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CHALLENGES IN FACILITATING ON-TIME AVAILABILITY OF AIRCRAFT SPARE PARTS IN THE MILITARY MAINTENANCE, REPAIR AND OVERHAUL CENTER, UNITED ARAB EMIRATES

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Challenges In Facilitating On-Time Availability Of Aircraft Spare Parts In The Military Maintenance, Repair And Overhaul Center, United Arab Emirates

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ABSTRACT

This dissertation explores the impact of barriers on MROs' spare part delivery needs, addressing a gap in existing literature. A comprehensive literature review confirmed the study's relevance, noting the scarcity of studies on military aircraft maintenance, repair, and overhaul in the UAE. Three hypotheses were formulated to understand operations and supply chain teams' perspectives. An independent sample t-test analyzed role differences between operations and supply chain employees, regression analysis assessed challenges' impact on productivity, and structural equation modeling evaluated effects on on-time delivery. Non-probability sampling yielded 214 respondents from GAL, UAE, who completed a seven-point Likert scale questionnaire. The instrument's reliability and validity were confirmed through pilot testing. Confirmatory factor analysis examined OEM collaboration, technological obstacles, inventory accuracy, inventory quality, supply chain transparency, spare parts tracking, manpower factors, and demand forecasting. Results showed high model fitness for challenges and OEM collaboration with CMIN/DF:1.428, $\chi 2$: 2560.603, RMSEA and SRMR < 0.08, and GFI, AGFI, NFI, IFI, TLI, and CFI exceeding 0.9. Operations teams had lower parameters, except manpower, compared to supply chain teams (M=3.853, SD=0.702) and t= -1.875, df=201, p= 0.040; P>.05. The study suggests new MRO efficiency measures, impacting operations and supply chain, and recommends addressing resistance hindering productivity. Future research could explore different MROs, nations, or employee groups, considering other significant variables.

Keywords: Aircraft on Ground, Maintenance, Repair and Overhaul, Original Equipment Manufacturers, United Arab Emirates, Global Aerospace Logistic

INTRODUCTION

The modern military industry is expanding in the Arab states, specifically in the UAE (Saab, 2014). According to Slijper (2017), the expansion of military bases in the UAE has been quite impressive in the last 25 years. The defense industry in the UAE faces an enormous shift in its outlook toward the purchase and maintenance of military aircraft (Gaub & Stanley-Lockman, 2017). According to a recent report by the Embassy of the United Arab Emirates in Washington DC (2021), the Emirati Airforce is acclaimed as the most prepared and efficient air component in the Middle East. The UAE aviation market is very dynamic and complex, as Spreen (2019) pointed out. In 2020, the UAE hosted the MRO Middle East Summit, which aimed to encourage invitees to collaborate with MRO (Maintenance, Repair, and Overhaul) experts from around the world and to fill the supply chain gaps effectively. Therefore, it is necessary to address the challenges that hinder maintaining a balanced level of aircraft inventory.

Research Objectives

1. To identify the key challenges that facilitate on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE.
2. To determine if the challenges facilitating on-time availability of aircraft spare parts in the military maintenance, repair and overhaul center in UAE change with respect to employee's role.
3. To assess the influence of the identified challenges to the on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE to firm's productivity.

Research Questions

1. What are the key challenges that facilitate on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE.
2. Is there a significant relationship between the challenges facilitating on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE with respect to employee's role?
3. How do the identified challenges that facilitate on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE influence firm's productivity?

LITERATURE REVIEW

The aircraft MRO industry produces a limited number of transactions, yet these transactions are quite complicated. This implies that each transaction needs a substantial amount of complicated processing. However, the finest part is that the standards, particularly for the technical side of aircraft MRO, were uniform and unambiguous. As a result, the major motivator for an application that could support aircraft MRO operations was performance, i.e., the capacity to conduct complicated transactions. During that decade, several unique in-house apps were created. Almost all of the major airlines, including American Airlines, British Airways, USAir, and Alitalia, created their own MRO software. However, only a handful are remarkable (Sahay, 2012).

Because of the high level of competition in the aviation business, cost reduction is becoming more important. An effective maintenance and spare part inventory management system that is based on a solid demand forecasting mechanism may greatly minimize operating expenses. However, the traditional forecasting techniques in the literature are inadequate to predict the amount and occurrence periods of the non-smooth demand (Şahin et al., 2022).

Because of the vast number of components and parts that need a lead-in time for delivery and the subsequent scheduling of work, typical MRO issues are connected to planned and unscheduled aircraft maintenance. It addresses three primary issues: OEMs, maintenance schedules, personnel, and turnaround time. To concentrate on an effective training plan, aircraft maintenance businesses propose that maintenance operators be trained twice a year in various seasons to prevent any deficiencies in operator size and to increase their expertise (Albakkoush et al., 2020).

The aircraft MRO market is the most complicated, requiring high-quality components to match airline safety, security, and specifications. Rapid expansion in the aircraft MRO

industry necessitates seamless technology, the capacity to monitor vital components quickly, inventory accuracy, parts quality, traceability, visibility, and transparency from upstream to downstream in the supply chain channel (Wong & Choy, 2021).

Lack of information for tracking and transparency means that practically all departments involved in the material flow will need information about the component to be followed through before conducting actions on the part. This covers the logistics department, warehouse department, material planning department, and manufacturing department. The location of the component is critical, but the system may not tally, causing issues in numerous engine building procedures and leading to quality failure (Wong & Choy, 2021).

An effective maintenance and spare part inventory management system that is based on a solid demand forecasting mechanism may greatly minimize operating expenses. However, the traditional forecasting techniques in the literature are inadequate to predict the amount and occurrence periods of the non-smooth demand. When cost reduction is used directly, it may drastically cut operating expenses. However, standard forecasting approaches in the literature are targeted; these traditional forecasting methods can provide false findings (Şahin et al., 2022).

Therefore, this study is logically relevant to fill the existing gap in academic research and will guide decision-makers in understanding the challenges and their impact on the productivity of the firm.

RESEARCH METHODOLOGY

The purpose of this research is to determine the statistical correlation between the independent factors, namely significant challenges to the timely availability of spare parts, and the dependent variable, namely the productivity of military MROs in UAE. Therefore, the research contemplates to collect primary data from the supervisory level employees of the military MRO company in the UAE. The primary data used in this study came from closed questionnaires with a Likert scale from 1 to 7. 216 managers and non-managers from the military MRO were chosen for this study. Structural Equation Modeling (SEM), which was run by the AMOS 20.0 program, was used to do research. Researchers use structural equation modeling (SEM) to add unobservable factors quantified indirectly by indicator variables. SEM is a research technique that can do complicated association analysis. In particular, SEM assessment of fit model and structural model are effective and capable of analyzing measurement model and structural analysis. SEM is a second-generation technique for assessing complicated correlations between many constructs. Traditional statistical approaches (e.g., regression, ANOVA, LOGIT) and SEM vary in significant ways (Jr *et al.*, 2014). SEM may build latent variables (abstract notions that cannot be directly measured) and evaluate complicated (e.g., hierarchical, recursive) causal connections among such variables, while typical statistical techniques can only examine pairwise associations between observable variables. In order to model complicated and multidimensional interactions, social science, behavioral science, and management science have increasingly used SEM.

RESEARCH FINDINGS AND DISCUSSION

Objective 1: To identify the key challenges that facilitate the on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in the UAE.

Key Challenges:

- The second order confirmatory factor analysis techniques were used to evaluate the relationships between eight key challenges:
    - Collaboration with OEM
    - Technological Challenges
    - Inventory Accuracy
    - Manpower Factor
    - Inventory Quality
    - Tracking Spare Parts
    - Tracking Supply Chain Channels
    - Demand Forecast
- The results of factor loadings showed that all positive paths were strong and statistically significant. Thus, the findings are consistent with the proposed model of availing spare parts on-time in the military MROs.

Objective 2: To determine if the challenges facilitating on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE change with respect to employee's role.

Findings:

- An Independent-Samples t-test was used to investigate the statistical differences in the dimensions of employee roles in terms of making on-time availability of spare parts.
- The probability for the F value of Levene's test for all dimensions was less than 0.05, indicating that the variances of the two groups are not equal.
- Therefore, the output in the "Equal variances not assumed" row was reported, proving that there is a relationship between the key challenges with respect to the employee's role in facilitating on-time availability of spare parts.

Objective 3: To assess the influence of the identified challenges on the on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE to the firm's productivity.

Findings:

- SEM techniques were used to evaluate the relationships between the eight key challenges (Collaboration with OEM, Technological Challenges, Inventory Accuracy, Manpower Factor, Inventory Quality, Tracking Spare Parts, Tracking Supply Chain Channels, and Demand Forecast) and the productivity of MRO.
- The results showed that all the key challenges, except the manpower factor, have an influence on the on-time availability of aircraft spare parts in the military maintenance, repair, and overhaul center in UAE, thereby impacting the firm's productivity.

CONCLUSION

This research has far-reaching implications for practice, policy, and research. Military planes and their repair are essential components of national defense. Since the mid-20th century, airplanes have been crucial to armed power, including ground-support, air-superiority, transportation, cargo, fighters, and bombers (Guilmartin & Taylor, 2023).

Contribution to Theory: The study introduces structural equation modeling (SEM) to identify challenges, significantly contributing to management and business studies. The SEM model predicts the relationship between challenges and on-time availability of spare parts in military MROs.

Contribution to Methodology: The research achieved procedural accuracy and rigorous validation. Confirmatory factor analysis on latent concepts forms the basis for knowledge expansion. Indicators meet the acceptable performance level, and steps taken can guide future similar studies. The positivist research paradigm analyzes primary and case study outcomes. SEM is powerful in understanding complex variable connections, especially in UAE academic contexts.

Implications for Management: This study offers extensive insights for individuals interested in military aircraft. It helps MRO organizations and policymakers allocate spare parts and resources to impact productivity positively. It identifies challenges affecting productivity and provides valuable information for defense research and policy development. Findings emphasize resolving delays in spare parts availability to ensure smooth MRO operations. Factors such as OEM collaboration, technological challenges, inventory accuracy, inventory quality, demand forecast, tracking spare parts, and supply chain transparency significantly impact on-time spare parts availability, except for the manpower factor. Human resources do not influence spare parts flow, while other factors do, affecting MRO productivity.

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