observed in the 2023 fiscal year, demonstrating that the process can be useful to the planning the costs of OMPS.

Keywords: Cost Forecast. Military Service Provider Organization (OMPS). Holt-Winters model. Brazil's Navy.

1. INTRODUCTION

The use of Cost Accounting in the public sector makes it possible to demonstrate how the resources obtained through taxes and fees from taxpayers have been applied by public bodies and entities in fulfilling their mission, which is to produce and deliver quality goods and services to citizens.

In this sense, public managers are the main users of cost information, which can be used to assist “the processes of planning, decision-making, monitoring, performance evaluation, transparency, accountability and responsibility” (CFC, 2021, p. 4).

In view of the need to ensure efficiency and optimize results, the public administration has been looking for tools to help managers accomplish these processes. Thus, in the quest to fulfill its constitutional mission, the Brazilian Navy (MB) established the OMPS System (Military Service Provider Organizations) in 1994, which is based on Cost Accounting (cost measurement and control), since its operation consists of a Military Organization (OM) providing services to other OM of the MB itself (BRASIL, 2020). Among them, those OM classified as Industrial (OMPS-I) stand out, as they provide services to the operational area of the Force, performing or managing the maintenance of its ships (SANTOS JUNIOR et al., 2023a).

It is worth mentioning that, at a strategic level, the MB has the Navy's Strategic Plan (PEM 2040), a document that contains conceptual and doctrinal elements to guide the institution’s planning through Naval Objectives (OBNAV). From the OBNAV, in less detail, the Naval Strategic Actions (NEA) are specified. In this way, it should be noted that this research is in line with AEN-ADM-3, a goal of the PEM 2040, which aims to improve Cost Management in the MB in order to support decision-making by the Naval Administration.

According to Santos Junior et al. (2023a), Cost Accounting provides management information for the Senior Naval Adminis-

1 UERJ – Rio de Janeiro State University – Maracanã - Rio de Janeiro – RJ – CEP 20550-900.

tration and, like all areas of the public sector, needs continuous improvement in line with modern techniques that allow for greater precision in decision-making, because, in addition to measuring and controlling costs, OMPS need to project production costs for the following fiscal year of operation in order to subsidize the collection of operating fees from customers, which is a significant challenge for OMPS (BRASIL, 2020), given that there is no support system for performing this task, thus presenting a gap in this cost forecasting process in the MB.

According to Sousa et al. (2017) and Hoover (2021), the adoption of statistical methods and tools for cost forecasting can contribute to the planning of institutions, while also enabling the identification of seasonalities and trends. Among the statistical methods used to create predictive models we can cite the Holt-Winters exponential smoothing method because, according to Petropoulos, Wang and Disney (2019), this method stands out for the simplicity of its application and for obtaining results with good accuracy when compared to more complex methods.

In this context, given that Cost Accounting, in addition to generating cost information, also needs to plan its costs, expenses and operating rates, this study aims to assess how the forecasting process, based on the Holt-Winters method, can contribute to the cost accounting planning of OMPS.

In this way, this research is relevant to the improvement of Strategic Cost Management, especially in the Brazilian Navy, since cost forecasting is a solid basis for effective decision-making and for the efficient application of public resources in an OMPS-I of the MB, which contributes to better planning, transparency, accountability and efficiency in financial management, benefiting the organization and society in general.

In addition, it broadens the research findings and the debate on the subject in question (cost forecasting in the public sector), and presents as a practical contribution the design of a tool that can be used by MB to project costs (forecasting model) for the following fiscal year, bringing opportunities for improvement to the Cost Accounting of OMPS-I. In order to achieve the established objective, this research is structured as follows: introduction, literature review, methodology, results and conclusion.

2. LITERATURE REVIEW

2.1 Planning in Public Administration

Planning can be defined as “the way of programming and managing the future, thinking about the consequences and adaptations to reality and to the physical, budgetary, financial and historical facts that intervene in the course of an action and that can influence the expected results” (SOUSA; BATISTA; ANDRADE, 2004, p. 45).

According to Casimiro and Moraes (2017), planning in public administration is essential for an efficient and effective performance by public managers and consists of a fundamental institutional tool for decision-making, for the allocation of resources and for the definition of public policies, going beyond the budgetary sphere.

Public management planning provides managers with a managerial vision and puts them on the path to fulfilling the mission legally imposed on public institutions, which allows accounting to prove all its forecasts and achievements. In addition, given the need to reliably demonstrate the use of public resources, accounting information has become an essential tool for planning and transparency in public bodies (SOUSA; BATISTA; ANDRADE, 2004; BRANDALISE; FELLA; ZAMIN, 2009).

Neto, Almeida and Almeida (2020) highlight that public administration has demanded that its planning processes be constantly improved with the use of tools and techniques similar to those used in the private sector. In this context, according to Mello, Santos Junior and Pessanha (2021), predictive processes in the public sphere are essential planning tools. This view is shared by Silva, Santos and Costa (2016), who mention that forecasting methods applicable to planning processes can contribute to reducing organizations' costs.

Thus, according to Hoover (2021), forecasting can be defined as the process that uses statistical methods to obtain estimates based on historical and current data. In addition, Hoover (2021) and Goodwin et al. (2023) state that the implementation of forecasting processes in organizations proves to be the key to success in a number of senior management decisions. As the authors state, the implementation of these processes in the context of the bodies' planning can provide greater precision and accuracy in the information generated and, consequently, in the decisions made.

However, when including predictive processes in the day-to-day of organizations, it is necessary for the top of the hierarchical chain to encourage their use and the preparation of managers, so that these processes are not forgotten and misused in the preparation of management documents (GOODWIN et al., 2023).

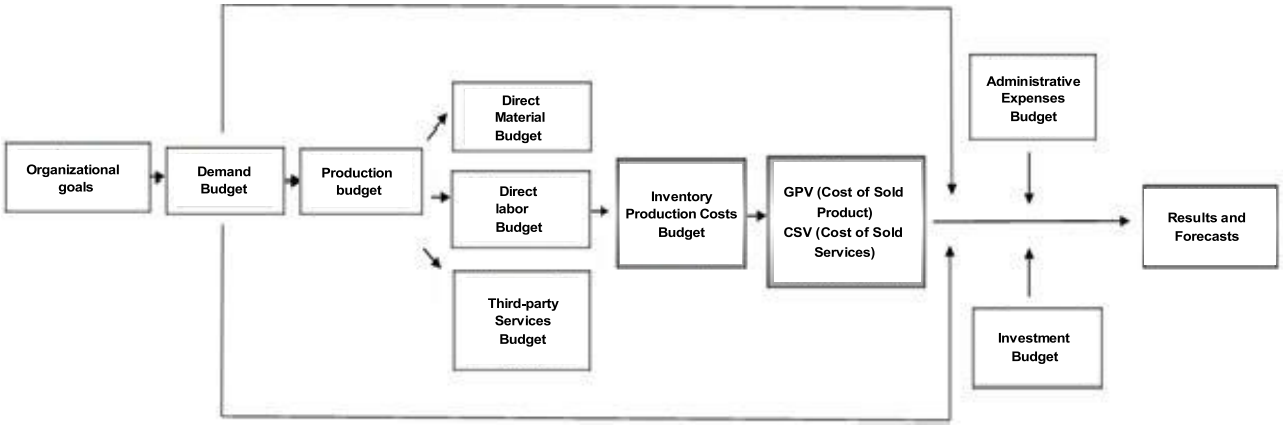
The cost accounting of OMPS-I, according to Santos Junior et al. (2023a), requires the Naval High Administration to adopt good management practices, which include tools and techniques, such as predictive processes operationalized by statistical software, such as R (R CORE TEAM, 2023), promoting efficiency, efficacy and effectiveness in its application. (SILVA; SANTOS; COSTA, 2016).

2.2 The OMPS System and Cost Accounting in the Brazilian Navy

The adoption of a managerial model in public administration, which took place from the 1980s onwards, represented a shift in focus from processes to results, increasing the need for control and monitoring by public managers in meeting what was planned, based on the comparison between budgeted and realized costs (OLIVEIRA; SILVA; BRUNI, 2012; SANTOS et al., 2013).

In Brazil, the effects of these new administrative standards became more visible in the early 1990s. At that time, because the Brazilian Navy did not have a well-structured cost system, it faced problems in the financial and asset management of its productive OMs. As a result, in 1994, the OMPS System (or systematics) was set up, a management model which, supported by Cost Accounting concepts and data from the Federal Government's Integrated Financial Administration System (SIAFI), aimed to boost efficiency and productivity in this part of the MB (BRASIL, 2020; SANTOS *et al.*, 2013).

Figure 1 – Scheme for the elaboration of the OROF



Source: MOROF (2024).

The OMPS handle/move around R$900 million annually and play a fundamental role in the logistical effort related to fulfilling the MB's constitutional mission. The main characteristic that differentiates the OMPS from other MB units is the financial and budgetary dynamics to which they are subject, which establishes that their only source of funding must be the income obtained from providing services. Therefore, the aim was to increase autonomy and encourage creativity and efficiency in the management of these OMs, since, due to the scarcity of public resources, managers are forced to seek to reduce production costs and improve services, in order to maintain the economic viability of operations (SANTOS JUNIOR *et al*., 2023b; SANTOS *et al*., 2013).

The OMPS costing system is based on absorption costing. As such, OMPS expenses are composed of direct and indirect costs, which are related to production, and administrative expenses, which are expenses intended to cover the cost of the military unit's administrative structure. Clients are charged fully for the direct costs, while indirect costs and administrative expenses are billed on an estimated basis, based on operating rates. The setting of rates is guided by the preparation of the Operational and Financial Budget (OROF), which is a budget planning tool designed to integrate the various activities of the OMPS and the goals foreseen in its strategic planning (BRASIL, 2020; BAPTISTA; SILVA, 2010). Figure 1, adapted from the OMPS Operational and Financial Budget Manual (MOROF), summarizes the planning process embodied in the OROF:

The use of operating fees is not just an accounting technique to cover costs but is a crucial aspect for the functioning of the budgetary and financial dynamics that sustain the OMPS system. Therefore, if they are too high, these fees can reduce the demand for OMPS contracts and produce high net results, unnecessarily charging clients, but if they are too low, they can produce insufficient revenue to maintain the physical structure of the OMPS, limiting its capacity to produce services for the MB. As a result, the OROF and the fees planned by OMPS are carefully evaluated by its Superior Command, with the aim of maintaining a healthy relationship between the prices charged and OMPS's cost structure (SANTOS JUNIOR *et al*., 2023b).

Within the financial and budgeting process of OMPS, the projection of production costs is a fundamental step, directly impacting the prices charged and, consequently, the results and productive capacity of these organizations. Although the OMPS accounting system provides a robust database to support the work of elaborating the OROF, in operational reality, estimating production costs remains a significant challenge for most OMPS. In the face of this scenario, the use of quantitative methods to forecast these expenses can be an effective approach to supporting PMSO financial planning.

2.2 Previous studies on cost forecasting models

During the literature review, no research was found on cost forecasting models in the MB using the Holt-Winters statistical method. However, it was possible to note that there are some studies on predictive models in the public sector, including in the MB, such as Mello et al. (2021), Mello and Pessanha (2021), Mello (2022), Oliveira et al. (2023) and Santos Junior et al. (2023).

Some authors have evaluated, using statistical methods, how the demand forecasting process can contribute to the planning and control of the provisioning (management of food stocks) of Brazilian Navy's OMs (MELLO et al., 2021; MELLO; PESSANHA, 2021; MELLO, 2022). Other researchers have examined how the ARIMA forecasting method can contribute to the planning of MB financial programming (OLIVEIRA et al., 2023). In addition, a group of scholars has dedicated themselves to assessing how the ARIMA statistical method can contribute to MB cost planning (SANTOS JUNIOR *et al*., 2023a).

Thus, although the last work mentioned was applied in the field of Navy cost accounting, it can be seen that the ARIMA method was used in that study, while the present research aims to assess how the forecasting process, based on the Holt-Winters method, can contribute to the cost accounting planning of OMPS.

According to Hoover (2021), the forecasting process uses statistical methods to obtain estimates based on historical data (past and present). In this sense, Santana and Correa (2014) found that the implementation of a process based on forecasts (estimates) contributes to achieving the goals set in government planning, to the success of cost information systems and to

control in public bodies, while Silva, Santos and Costa (2016) assessed that forecasting methods are possible tool options for managers in the planning processes of institutions, contributing to cost reduction.

The study by Sousa et al. (2017) corroborates that cost forecasting in the planning process of institutions can benefit cost management and offer greater accuracy for decision-making by managers. Thus, when dealing with cost management in public institutions, Borges, Mario and Carneiro (2013) argue that links are automatically established with budgetary aspects (income and expenses), since cost forecasts enable an estimate to be made of the budgetary resources that will be needed in a given period to meet the costs of fulfilling the mission of a public entity.

In this context, we can see that it is plausible to use statistical methods to improve the activities developed by public sector bodies and entities, especially in the MB's cost area, in order to optimize the measurement and disclosure of its costs.

3. METHODOLOGY

In accordance with Malhotra (2012), the structuring of this study, in terms of its development, consists of identifying the procedures adopted throughout the work, so that it is possible to obtain the information needed to conduct it. Thus, in terms of the nature of the objective, this is a descriptive study, since it is a pre-planned and structured study, and it reports on the process that made it possible to obtain cost forecasts for an OMPS for the 2023 fiscal year. The approach to the problem is quantitative, since the Holt-Winters statistical forecasting method was used to process the data.

Currently, MB has nine OMPS-I distributed in different regions of the country, designed to perform repairs and maintenance on ships of the Force. For this research, a River Base was selected, whose historical cost series does not show a high degree of irregularity, since, according to Ballou (2006), this aspect is a prerequisite for a good forecast.

Considering that the aim of this study is to assess how the forecasting process, based on the Holt-Winters method, can contribute to the cost accounting planning of the Brazilian Navy's OMPS, a sample of data was selected comprising the time series of the production costs of the OMPS analyzed, from 2019 to 2023 (60 months), as suggested by Makridakis, Spiliotis and Assimakopoulos (2018) and by Pochiraju and Seshadri (2019) in order to adjust predictive models.

The data used to develop the study was extracted from the Federal Government's Financial Administration System (SIAFI). The period from 2019 to 2022 was used in the in-sample (training set) to obtain the predictive model, while the data for the year 2023 formed the out-of-sample sample, for comparison with the forecasts obtained.

The data was processed using the R software (R CORE TEAM, 2023), since, according to Silva et al. (2017), this tool enables researchers in the areas of accounting and finance to obtain robust results in quantitative research. In addition, Hyndman and Khandakar (2008), Martínez et al. (2019) and Mello et al. (2021) elucidate that the use of the forecast package in the R software provides mechanisms for adjusting forecasting models based on the Holt-Winters method used in the present study.

The Holt-Winters method is one of the statistical tools capable of providing forecasts based on time series, especially those with trend and seasonality components (MORETTIN; TOLOI, 2018). As for the treatment of the influence of seasonal aspects, this can be approached in an additive or multiplicative way (BARROS et al., 2020). According to Barros et al. (2020), the additive version of this method, when the forecasting process *m* steps ahead of a monthly time series (*m*=12), can be expressed according to the following equation:

$$\hat{y}_{t+m} = a_t + b_t m + S_{t-s+m} \qquad (1)$$

whose trend coefficients (*at* e *bt*) and seasonality *St-s+m* are updated based on the equations (2)-(4), whose results depend on smoothing constants α, β and γ belonging to the interval [0,1] and previously determined (TRATAR; STRMCNIK, 2016).

$$a_t = \alpha(y_t - S_{t-s}) + (1-\alpha)(a_{t-1} + b_{t-1}) \qquad (2)$$
$$b_t = \beta(a_t - a_{t-1}) + (1-\beta)b_{t-1} \qquad (3)$$
$$S_t = \gamma(y_t - a_t) + (1-\gamma)S_{t-1} \qquad (4)$$

Barros et al. (2020) add that values closer to 1 indicate that the most recent observations have a greater influence on the forecasts, while values close to 0 indicate that the oldest observations in the series have a greater influence on the forecasts. According to Morettin and Toloi (2018), the smoothing constants α, β and γ are calibrated aiming to reduce the deviations betwe- en the time series *y*t and the corresponding forecasts.

To check the accuracy of the forecasting model obtained, the Mean Absolute Percentage Error (MAPE) was used, as shown below:

$$MAPE = \frac{1}{N}\sum_{t=1}\frac{|Z_t - Z_t|}{Z_t} \times 100\%$$

in which Zt and $\hat{Z}$t denote, respectively, the observed and predicted values over a period of time t.

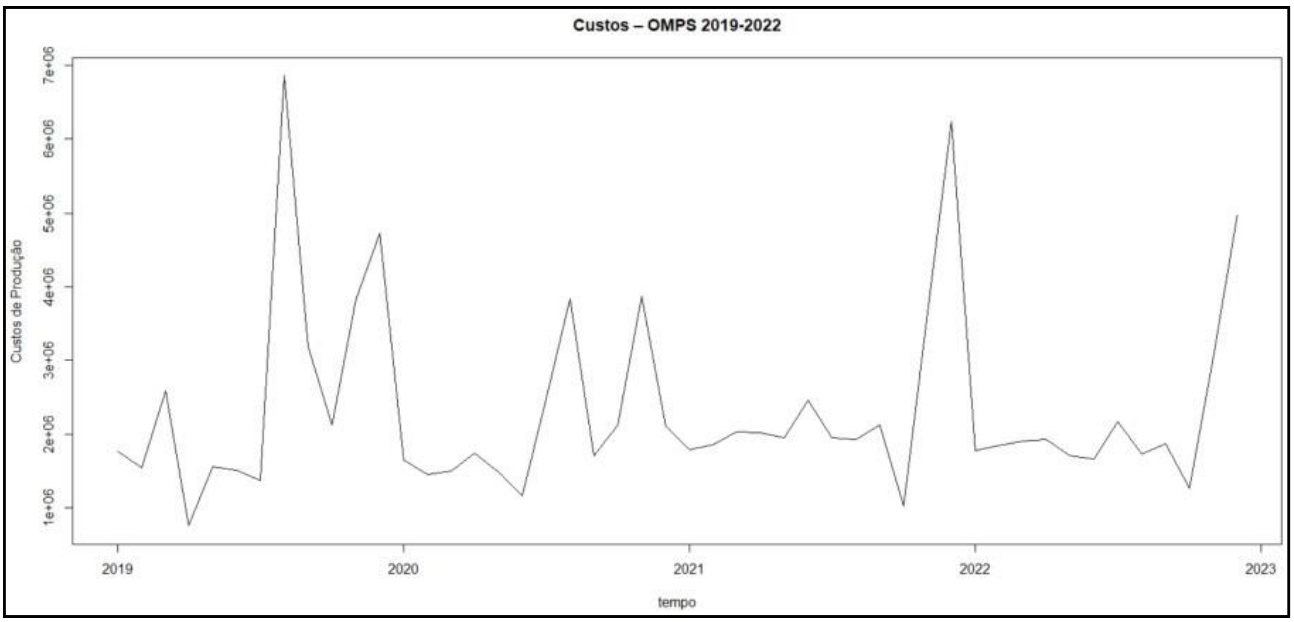
4 ANALYSIS OF RESULTS

Based on the monthly production cost data of an OMPS-I of the MB, extracted from the SIAFI, an exploratory analysis of the data was conducted, so that it would be possible to identify and extract preliminary management information that could help in the process of obtaining the forecast models and, consequently, analyze the forecasts for the fiscal year 2023, based on the model obtained using the Holt-Winters method.

In this way, this data, which covers the period from 2019 to 2022, was used in the in-sample sample, i.e. for the training set of the models, making it possible to obtain the forecast for 2023. The data for 2023 was used in the out-of-sample so that a comparison could be made between the observed data and the results obtained by the predictive process. Therefore, the data for the period 2019 to 2022 was imported into the R software environment in order to enable analysis and obtain the results.

Once the data had been loaded, the OMPS time series cost graph was generated for the period 2019 to 2022, as shown by Figure 2. It shows that there is no clear presence of a trend,

Figure 2 – Time series of production costs – 2019-2022



Source: Elaborated by the authors based on research data.

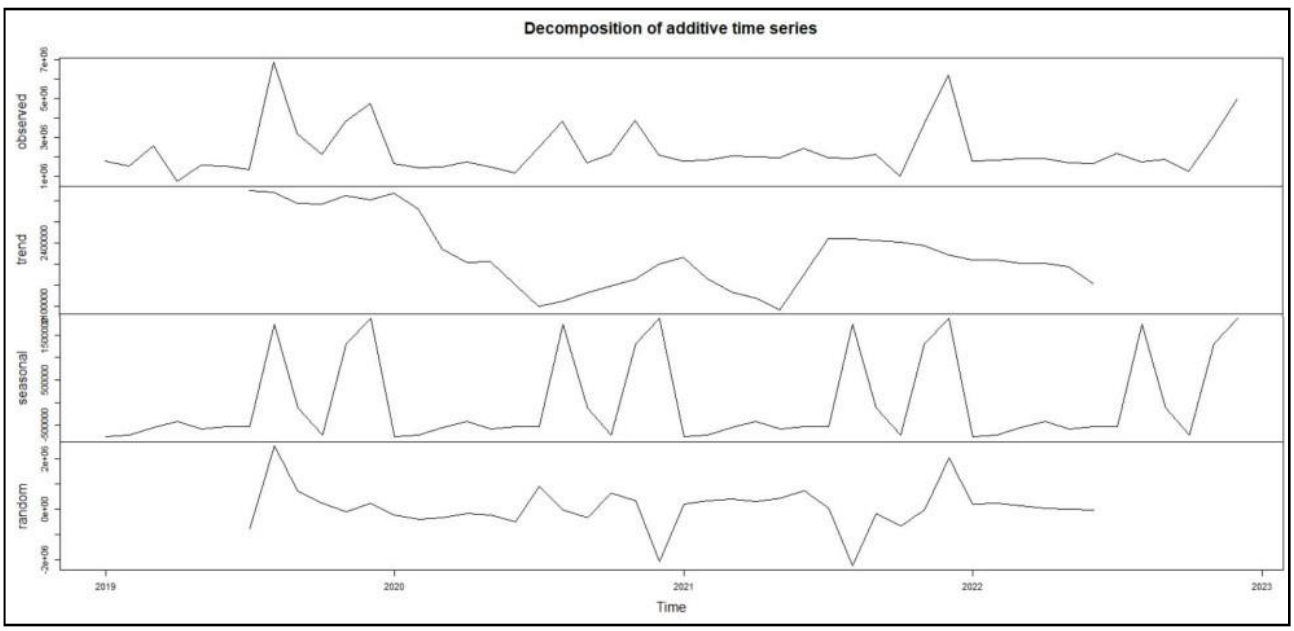
although the presence of seasonal peaks at the end of the fiscal years is noticeable, indicating the presence of a seasonal component in the cost series.

In order to obtain greater detail about the series analyzed, the time series was broken down into its non-observable components, i.e. trend, seasonality and irregularity, as illustrated in Figure 3.

Figure 3 illustrates the unobservable components of the cost series, which can provide OMPS accounting managers with information on the behavior of the cost in sensitive periods throughout the year. The trend component shows a sharp drop during 2020 until halfway through 2021, at which point it shows a recovery to the level it had previously been at, with a slight decrease during 2022. It should be noted that the period between 2020 and 2021 was marked by the COVID-19 pandemic, which had an influence on OMPS' level of service and, as a result, there was a reduction in its production costs during that period.

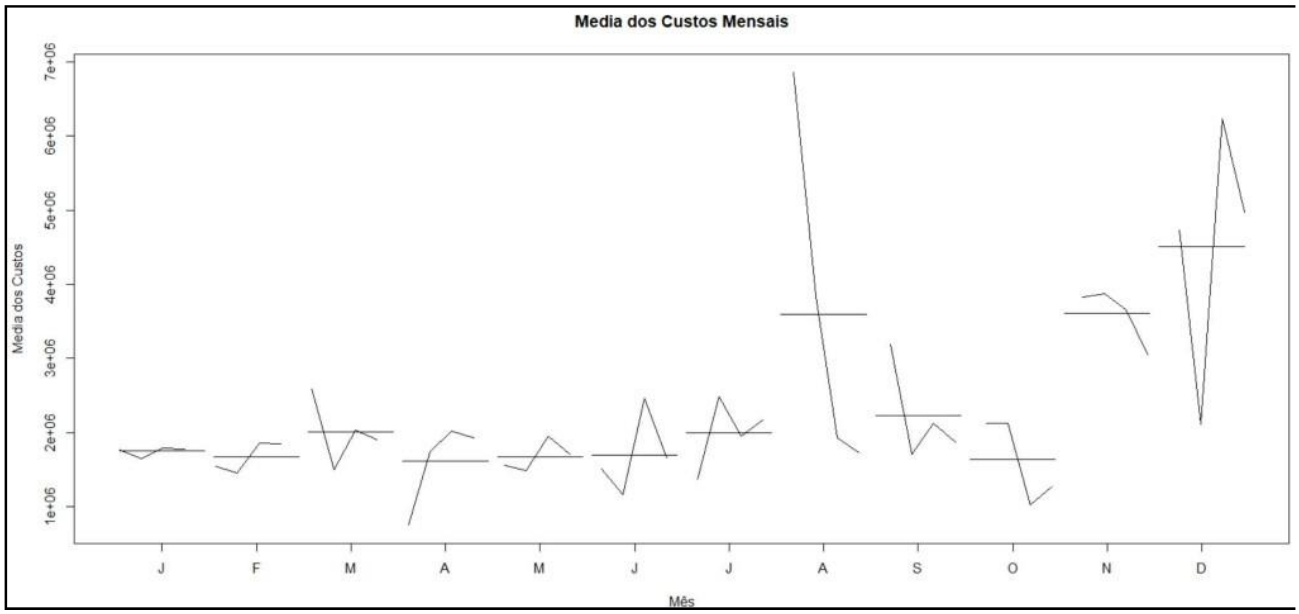
At the same time, the seasonality component points to seasonal peaks in the months of August and December, periods in which there is the possibility of scheduled resource allocations for ship repairs. In addition, the cost calculation includes the portion relating to the labor costs of the military and civil ser-

Figure 3 – Breakdown of the production cost series



Source: Elaborated by the authors based on research data.

Figure 4 – Average monthly production costs – 2019-2022



Source: Elaborated by the authors based on research data.

vants working at the OMPS, whose thirteenth-month pay is paid in December.

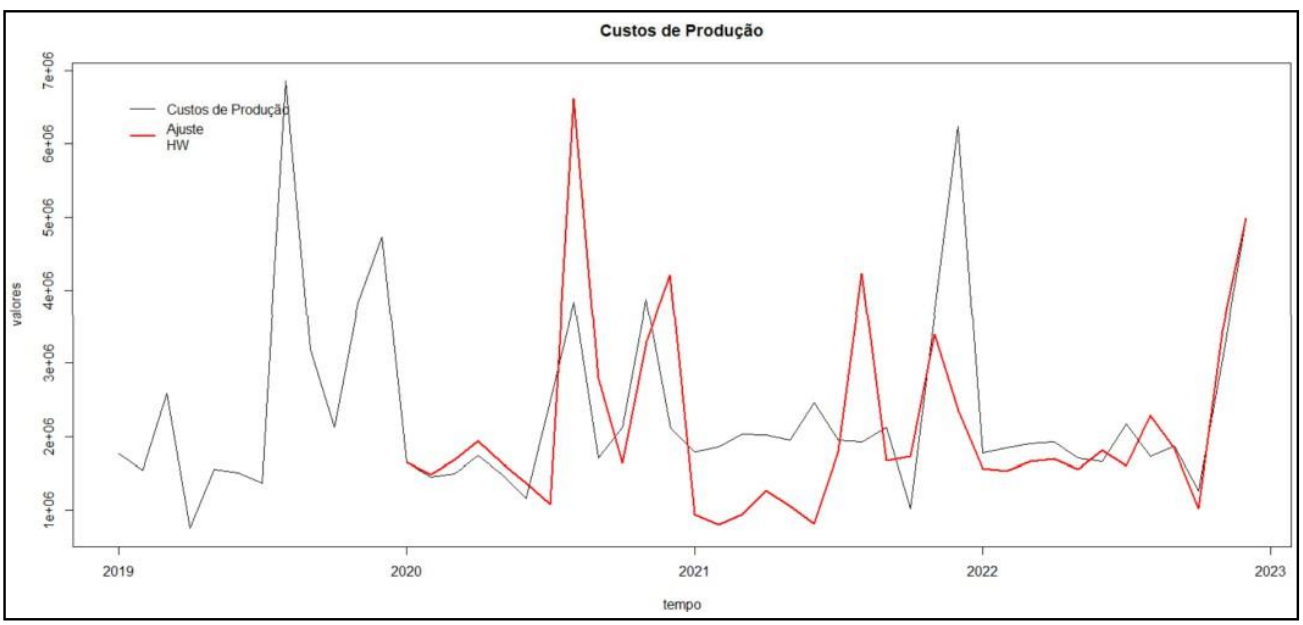
Additionally, Figure 4 illustrates the specific behavior of each month over the period from 2019 to 2022, showing the average monthly costs.

In general, the monthly average costs (horizontal line represented in each month) shows the same level from January to July, with sharp rises in August, November and December. As previously observed in Figure 2, which showed a seasonal peak in December, Figure 3 shows that the highest monthly average cost also occurs in that month.

According to Mello and Pessanha (2021) and Oliveira et al. (2023), the preliminary information from the predictive process can be useful for planning institutions, and in the case of the accounting structure of the MB's OMPS, this information can be used to support the cost accounting sectors, since it can signal a greater need to allocate resources at certain times of the year, as well as pointing out the periods in which the highest volumes of costs are calculated, and can thus be a mechanism for strengthening the institution's management accounting aspects.

Thus, the adjustment of the predictive model based on the Holt-Winters method resulted in the following smoothing cons-

Figure 5 – Seasonal Adjustment of Production Costs – 2019-2022



Source: Elaborated by the authors based on research data.

Table 1 – Production Cost Forecast – 2023

Mês	Observado (R$)	Previsto (R$)	Desvio Relativo
Jan	1.307.465	1.312.887	0,41%
Fev	1.630.276	1.341.009	17,74%
Mar	1.057.130	1.396.337	32,09%
Abr	1.353.507	1.407.431	3,98%
Mai	2.091.324	1.197.239	42,75%
Jun	1.133.543	1.225.979	8,15%
Jul	1.143.840	1.546.799	35,23%
Ago	1.134.989	1.383.092	21,86%
Set	1.263.823	1.391.308	10,09%
Out	1.176.152	732.103	37,75%
Nov	2.583.749	2.672.411	3,43%
Dez	4.446.088	4.510.865	1,46%
TOTAL	**20.321.886**	**20.117.460**	**1,01%**

Source: Elaborated by the authors based on research data.

tants: α=0,0591, β=0 and γ=0,7699. The results found for the coefficients α = 0.0591 and β = 0, mean that the OMPS-I production cost time series considers older data with greater weights for the level and trend equations. In addition, the coefficient of the seasonality component equation showed a result close to 1 for the series under analysis, which means that in this component, the most recent seasonal pattern has greater weight.

The quality of the resulting adjustment can be seen in Figure 5, in which the time series of production costs from 2019 to 2022 (black line) and the respective estimates obtained by the Holt-Winters model (red line) are shown.

After adjusting the Holt-Winters predictive model, the forecast was obtained up to 12 steps ahead for the cost of production in an OMPS-I. Table 1 shows the monthly values observed for the 2023 fiscal year, taken from the SIAFI, and the respective forecasts calculated using the Holt-Winters method.

Table 1 shows that the production cost forecast for 2023 was nearly 98.99% of the annual cost actually calculated for that year, making it a good parameter for planning the OMPS cost accounting sector. In addition, the MAPE, which represents the Average Percentage Error of the cost forecasts, was 17.91%.

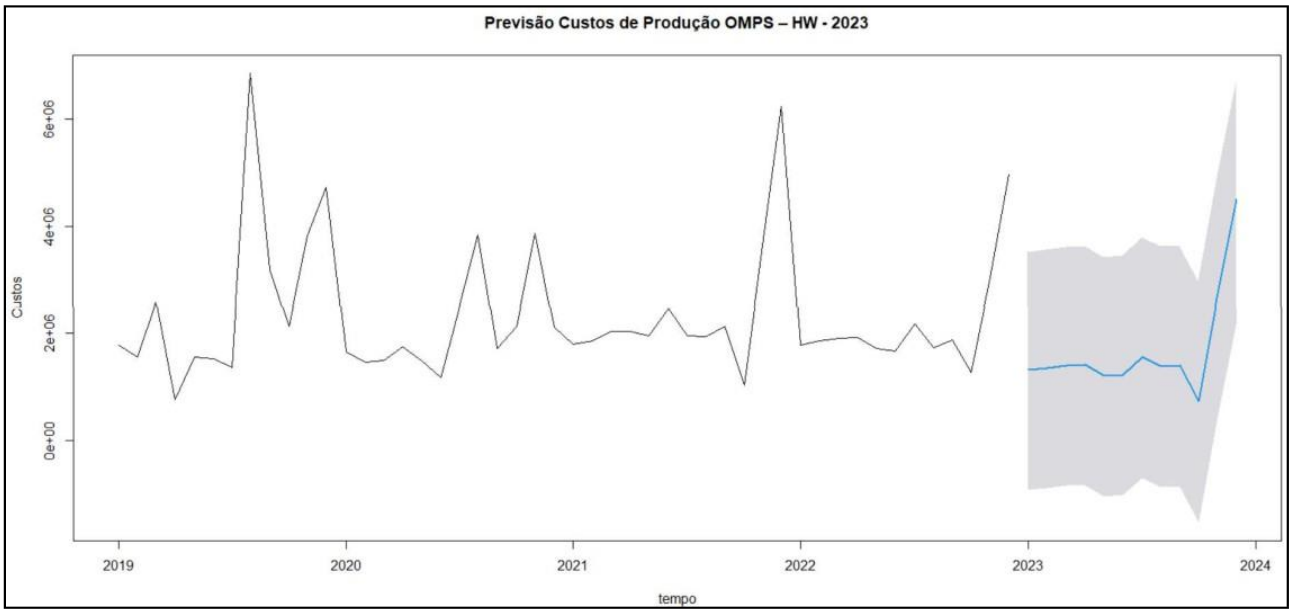
Santos Junior et al. (2023b) emphasize the need for OMPS to have an adequate estimate of costs for the year, considering the setting of rates in the prices of the services provided, which aim to cover their administrative and indirect costs. With this, the result obtained can provide a guide for the percentage to be set in these fees to be applied to their prices.

Figure 6 shows the graph of the production cost forecast for 2023 (blue line).

In this way, the forecast generated by the Holt-Winters method follows a slightly downward movement in terms of production costs and therefore proved to be in line with the verified value. The gray area is delimited by the limits of the forecast intervals, indicating the range of possible cost fluctuations estimated by the methodology used. The result obtained through the process in question can be used to draw up the budget for future OMPS fiscal years, which is in line with the findings of Silva, Santos and Costa (2016), who point out that the Holt-Winters method is a plausible tool for drawing up budget processes, given the robustness of its results.

In overall terms, in addition to the possible managerial gains that can be used by OMPS accounting managers, according to Goodwin et al. (2023), predictive processes can be a success factor for high-level decisions in institutions, which is in line with the quest to improve the Force's Cost Management, explained in the Navy's current Strategic Planning (PEM 2040).

Figure 6 – Production Cost Forecasts in 2023 – Holt-Winters



Source: Elaborated by the authors based on research data.

5. CONCLUSION

The aim of this study was to assess how the forecasting process, based on the Holt-Winters method, can contribute to the cost accounting planning of OMPS. After implementing the process, it was possible to adjust a predictive model that generated an estimated annual result, which was 98.99% close to the annual production cost result observed in the 2023 financial year, as well as indicating a MAPE of 17.91%.

The operationalization of the cost forecasting process, based on the Holt-Winters method, was carried out using R software, which is an Open-Source tool that can be used by the managers responsible for the OMPS accounting sector, without the need to spend public funds.

During the exploratory analysis of cost data, it was possible to obtain information indicating seasonal periods, trends and analysis of monthly cost averages in the historical series. These findings can be useful to the managers of the Brazilian Navy's OMPS when drawing up annual accounting plans, given that it is necessary to calibrate the rates to be charged to (internal) clients for the services provided.

In addition, the preparation of the annual budget, which is part of OMPS planning, must consider the estimate of revenue that can support the volume of costs. By obtaining projected values during the process applied in this research, the results can generate greater robustness and precision in the values to be set, which may result in greater efficiency and effectiveness in the use of public resources applied to maintenance and repair. result in greater efficiency and effectiveness in the use of public resources applied to the maintenance and repair of Brazilian Navy ships.

In this way, this study assessed that the forecasting process, based on the Holt-Winters statistical method, can bring managerial gains to the planning of OMPS in terms of their costs, as well as in other actions that require decision-making by the managers of these organizations.

The subject of forecasting based on time series is very broad and could be explored in other research in the area of cost accounting for OMPS. We therefore suggest that future research apply this process to OMPS in the area of Science and Technology, in addition to the possibility of applying other widespread methods in the field of forecasting, such as the Box & Jenkins methodology.

REFERENCES

BALLOU, R. H. Gerenciamento da cadeia de suprimentos/logística empresarial. 5. ed. Porto Alegre: Bookman, 2006.

BAPTISTA, A. N.; SILVA, A. S. A adoção de faixas de relevância para a análise gerencial dos indicadores de desempenho das Organizações Militares Prestadoras de Serviços Industri- ais da Marinha do Brasil com base nas informações de custos. In: Anais do Congresso Brasileiro de Custos-ABC. Anais [...]. Belo Horizonte, 2010.

BARROS, A. C.; MATTOS, D. M. de; OLIVEIRA, I. C. L. de; FERREIRA, P. G. C.; DU-CA, V. E. L. de A. A Análise de Séries Temporais em R: curso introdutório. 1. ed. São Paulo: Atlas, 2020.

BORGES, T. B.; MARIO, P. do C.; CARNEIRO, R. A implementação do sistema de custos proposto pelo Governo Federal: uma análise sob a ótica institucional. Revista de Administração Pública, v. 47, n. 2, p. 469 a 492, 2013.

BRANDALISE, F.; FELLA, L. J.; ZAMIN, L. M. O contador público no contexto da gestão pública. Revista de Administração e Ciências Contábeis do IDEAU, v. 4, n. 8, p. 1-17, 2009.

BRASIL. Secretaria-Geral da Marinha. SGM-307 Normas sobre o Sistema de Custos da Marinha do Brasil. 1. ed. Brasília, DF, 2020.

CASIMIRO, L. M. S. M.; MORAES, F. Planejamento social na administração pública: um instrumento essencial na promoção dos direitos fundamentais sociais. Revista de Direito Econômico e Socioambiental, v. 8, n. 2, p. 443-461, 2017.

CONSELHO FEDERAL DE CONTABILIDADE (CFC). Norma Brasileira de Contabilidade, NBC TSP 34, de 18 de novembro de 2021. Aprova a NBC TSP 34 – Custos no Setor Público. Brasília, DF.

GOODWIN, P.; HOOVER, J.; MAKRIDAKIS, S.; PETROPOULOS, F.; TASHMAN, L. Business forecasting methods: Impressive advances, lagging implementation. PLOS ONE, v. 18, n. 12, p. 1-12, 2023.

HOOVER, J. The UFO Project: Initial Survey Results. Foresight: The International Journal of Applied Forecasting, n. 60, p. 45-47, 2021.

HYNDMAN, R. J.; KHANDAKAR, Y. Automatic time series forecasting: the forecast package for R. Journal of Statistical Software, v. 27, n. 3, p. 1-22, 2008.

MAKRIDAKIS, S.; SPILIOTIS, E.; ASSIMAKOPOULOS, V. Statistical and machine learning forecasting methods: concerns and ways forward. PLoS ONE, v. 13, n. 3, p. 1-26, 2018.

MALHOTRA, N. K. Pesquisa de marketing: uma orientação aplicada. 6. ed. Porto Alegre: Bookman, 2012.

MARTÍNEZ, F.; FRÍAS, M. P.; CHARTE, F.; RIVERA, A. J. Time series forecasting with knn in R: the tsfknn package. The R Journal, v. 11, n. 2, p. 229-242, 2019.

MELLO, L. S. C. de. Previsão de demanda no Municiamento das Organizações Militares da Marinha do Brasil. 2022. 166 f. Dissertação (Mestrado em Ciências Contábeis) – Universidade do Estado do Rio de Janeiro, Rio de Janeiro.

MELLO, L. S. C. de; CARDOSO, L. F.; PESSANHA, J. F. M.; COELHO, C. U. F. A utilização de métodos de previsão de demanda nas atividades contábeis da gestão de estoques de alimentos da Marinha do Brasil. Revista Acanto, v. 5, n. 2, Rio de Janeiro, 2021.

MELLO, L. S. C. de; PESSANHA, J. F. M. Previsão de demanda no planejamento das aquisições de alimentos em organizações militares da Marinha do Brasil. In: Congresso UFSC de Controladoria e Finanças, 11, On-line, 2021. Anais..., On-line, 2021.

MELLO, L. S. C. de; SANTOS JUNIOR, M. T. dos; PESSANHA, J. F. M. Um modelo de regressão linear múltipla para a gestão contábil de alimentos dos navios da Marinha do Brasil. In: Simpósio de Engenharia, Gestão e Inovação, 4, Juazeiro do Norte, 2021. Anais [...], Juazeiro do Norte, 2021.

MORETTIN, P. A.; TOLOI, C. M. C. Análises de Séries Temporais. 3. ed. São Paulo: Blucher, 2018.

NETO, A. A. L., ALMEIDA, D. R., & ALMEIDA, L. R. Orçamento e planejamento na UFBA: refletindo sobre possíveis relações. In: Encontro da Associação Nacional de Pós- Graduação e Pesquisa em Administração, 2020, on-line. Anais [...], Maringá.

OLIVEIRA, A. B. R. e; SILVA, U. B. da. BRUNI, A. L. Gerencialismo e desafios contemporâneos da gestão dos custos públicos no Brasil. Revista de Estudos Contábeis, v. 3, n. 5, p. 63-82, 2012.

OLIVEIRA, R. G. de; MARMELLO, C. R. M.; MELLO, L. S. C. de; SANTOS JUNIOR, M. T. dos; PESSANHA, J. F. M. Um modelo de previsão para o planejamento da programação financeira da Marinha do Brasil. In: Encontro Brasileiro de Administração Pública, 10, Brasília, 2023. Anais [...], Brasília, 2023.

PETROPOULOS, F.; WANG, X.; DISNEY, S. M. The inventory performance of forecasting methods: evidence from the M3 competition data. International Journal of Forecasting, v. 35, n. 1, p. 251-265, 2019.

POCHIRAJU, B.; SESHADRI, S. Essentials of business analytics. International Series in Operations Research & Management Science, 264. Springer Nature Switzerland, 2019.

R DEVELOPMENT CORE TEAM. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2023.

SANTANA, E. C. de; CORRÊA, C. R. O emprego do Sistema de Informação de Custos (SIC) do governo federal na Marinha do Brasil: uma análise gerencial dos custos no setor público. Revista Pensar Contábil, Rio de Janeiro, v. 16, n. 61, p. 37-44, 2014.

SANTOS, M. de F. B. dos; SANTOS, J. L. T.; QUINTAL, R. S.; SANTANA, E. C. de; DAVIS, M. D. A Sistemática de Organizações Militares Prestadoras de Serviço (OMPS): Perspectivas e Tendências em 19 Anos de Existência. In: Anais do X Simpósio de Excelência em Gestão e Tecnologia. Anais [...] Rio de Janeiro, 2013.

SANTOS JUNIOR, M. T. dos; MELLO, L. S. C. de; CARDOSO, I. L. da S.; MIRAS, T. F. Gestão Estratégica de Custos: um modelo de previsão de custos para uma Organização Militar Prestadora de Serviços (OMPS) Industriais da Marinha do Brasil. In: Anais do III Congresso UFG de Contabilidade Controladoria e Finanças. Anais [...] Goiânia, 2023a.

SANTOS JUNIOR, M. T. dos; MELLO, L. S. C. de; CARDOSO, I. L. da S.; MIRAS, T. F. Proposta de Novos Indicadores para as Organizações Militares Prestadoras de Serviços (OMPS) da Marinha do Brasil. In: Anais do Congresso de Administração, Sociedade e Inovação - CASI. Anais [...] Rio de Janeiro, 2023b.

SILVA, D. A.; SANTOS, M. E.; COSTA, D. F. A utilização do modelo Holt-Winters na elaboração de um orçamento de resultado de uma cooperativa de crédito rural. Revista de Contabilidade do Mestrado em Ciências Contábeis da UERJ, v. 21, n. 1, p. 39-56, 2016.

SILVA, S. A. L.; SANT`ANA, N. L. S.; MENEZES, J. P. C. B.; PAULA, J. S.; CHAIN, C. P. Métodos e técnicas quantitativas em contabilidade e finanças: uma análise sob a ótica do software R. Revista Pensar Contábil, v. 19, n. 68, p. 37-46, 2017.

SOUSA, C. B., BATISTA, D. G., ANDRADE, N. A. O planejamento como base da contabilidade para a gestão pública. Revista Pensar Contábil, Rio de Janeiro, v. 6, n. 24, p.45- 50, 2004.

SOUSA, D. C. F.; CLAUDINO, C. N. de Q.; AQUINO, J. T. de; MELO, F. J. C. de. Utilização de Ferramentas Gerenciais para o Controle de Estoques: Um Estudo de Caso de uma Empresa do Setor Alimentício. Gestão.Org, v. 15, n. 2, p. 546–563, 2017.

TRATAR, L. F.; STRMCNIK, E. The comparison of Holt-Winters method and Multiple regression method: A case study. Energy Journal, v. 109, p. 266-276, 2016.