Digitalization of Complaint Handling Process and Cargo Revenue Management at Middle East Airlines (MEA)

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***Abstract*— Passenger complaints are very common in the airline industry, and leading airlines continuously work to minimize the number of complaints by examining their root causes. However, major airlines also put considerable emphasis on efficiently handling complaints using modern systems. Middle East Airlines (MEA) still uses a manual complaint handling system, where complaints are stored in and retrieved from physical books, which makes handling complaints a difficult and unorganized activity. Another problem that MEA faces is the lack of a systematic cargo shipment policy, which is leading to missed revenues. This problem is exacerbated by the fact that the airline industry is known for its low profit margins. In light of these problems, and with MEA's desire to digitalize its operations and improve its performance, we set out to accomplish two objectives: digitalizing the complaint handling process and optimizing cargo loading at MEA. For our first objective, we started by interviewing key people in the Customer Relations department and, based on their inputs, created process flow diagrams for both the current and future (proposed) states of the process. We then worked on digitalizing the process by developing an Excel application that features a user-friendly interface and easy-to-use commands. To complete our second objective, we started by interviewing key decision-makers in the Cargo Shipment department to understand how they currently plan cargo shipments. We were then given previously collected data about the Paris-Beirut route, including the number and weight of passengers carried, and the weight and allocation of bags and cargo. After that we forecasted future outstanding weights and developed an Integer Linear Program that aims to optimize cargo loading and thus help MEA in generating higher revenues from cargo shipments.**

Keywords*— *Customer Complaints, Digitalization, Cargo Loading, Forecasting, Linear Program

I. INTRODUCTION

Customer complaints are an inevitable part of any organization as human errors and machine failures tend to occur in even the largest of companies. And while most leading companies strive to offer flawless products or services to their customers, and in turn minimize complaints, the existence of a well-managed customer complaint system can be a source of crucial customer data that companies can leverage to improve their offerings and remain competitive. Airlines are no strangers to customer complaints that originate from bad in-flight experiences and especially from damaged or lost bags. In fact, the 2018 American Customer Satisfaction Index (ACSI) report shows that airlines had a customer satisfaction score of 73% during that year, ranking in the bottom 20% of companies (industries) [1]. These numbers indicate that reducing the number of complaints in this industry is a desirable yet challenging goal, and airlines should keep improving their complaint handling processes. For Middle East Airlines (MEA) to keep up with increasing customer demand, it should move from its traditional, manual methods of handling complaints towards modern digital solutions that can greatly benefit the organization. Faster replies to passengers, easier and quicker data retrieval, and a reduced risk of losing critical passenger information in case of loss of books are some of the benefits that MEA can realize by implementing a digital complaint handling process. Creating a Microsoft Excel application that enables employees to store all records that are currently written on books, as well as using Visual Basic for Applications (VBA) to automate tasks such as classifying complaints and linking different sheets, can help MEA shift towards a digital complaint handling process.

Airlines are further characterized by difficulties in improving profits due to high fixed costs and price-sensitivity of customers, among other factors, with profits averaging $4 per passenger in 2012 [2]. MEA, similar to most other airlines, operates air cargo shipments in parallel with its passenger line of business, and it is a revenue stream that the company should optimize to boost profits. A 2018 report by the International Air Transport Association (IATA) indicated that there was a 9.3% growth in cargo volume between 2016 and 2017 [3]. A sound air cargo revenue management policy would help MEA not miss out on potential revenues, and several tools can help in specifically determining the optimal loads. According to a 2015 survey by Accenture [4], a multinational professional services company, more than 60% of senior airline executives consider cargo load optimization a standout improvement. The tools include forecasting capacity and demand to predict the available cargo space and potential demand, developing linear programs to optimize loads across different flights based on several constraints, and using software to generate results. These techniques will reduce the role of uncertainty, which will result in managers in the cargo shipment

department at MEA no longer rejecting cargo orders because of uncertain ticket demand, i.e., uncertain airplane capacity. Thus, applying scientific cargo revenue management will directly impact MEA's bottom line, which will boost its standing among airlines.

II. Objectives

Our first objective, which we achieved in the fall semester, dealt with digitalizing the complaint handling process at MEA. We started by interviewing key people in the Customer Relations department, and then developed process flow diagrams for both the current and future (proposed) states of the process. We then developed a macro-enabled Excel application that features a user-friendly interface and easy-to-use commands.

Our second objective deals with cargo load optimization, and we aim to complete this objective by the end of the spring semester. We have already met representatives from the Cargo Shipment department at MEA and gained an understanding of how they currently assign cargo loads. We also collected passenger and demand data for the Paris-Beirut route. After that, we forecasted future outstanding weights, as well as spatial capacity data. We have also developed an Integer Linear Program that aims to optimize cargo loading and thus help MEA in generating higher revenues from cargo shipments. We still need to run the model and check the results.

III. Background

Customer complaints are expensive as they lead to both direct and indirect costs [5]; however, if there is a good complaint management system in place, companies can benefit from the Voice of Customer data contained in complaints. In his paper, Zairi argues that adequately handling complaints results in higher customer retention and loyalty [6]. The author argues that most companies that face challenges when handling customer complaints do not follow a systematic approach when handling complaints. He then suggests a process that includes receiving the complaint, assigning the task to a proper team, fixing the issue, providing feedback, closing the problem, reviewing by executives, and finally assigning responsibilities for recurring problems. Our objective is to implement a similar process at MEA by using digital instead of traditional methods.

In order to design an efficient and reliable complaints management system, some authors have proposed a web system for complaints management [7]. The system was designed and executed using the Unified Modeling Language (UML), Microsoft (MS) Access and Visual Studio-ASP.NET programming language. The system facilitates the process of reporting, coordinating, monitoring, tracking and resolving complaints. The authors follow a clear methodology by first understanding the current process and then analyzing it and identifying the problems that lead to inefficiency. Furthermore, the authors develop an entity relationship diagram (ERD) of the proposed system and design queries on Access.

Other authors have shed a light on how to employ MS Access and MS Excel after spotting the weaknesses and strengths of both software [8]. Points of comparison included data retrieving and analysis, security, data storage, data importing and exporting, and user cooperation. Furthermore, the authors also provided best practices for integrating MS Access and MS Excel in an organization including accessing tables from excel sheets to linking files. Furthermore, Alexander and Clark define the basic integration techniques - specifically getting Excel data into Access and leveraging Access utilities and vice versa - and discuss the advanced techniques that simplify the integration process using VBA and XML [9]. They also discuss the integration of Excel with other MS services such as Word, PowerPoint, and Outlook. These are features that we used in designing an automated and user-friendly customer complaints system at MEA, especially on Excel.

In their airline case study, Gonzalez Bosch and Tamayo Enriquez present a customer complaint management system that incorporates tools from Total Quality Management [10]. This paper highlights the importance of having a methodological system in place and relying on automated tools to make the process faster. The process starts by documenting VOC data and then translating these into customer needs. It then continues by performing an in-depth analysis of customer complaints and needs, notably by developing a "Needs vs Processes" matrix that matches needs, i.e., different types of complaints, with the processes in place at this airline, such as ticket purchasing and boarding. This matrix helps in identifying recurrent patterns so that problematic processes are re-designed. This management system also involves the use of Microsoft Excel worksheets to store data and draw tables and matrices. One important feature used in this case that we implemented in our project is the generation of automatic "apology e-mails" to customers using VBA, which eliminates the need to manually draft lengthy e-mails.

Another problem that MEA faces is the absence of a cargo revenue management policy to determine optimal allocations within and between aircrafts. Given that passenger bookings take priority over cargo bookings, MEA loses potential revenues by rejecting cargo orders in favor of leaving enough space for passengers, many of whom cancel or do not show up, which results in airplanes being under-loaded. Fok, Chun, and Wai address this issue where they use mathematical optimization to minimize under-loading in airplanes [11]. They develop a linear program model that aims to minimize what they define as the "cargo loading residual", i.e., under-load, subject to several constraints that include the available mass (computed by subtracting the masses of fuel, passengers and other masses from the total mass of the aircraft), the number of containers, and any freight that has priority over others. We will be also developing a linear program that incorporates weight constraints.

Alternatively, Hoffman tackles the problem of cargo capacity control by proposing a heuristic that leads to near-optimal solutions [12]. The author considers an aircraft with remaining weight and capacity, where cargo shipment requests arrive according to probability distributions. The decision maker has to choose whether to accept a request when it arrives or leave capacity for requests that may generate higher revenues. Our linear program will provide the decision-maker with optimal results concerning the acceptance or rejection of cargo shipment requests.

IV. Methods

A. Digital Complaint Handling System

We first conducted three visits to MEA where we met with the Head of Customer Relations and the employees at the

department. The meetings helped us understand how the department currently handles complaints, and we developed a process flow diagram for the existing process accordingly. We then suggested a new process that keeps the same tasks required to study passengers' claims but includes an automated approach when it comes to entering, editing, reviewing, and manipulating complaints. We then developed a customer complaint handling application on Microsoft Excel that includes a user-friendly interface and commands that enable employees to perform their tasks in a faster way. We programmed the commands using Visual Basic for Applications (VBA) and wrote the code in a format that allows to easily identify and solve any bug. We designed the workbook so that the user only has access to the pages (sheets) he/she needs, while other sheets are hidden as they only contain data to which other cells are linked.

B. Cargo Revenue Management

The head of the Cargo Shipment department provided us with passenger and baggage data concerning the Paris-Beirut route, which accounted for more than 60% of flights in 2019. The data included passenger and baggage weights in both the "210" and "212" flights, as well as data concerning the allocation of bags and cargo. These are allocated using two types of containers, PMCs and AKEs. We then proceeded to forecasting future data that would be inputted in our linear program later on.

We built a model that forecasts future remaining weights on both flights to the Paris Charles de Gaulle (CDG) airport. The model also forecasts futures PMC and AKE allocations. The forecasting model used is the Holt-Winter Exponential Smoothing Model. This model assumes a linear trend with a multiplicative seasonality effect over both level and trend. The variables and factors used in the model are:

w_t: Actual Weights at period t
$\widehat{w}_{t,t+1}$: Forecasted Weight
α: Exponential Smoothing Level Factor $(0 \leq \alpha \leq 1)$
β: Exponential Smoothing Trend Factor $(0 \leq \beta \leq 1)$
γ: Exponential Smoothing Seasonality Factor $(0 \leq \gamma \leq 1)$
F_t: Multiplicative seasonal index for period t
P: Number of time periods within the seasonality period
$\hat{a}_0$: Level estimate at time 0
$\hat{b}_0$: Trend estimate at time 0
e_t: Error at observation t, $e_t = w_t - \widehat{w}_t$
n: number of observations

We started by initializing the Exponential Smoothing Factors (α,β, and γ) by trial and error to best fit the distribution of the actual weights and decrease the variance of the forecasted weights by minimizing the root mean squared error (RMSE).

$$RMSE = \sqrt{\frac{\sum_{t=1}^{n} e_t^2}{n}} \quad (1)$$

The equations used to find the parameters are:

$$\hat{a}_t = \alpha\left(\frac{w_t}{\hat{F}_{t-P}}\right) + (1-\alpha)\left(\hat{a}_{t-1} + \hat{b}_{t-1}\right) \quad (2)$$

$$\hat{b}_t = \beta(\hat{a}_t - \hat{a}_{t-1}) + (1-\beta)\hat{b}_{t-1} \quad (3)$$

$$\hat{F}_t = \gamma\left(\frac{w_t}{\hat{a}_t}\right) + (1-\gamma)\hat{F}_{t-P} \quad (4)$$

To use the above equations, we had to initialize the parameters $\hat{a}_0$, $\hat{b}_0$, and $(\hat{F}_0, \hat{F}_1, \dots, \hat{F}_P)$ respectively. To estimate both $\hat{a}_0$ and $\hat{b}_0$, we fit a regression model for several periods by using the regression equation $w_t = \hat{a}_0 + \hat{b}_0 t$ where $\hat{b}_0$ is the slope and $\hat{a}_0$ is the y-intercept. To estimate the seasonality indices$(\hat{F}_0, \hat{F}_1, \dots, \hat{F}_P)$, we considered the first two seasons of data, determined the demand level for each season period and the demand for all periods, and set the initial seasonality indices to ratio of each season to all periods.

We finally found the forecasted weights using:

$$\widehat{w}_{t,t+\tau} = \left(\hat{a}_t + \tau\hat{b}_t\right)\hat{F}_{t+\tau-P} \quad (5)$$

We then developed an integer linear program that aims to maximize the number of assigned cargo orders. We defined the following decision variables:

x_{ijk}: binary variable that takes on a value of 1 if order K is assigned at flight i and date j, and 0 otherwise
p_k: variable denoting the priority of order k
NP_k: number of PMCs in order k
NA_k: number of AKEs in order k
W_k: weight of order k (in kg)
RP_{ij}: remaining number of PMCs in flight i, date j
RA_{ij}: remaining number of AKEs in flight i, date j
RW_{ij}: remaining weight (in kg) in flight i, date j

We defined the objective function such that it maximizes the number of assigned orders while still taking order priority into consideration. This prevents the program from always favoring small orders. The objective function is:

$$\sum_i \sum_j \sum_k x_{ijk}\, p_k \quad (6)$$

Subject to the following constraints (in addition to the non-negativity constraint for all variables):

$$\sum_i \sum_j \sum_k x_{ijk}\, NP_k \leq \sum_i \sum_j RP_{ij} \quad (7)$$

$$\sum_i \sum_j \sum_k x_{ijk}\, NA_k \leq \sum_i \sum_j RA_{ij} \quad (8)$$

$$\sum_i \sum_j \sum_k x_{ijk}\, W_{ijk} \leq \sum_i \sum_j RW_{ij} \quad (9)$$

We still need to estimate the priority variable and run the model to check the results.

V. RESULTS

A. Digital Complaint Handling System

The first sheet in the application is the "Home" page that contains buttons that, when pressed, lead the user to one of the other pages. The home page also contains a "Report a Bug" button that the user can press in case the application is not functioning properly; this button generates an automatic e-mail template that the user can immediately send to the IT department. The user starts by pressing the button that takes him/her to the "Complaints" page.

The "Complaints" page (Fig. 1a) contains a table where the user enters the necessary words/values to register an incoming complaint. A complaint number with the format "YYMM###" is given; we chose this format because it refers to the month and year that a complaint was recorded. The user then specifies the source of the complaint; we created a list box that presents the user with different source options (Lost & Found, E-mail, Call Center, Chairman's Office, Social Media, Other). The complaint source is set to "Lost & Found", the most common source, to reduce data entry time. When the user enters the passenger's name, a box appears on the screen and requires him to enter the phone number and e-mail of the passenger. A warning message also

appears if the user's name is on the blacklist. The user then chooses the flight number from a list box and enters the flight date where a pop-up calendar appears to make it easier for the user to enter the date. The user then enters the complaint type by choosing from a list box that contains the four types under which a complaint can be classified (Damaged, Delayed, Lost, and Pilfered). In case the user chooses "Lost" or "Pilfered", a window automatically appears on the screen prompting him/her to enter each lost or pilfered item along with its quantity (Fig. 1b). The user also has to specify whether the passenger is a female or a male; this helps in generating a different list box for each gender according to the items that are most commonly associated with it in customer complaints. The application then automatically generates a compensation (in US dollars), calculated in a hidden sheet by multiplying the weight of lost items by compensation per kg (in this case $23). The weights of items are set by IATA (we collected the data and inputted it in the hidden Excel sheet). The application also automatically generates a date for "Date Recorded" depending on the date on which the user enters the complaint. The user can also enter an optional comment to give his feedback. The user, in this case the Head of Customer Relations, chooses from a list box the employee to which he would like to assign the complaint study. The user then has to specify the status of the complaint by choosing from a list box ("Approved", "Not Approved", "Review", "Closed"). In case he/she chooses "Closed", the closure date automatically appears on the screen. We also created a button that, when pressed, only displays the cases (complaints) assigned to a specific employee; this helps the employees when they want to see what cases they are assigned instead of reading the whole document.

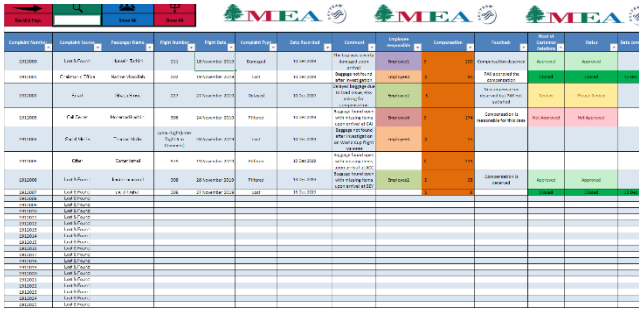

Fig. 1a. "Complaints" page

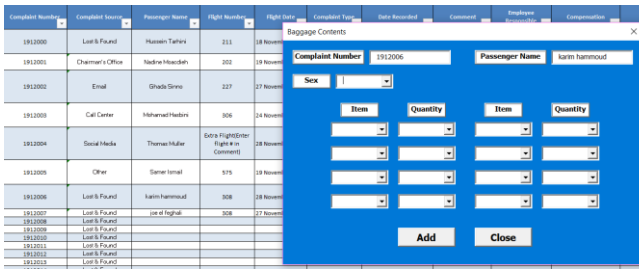

Fig. 1b. Automatic window

Another important page is the "Finance" page that contains an "Import Complaints" button that imports complaint numbers, passenger names and the compensation associated with each complaint. The page also contains a "Send to Finance Department" button that, when pressed, opens outlook and generates an e-mail template that the user can send to the Finance Department for disbursement of funds.

We also created a "Search" button on every page. This button, which is not case sensitive, performs a dynamic search and highlights the cells that contain what the user wants. In addition, we designed the sheets such that every user should enter a password to unlock the cell range related to him/her.

B. Cargo Revenue Management

We found forecasts for both the F210 and F212 flights (Fig. 2a, 2b, and 2c show forecasts for the F212 flight). For the outstanding weight, the forecasts are in blue and the original data in green. The yellow curves represent actual data that we compared with our forecasts to visualize the forecasting accuracy. For the PMC and AKE forecasts, the orange curves represent the forecasted data while the blue curves represent the original data.

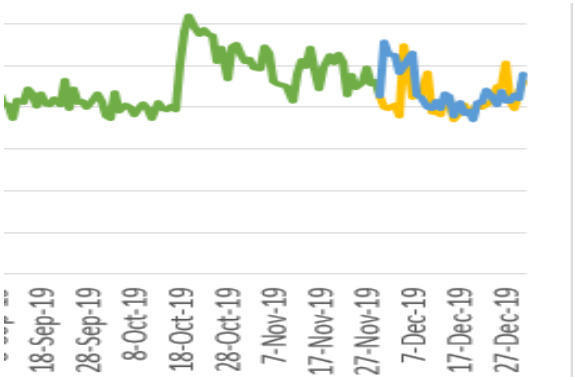

Fig. 2a. Part of the forecasted outstanding weight for the "212" flight

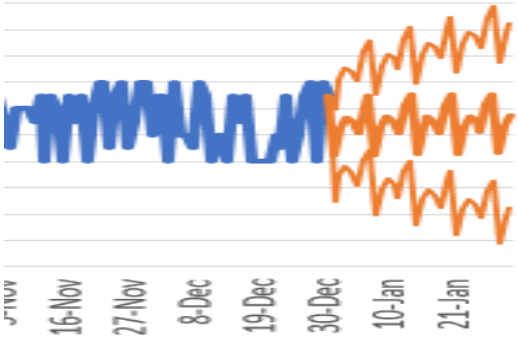

Fig. 2b. Part of the forecasted PMC data for the "212" flight

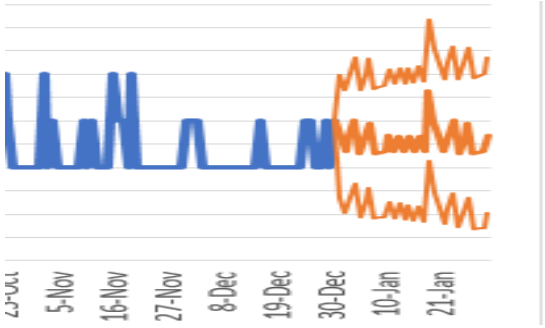

Fig. 2c. Part of the forecasted AKE data for the "212" flight

Given the increased volatility in the data since October, we introduced a 95% confidence interval in the weights forecast (shown by the diagonal lines in the graphs). Keeping track of the confidence intervals allows us to spot any change in the actual behavior of the PMCs and AKEs.

VI. Discussion and Conclusion

By using our Excel application, employees at the Customer Relations department will be able to complete their tasks more efficiently, which will lead to faster replies to customers and thus higher customer satisfaction. In addition, the implementation of this system at MEA will come with no added cost whereas using Microsoft Access would have required the company to purchase a license as it does not have the software available. One limitation of using Excel is that the file cannot be shared simultaneously between employees, as opposed to MS Access. Possible extensions to the project include analyzing actual operations at the airport in order to minimize the number of lost or pilfered bags and thus decrease the number of customer complaints.

For our cargo loading model, we will use the forecasting results that we got as inputs in our linear program later on. The forecasted data are subject to increased volatility in ticket sales due to the ongoing situation in the country. The results should highlight the improvements of shifting from arbitrarily assigning cargo to implementing a precise cargo loading policy.

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