NOVA IMS Information Management School

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Mestrado em Gestão de Informação
Master Program in Information Management

A CONCEPTUAL FRAMEWORK OF SALES FORECAST:

In business processes dependent on the actual location of sales with analysis of past data and coming information about future days from valid online resources

Alireza Majidi

Dissertation presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Systems and Technologies Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
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A CONCEPTUAL FRAMEWORK OF SALES FORECAST IN BUSINESS PROCESSES DEPENDENT ON THE ACTUAL LOCATION OF SALES WITH ANALYSIS OF PAST DATA AND COMING INFORMATION ABOUT FUTURE DAYS FROM VALID ONLINE RESOURCES

By

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Advisor: Dr. Vitor Santos

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And I also need to thank the respected manager of the 1001nights restaurant located in Lisbon, the beautiful capital of Portugal, which allowed me to access their financial software system and use its data as a case study in this research.

ABSTRACT

Despite the advent of cyberspace in the provision of services and online sales, still, some of them require customer presence, such as restaurant food or medical and health services in clinics. For the high efficiency of the service provider and greater profitability and customer satisfaction, obviously, the capacity of service or sale of the goods should be proportional to the demand of customers. The number and type of customers of these service providers are affected by various factors, some of them may be fixed and pre-booked, as well as some of them are casualties. On the other hand, in addition of the time and energy required to provide service and products in these types of businesses, some of the raw materials necessary to produce the final product or service might have a short life-cycle that even modern warehousing, supply systems and enterprise resource planning are not responsive. For example, cooking some foods and serving at a certain restaurant may require fresh meat or fresh ingredients that cannot be stored in the restaurant's stockpiles, so they should be supplied from original supplier in the same day. Therefore, forecasting the number of services and sales in the coming days can be beneficial.

Already, there are several ways to forecast sales and service providing. In this study, with a brief overview of them, a conceptual framework provided that focuses on the precise analysis of data of sales in the past days and the identification of effective factors on sales in abnormal days as well as the acquisition of accurate information from online information resources about the status of similar coming days. Then by the case study that was a good restaurant in Lisbon, with analysis of the data history in the sales system over the course of a year, we were able to identify the factors affecting on the number of sales by this method.

KEYWORDS

Business process; business performance improvement; business analytic; sales forecasting; forecast sales; process mining; data analytics; event log; retailer business.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADL	Autoregressive Distributed Lag
B2B	Business to Business
BA	Business Analytics
BI	Business Intelligence
BPI	Business Process Intelligence/Business Process Improvement
BPM	Business Process/performance Management
CRM	Customer Relationship Management
DSR	Design Science Research
EPR	Enterprise Resource Management
HR	Human Resources
IT	Information Technology
KPIs	Key Performance Indicator
PAISs	Process-Aware Information Systems
SCM	Supply Chain Management
SKU	Stock Keeping Unit
UPC	Universal Product Code
WfM	Workflow Management

1. INTRODUCTION

1.1. INTRODUCTION

"Business Performance Management (BPM) offers organizations an IT-enabled approach to formulate, modify, and execute strategy effectively"(Frolick & Ariyachandra, 2006).

There is four fundamental step in business performance management: 1) Strategize, 2) Plan, 3) Monitor and analyze, and 4) Take corrective action (Frolick & Ariyachandra, 2006).

One of the main outputs of the planning stage is a detail about process budget that shows how to allocate resources in the process by key performance indicators (KPIs)(Frolick & Ariyachandra, 2006). In each business process, it also comes with a good plan and appropriate allocation of resources that will prevent the loss of resources and, consequently, reduce costs and increase income. Although there are advanced systems such as ERP (Enterprise Resource Planning) for managing executed business processes and controlling and monitoring enterprise resources (James R. Evans, n.d.), the forecast of the business process situations in coming days is essential to improve performance.

Despite the fact that determining future customer request is a fundamental part of business planning and executing, most of the anticipating strategies are used just to predict the number of sales of things consumed regularly, and forecasting of seasonal period sales. However, most of the retail products sales which have irregular consuming are forecasted by fluctuated and non-linear functions (Tanaka, 2010).

One of the vital subjects in context retail businesses further than all strategize and plan steps to make right decisions is future sales forecasting. In order to increase income in retail businesses, forecasting precisely of the customers' demand in the future is important in managing the production planning, transportation and labor force. "Retail sales series belong to a special type of time series that typically contain trend and seasonal patterns, presenting challenges in developing effective forecasting models."(Ramos, Santos, & Rebelo, 2015).

Business users generally utilize traditional BI (business intelligence) systems to make good decisions in their business processes, indeed BI platforms are able to analyze the historical data in order to answer the end user's questions (such as 'what happened?'), but if the questions are like 'why did it happen in the process executing?' or, 'what will happen?', then the forecasting is looking essential to get organizational effectiveness. So to answer to these kinds of questions, creation knowledge with historical data and external information is the key reason of the business improvement to achieve competitive by optimizing resources, decrease costs as well as increasing benefits, and meet all business goals(Vera-baquero, 2015).

1.2. RESEARCH QUESTION

Because most process-related information is stored on IT systems in the larger part of businesses, a computer system separately can be set up to get the information from these resource systems and to utilize these information to reproduce an order processing chain, e.g. from the buying request a goods or service by customers to receipt of the item and exchange and payment sub-process. For the parts of the business process some of the activities can be accumulated by manual techniques(Scheer, Jost, He, & Kronz, 2006).

As we see today, in most commercial companies, the business process management systems, such as the ERP system, which today's versions have the ability to instantly track resources such as cash, raw materials, and production capacity, and also they can create data shares between different departments of the organization with a variety of data access permissions (Almajali, Masa'deh, & Tarhini, 2016a). The output information of these management and monitoring systems, such as reports, diagrams, charts, etc., is a source of information for process analysis systems for accurately analyzing the business process. Another source of data inputs to process analysis systems, and in fact, the most important of them are the resources of event logs of the process. Another resource to the provision of input data for analysis systems is external resources that have not received much attention in most existing research.

Despite significant advances in online shopping and sales, many businesses in particular small businesses still require the physical presence of the customer at the geographical location of the service or sale of the goods. For example, providing health services in clinics, entertainment services in sports clubs, providing food and fast food at restaurants, purchasing goods and living items from hypermarkets, providing beauty services, etc.

In this kind of businesses, accurate prediction of the customers' demand and the provision of primary resources for products and services in the coming days is important and influential. This accurate forecasting depends on obtaining accurate information about future days from trusted external resources such as Google's services, online news services, weather forecasting services and etc.

The main question of this study is that the particular attention paid to the impact of external factors on such businesses, as well as the accuracy and obsession with how to choose the correct and safe external resources to collect information about these factors, would affect the overall revenue of business?

After analyzing historical data of the business process manually and getting respond 'YES', to design a framework combined of a sub-system as a listener standby for get these external information and another sub-system as analyzer, in order to forecast sales in the coming days of the business has been followed.

2. THEORITICAL BACKGROUND

2.1. BUSINESS PROCESS MANAGEMENT

Business Process Management (BPM) has gotten one of the most important management tools that facilitate organizations attain their business aims as well as get a competitive advantage (Shahzad & Zdravkovic, 2010).

Although in most cases BPM clearly includes Workflow Management (WFM), there is almost a comprehensive definition of BPM in (De Weerdt, Schupp, Vanderloock, & Baesens, 2013): "*Supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information*".

2.2. BUSINESS PERFORMANCE MANAGEMENT

"*Business performance management (BPM) is a key business method that enables companies to align strategic and operational objectives with business activities in order to fully manage performance through better-informed decision making and action*."(Shi & Lu, 2010).

In the other definition business, performance management is all of "*the processes, methodologies, metrics and technology used to monitor, measure and manage a business*" (Scheer et al., 2006).

2.3. BUSINESS ANALYTICS

James R. Evans in (James R. Evans, n.d.) states "*Business Analytics is a convergence of three key disciplines that have been taught and used for a long time: statistics, business intelligence and information systems, and modelling and optimization (traditionally, operations research and management science)*"(James R. Evans, n.d.)as illustrated by Figure 1.

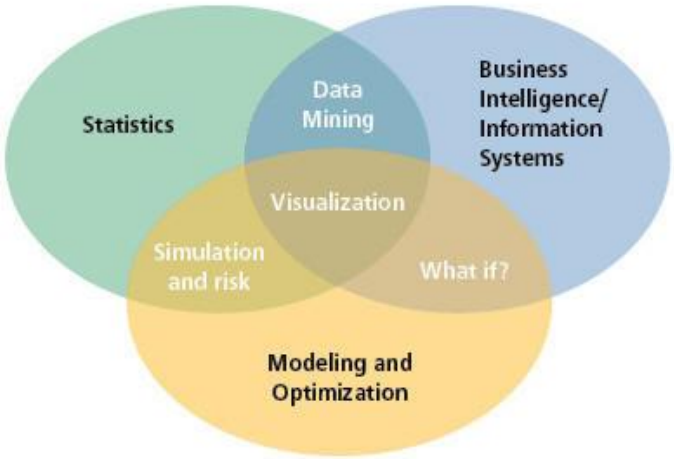

Figure 1: Business analytics conceptual graphic (James R. Evans, n.d.)

Process-aware information systems (PAISs) that included in the value chain are: ERP (Enterprise Resource Planning), WfM (Workflow Management), CRM (Customer Relationship Management), case handling, B2B (Business To Business) and SCM (Supply Chain Management) systems that usually can monitor the running of the business processes by recording a lot of information as the input for process analysis techniques(Weerdt, Schupp, Vanderloock, & Baesens, 2013).

2.4. Business Intelligence and Business Process Improvement

"*Business Intelligence is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision-making*"(Cristian-Mihai, n.d.)(Statchuk & Craig, 2011). Today in most companies the supplier and customer data resulted from business transactions are handling by certain widespread systems such as enterprise resource planning (ERP), supply chain management (SCM) and customer relationship management (CRM)(Vera-baquero, 2015).

"*Those various operational and transaction data can be transformed into information and then into knowledge by using business intelligence (BI) tools*"(Wu, 2010).

Business process users utilize traditional BI systems as a strong tool to make better decisions in their processes. While BI systems are able to collect, store and analyze the historical data of the processes and then answer some end-user questions like "WHAT HAPPENED?", business companies in order to improve their business, obtain more value, have competitive advantages, resources optimizing, and so on need to answer other kinds of questions like "WHY DID IT HAPPEN?", "WHAT IS GOING TO HAPPEN?", "WHAT WOULD HAPPEN IF…?" and etc. in order to improve the business process the other words BPI. Gathering and making the right knowledge from the business process perspective is necessary to answer properly to these kinds of questions which leads to meet business goals (Vera-baquero et al., 2015).

2.5. Business Process Intelligence

Business Process Intelligence (BPI) is "*a set of integrated tools that support business and IT users in managing process execution quality by providing several features, such as analysis, prediction, monitoring, control and optimization*"(Grigori, 2004).

Business Process Intelligence (BPI) refers to the application of Business Intelligence techniques to business processes and comprises a large range of application areas spanning from process monitoring and analysis to process discovery, conformance checking, prediction and optimization. One of main drivers for BPI is the need to improve business process efficiency, to analyse the processes, establish capacity to react fast to changes and to meet regulatory compliances. It includes Process Mining (i.e., process discovery, conformance checking), predictive analytics and many other techniques that are all gaining interest and importance in industry and research. In practice, BPI is embodied in tools for managing process execution quality by offering several features such as analysis, prediction, monitoring, control, and optimization(Sayal et al., 2003).

2.5.1. Process Mining

According to Van der Aalst, most of the business companies tend to utilize business process management (BPM) to perform their own operational processes. These systems use process models to analyze "*as-is*" and "*to-be*" processes that unfortunately these models are not always connected fully to actual event data. Therefore results of analytics based on just an idealized model of reality are not reliable(Van Der Aalst, 2011).

The aim of process mining is ''*to discover, monitor and improve real processes (i.e., not assumed processes) by extracting knowledge from event logs readily available in today's systems*'' (Van Der Aalst, 2011)(Vera-baquero, 2015).

Van der Aalst states in (Van Der Aalst, 2011) that "*process mining aims to bridge the gap between BI and BPM. The combination of both process models and event data allows for new forms of process-centric analytics.*"(Van Der Aalst, 2011).

To better understand the concepts, we will discuss several definitions:

"*An event is the most atomic part of a specific process execution.*"(Claes & Poels, 2014). There are usually a large amount of event data in Information Systems in form of activity records for example 'mail sent' or in form of status updates, for instance, updating 'invoice sent' to 'invoice paid'. The events as an entity of a process might have several attributes with value besides the name and identifier (Claes & Poels, 2014).

"*An event log is a hierarchically structured file with data about historical process executions.*"(Claes & Poels, 2014).

An event log is a key point in a process mining. Every event log contains the information about its own event. The event refers to an activity. As illustrated in Figure 2 a process consists of some well-defined steps called activity. Any run case of the process by its ordered activities called process instance. Whenever it is required the event logs can store other extra information about the events. Indeed, process mining techniques use appropriate information such as the originator (i.e., person or device) running or initiating the activity, the timestamp of the event, and other attributes (e.g., the size of an order) (Van Der Aalst, 2011).

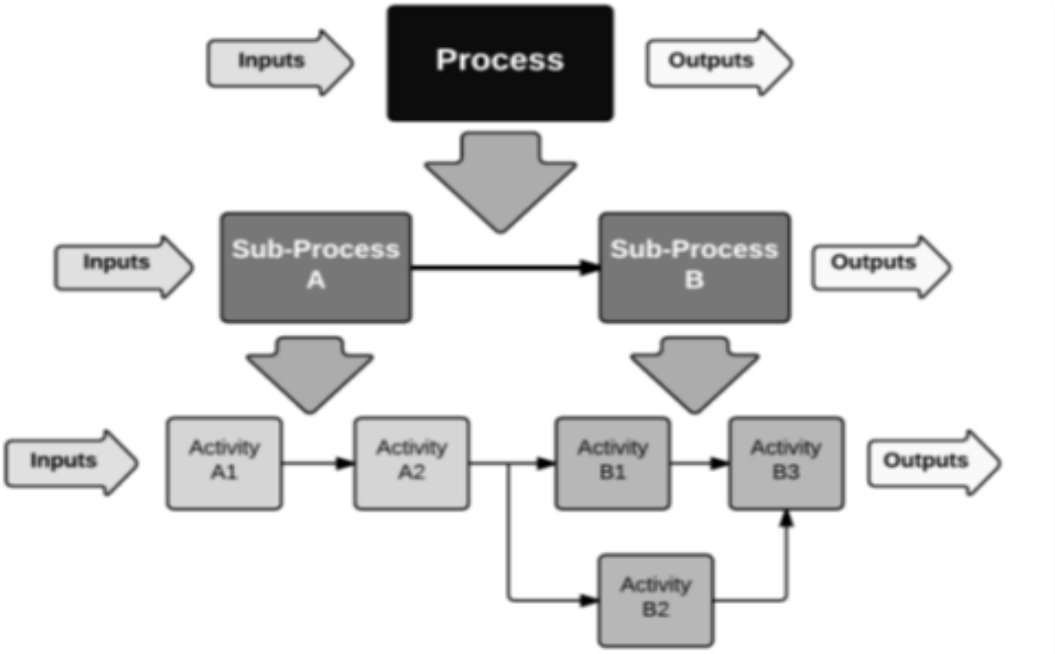

Figure 2: Hierarchical structure of a process(Vera-baquero et al., 2015)

Generally, process mining techniques can be grouped into three categories: (1) Discovery techniques that are the way of constructing a process model with historical data which stored structurally in event logs. (2) Conformance techniques, basically check the given process model for any deviation in the process between model and log with historical event logs. (3) Enhancement techniques used to repair or extend the current model that made by hand or discovered before and more likely has no efficiency with historical event logs (Van Der Aalst, 2011).

"A trace is a collection of events that belong to the same process execution."(Claes & Poels, 2014). For example, all logged data about a sales order could make a trace. Suppose an order type for example 'offline or online' that is considered as order id actually can be used as trace identifier (Claes & Poels, 2014).

2.6. ENTERPRISE RESOURCE PLANNING

"*Enterprise resource planning (ERP) is the integrated management of core business processes, often in real-time and mediated by software and technology*"(Gaonkar, Velugula, & Prasad, 2017).

ERP is provided with an integrated package of useful and functional applications for managing businesses used by organizations and companies to collect, store, manage, and interpret and analyze data from business process activities. ERP systems consist of facilities that can manage continuously the business resources (e.g. cash, raw materials, and production capacity) and the situation of all commitments (e.g. orders, purchase orders, and payroll) whilst it can set up a data sharing among all parts of the organization that produce data like manufacturing part, purchasing, sales, accounting(Almajali, Masa'deh, & Tarhini, 2016b).

Enterprise Resource Planning (ERP) "*is defined as an integrated computer-based system that manages internal and external organization resources*."(Bidgoli, 2004). The organizational resources consist of sensible possessions, monetary property, hardware, and HR (Human Resources) as illustrated in Figure 3. While ERP is an application, it can also be a software architecture framework that enables the flow of information between different functions inside and outside the organization, and thus is an organizational information system. ERP connects all business operations to an integrated system environment using a centralized database and on a common computing platform. The letter 'E' is an abbreviation of the Enterprise, indicating that this system, regardless of the nature of the organization, integrates the process in a single organization that can be implemented in manufacturing, education, banking, healthcare, transportation, and other distributed industries. "*ERP facilitates information flow between all business functions and manages connections to outside stakeholders*"(Radovilsky, Zinovy (2004). Bidgoli, Hossein, n.d.).

3. METHODOLOGY

In this study, it is pursued the DSR (Design Science Research) methodology for Information Systems. Hevner and et al. present 7 guidlines for a DSR:

- Design as an artifact
- Problem relevance
- Design evaluation
- Research contributions
- Research rigor
- Design as a search process
- Communication of research(López-Rodríguez et al., 1999)

Based on this methodology for realizing the goals in this research, in Section 1.2, while expressing motivation as a question, the proposed conceptual framework is presented, in Section 4.2. This proposed framework is roughly the same as the new BPI (Business Process Improvement) practices, which are based on three stages of **description**, **prediction** and **prescription**, and discussed in the theoretical discussions, especially in Section 2.

The importance of the subject under objectives of framework is listed in section 4.3.

To follow the methodology adopted in this study, the evaluation of the project based on the selection of a case study of a restaurant, called 1001 nights, in Lisbon, Portugal, the sales and audit data of the past two years were analyzed. This item was derived from data records as outputs in the form of tables and charts whilst that it was done with common office tools. While the simulation tool can be used to evaluate the benefit plan, the evaluation method is currently handled manually.

In the following, as presented in Section 5, the formulas corresponding to the case study presented in this section are included.

Most contributions of this research emphasize on various tactics of forecasting sales in online and cyber business, as mentioned in section 4.1. Others focus on improving the performance and optimization of business process models where prediction is one of the key pillars.

In order to achieve the stated goals, based on the methodology (research rigor), this plan shall be implemented by standard software tools and in larger and more realistic environment, being and not being in a real system will be evaluated.

And it is obvious that this framework, in the form of an artifact, must be constructed in such a way as to be capable against of developing new challenges.

And finally in order to achieve good communication this study can be published on a scientific journals, international conference, as well as published by NOVA IMS as partial requirement for obtaining the Master's degree in Information Management.

4. PROPOSED FRAMEWORK

4.1. ASSUMPTION

By reviewing several studies in the field of to improve the efficiency of businesses, it can be concluded that the importance of proper management decisions in organizations and business processes and the role of data, information and knowledge in the survival of business competition is very significant. Delen and et al. in (Delen & Demirkan, 2013) have presented a framework for service oriented thinking in business management, which shown in a high-level conceptual framework in Figure 3.

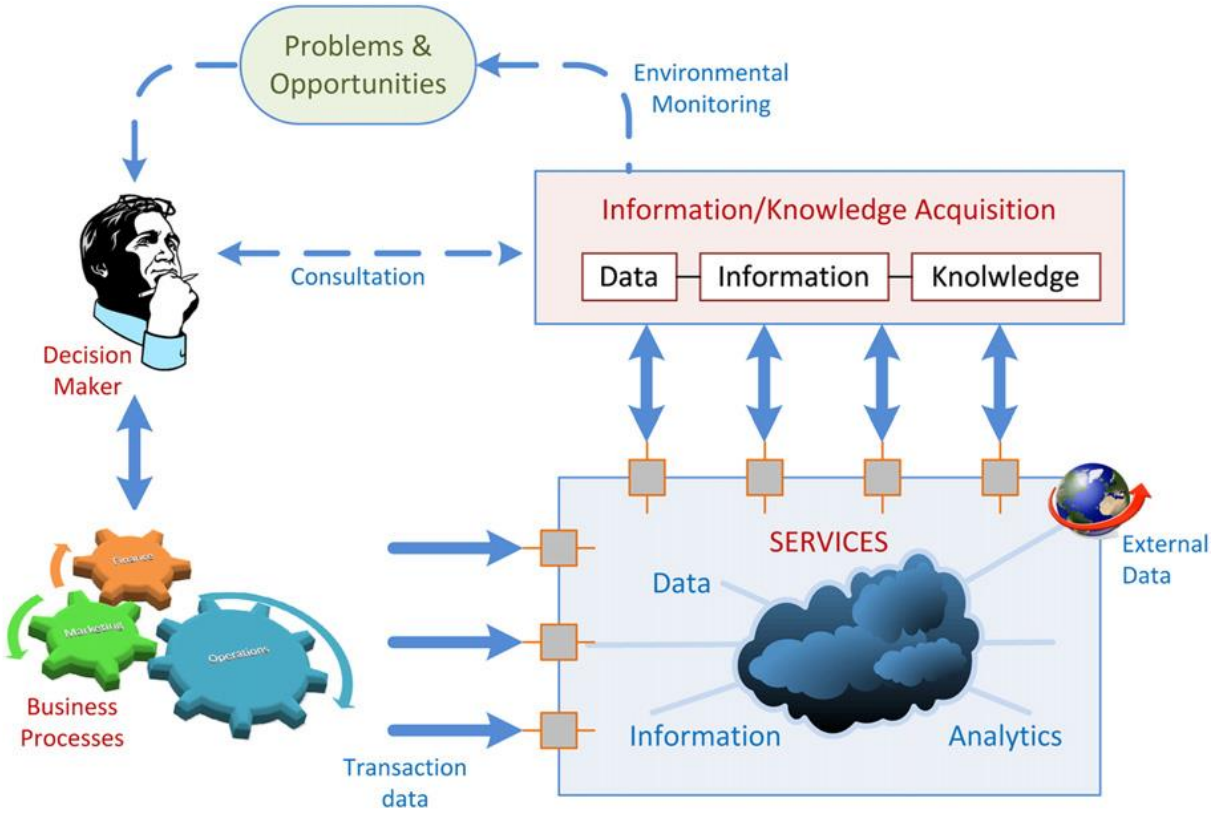

Figure 3: A high level conceptual framework by (Delen & Demirkan, 2013)

A cyclic process aimed at supporting corporate executives in obtaining business-oriented decisions. Because with the advent of technology and business processes, in business management, decision-making is also becoming more complicated. With this increasing complexity, the need for data collection, and the acquisition of accurate knowledge from more reliable resources become more and serious. (Delen & Demirkan, 2013).

Kenji Tanaka in (Tanaka, 2010) proposed a model to forecast sales of the new-released items with the help of a database of related knowledge. This model is able to anticipate a long-term sales forecast by estimating the result of the items' sale which has a so earlier delivery based on cohesion between short term and long term accumulations. Totally this model involves three points: Precision, forecast the timing for delivering items, and a simple procedure without a common set of each item

in order to cover a wide range of items. In this research, its performance has been investigated by applying it to the prediction of book items(Tanaka, 2010).

Before examining other methods, here, it is necessary to define some terms: the terms UPC and SKU[1], Two completely different numeric-based codes assigned to the products. SKU, or stock keeping unit, is a number that is designated by the company for a product for internal maintenance purposes and internal operations but UPC or universal product codes are standardized for commercial use and provide product descriptions that can be scanned every time anyone can read. The UPC is attached to a product wherever it is sold, it is stable in the shelf lifetime of the product. As a result SKU code is used internally and UPC code is used externally, or for universal purpose. As shown in Figure 4, SKU has typically 8 alpha-numeric digits, while UPC has 12 digits, numeric only("UPC vs SKU - Barcoding, Inc. - Barcoding, Inc.," n.d.).

Figure 4: An example for UPC and SKU ("UPC vs SKU - Barcoding, Inc. - Barcoding, Inc.," n.d.)

Forecast of sales in retailers at the UPC level is difficult. The sales depend on a lot of factors like marketing attempts such as products pricing and promotions(Huang, Fildes, & Soopramanien, 2014).

Huang and et al. in (Huang et al., 2014) presented some impressive techniques that able to forecast sales at the level of UPC(Universal Product Code) retailing aid analysis data such as competitive prices and promotion. Their proposed way include two steps. The first step they get and clean the competitive data. They find and select the main explanatory variables if it's possible, otherwise, data of variables by analysis factors are gathered to make a few numbers of diffusion indexes. In the second step, Huang and et al. "*specify the Autoregressive Distributed Lag (ADL) model following a general to specific modelling strategy with the identified most relevant competitive explanatory variables and the constructed diffusion indexes*"(Huang et al., 2014). In this study, they pay a particular attention to the competitive information because first, competitive marketing activities including pricing and advertising of competitive products are factors that influence the sales of the product. Secondly, competitive information has already been used to predict product sales at the brand level(Huang et al., 2014).

[1] Universal Product Code; Stock Keeping Unit

Over the years, most of the retailers have been scrambling with stock out[2]. Stock outs lead to direct loss of potential sales as well as dissatisfied customers. In order to avoid stock out conditions, retailers can mainly increase safety stocks (i.e. to over stock), which significantly reduces profits(Huang et al., 2014). One of the solutions is to get trade-off between service and cost is the use of precise forecasts for sales at the UPC level(Corsten & Gruen, 2003).

Actually, most of the retailers engage the base-times-lift approach to forecast sales at UPC level. This approach includes two stages that at the first, the baseline forecast is made with the simple time series, and then the needed modification and adjustment for any promotional event in the coming days is done. The approach that makes baseline forecasts firstly and then generates adjustments for any incoming promotional event(Huang et al., 2014).In the more recent literature, some studies focus on how to make the adjustment more effectively. For example, a string of studies have been devoted to helping managers with their judgmental decisions for the lift effect. In recent literature, some studies have focused on how to improve the adjustments. For instance, a series of studies wants to guide managers to make their own decisions based on the lift effect(Huang et al., 2014)(Gür, Sayın, Woensel, & Fransoo, 2009).

Because of complexity in data and technique utilizing regression trees(Loh, 2011) with clear features is recommended that these features made from sales and advertising time series of the central and related SKU-store[3] mixes. They encounter data storing, improves model performance. The results indicate that simple time series techniques perform very well for periods without promotions. However, for cycles with promotions, regression trees with clear features improve accuracy mainly. More complex information is just advantageous when the advanced techniques are utilized. Actually, a technical way is presented in (Gür et al., 2009), to answer the main question while creating a grocery sales forecasting system.

Lau et al. in (Yiu & Lau, 2018) have suggested firstly the plan of a novel big data analyzing technique that is supported by a parallel viewpoint situated estimation algorithm to obtain customer knowledge from online product comments and reviews and secondly the design improved sales forecasting strategy that is enabled by a parallel evolutionary mutually learning machine (Yiu & Lau, 2018).

In one of the recent researches, some sales forecasting strategies are evaluated to make improvement in sales forecasting aid by "*macro-economic leading indicators*"(Sagaert, Aghezzaf, Kourentzes, & Desmet, 2018). The proposed statistical forecasting chooses "leading indicators", automatically and also the order of the lead for each of the selected indicators(Sagaert et al., 2018).

[2] A situation where the demand or requirement for an item cannot be made from existing inventory("What is stockout? definition and meaning - BusinessDictionary.com," n.d.)

[3] Storing based on Stock Keeping Unit

4.2. CONCEPTUAL FRAMEWORK PROPOSED

In this study, it is assumed that the process model is ideal. Therefore, our goal is not to provide a method to improve the process model, but to provide the best solution by presenting a new framework as a complement to the critical moments of the process in operational mode.

For a better understanding of Figure 5, a graphical representation of the operation stages of the proposed framework is shown that actually derived from paper(Delen & Demirkan, 2013).

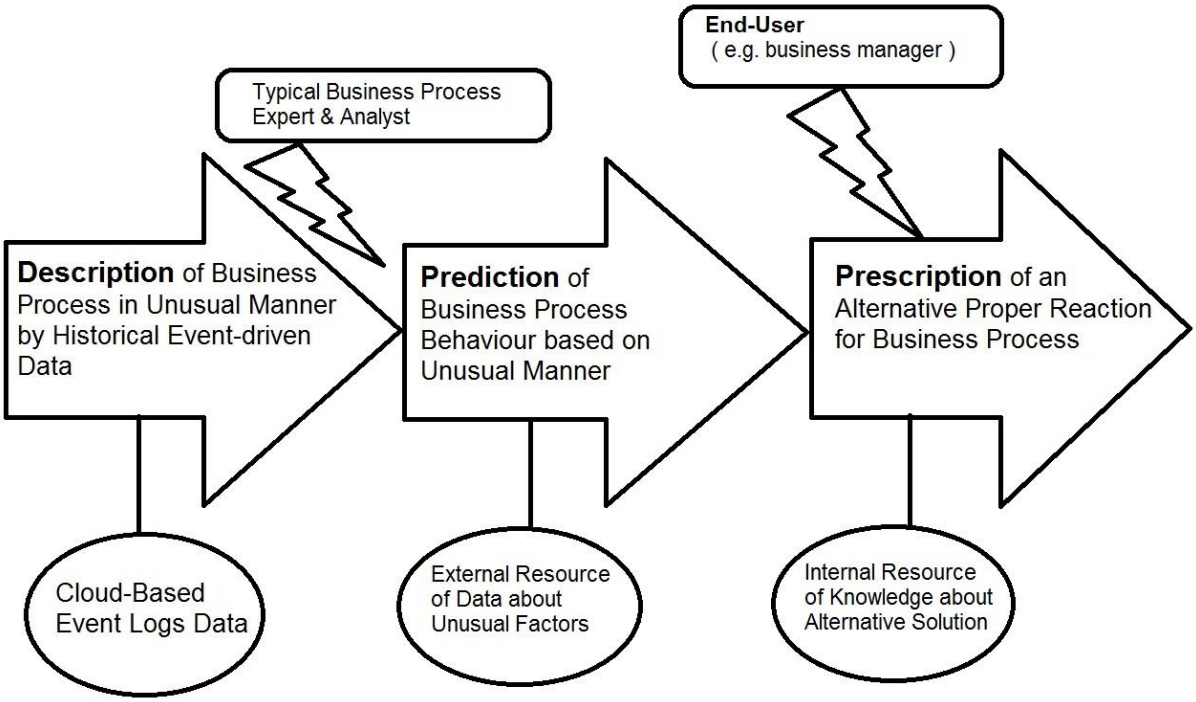

Figure 5: Proposed framework

The proposed framework in this study can be described as follows:

- Extraction of information from the source of Event Logs of the business process and turning these process data into necessary information such as the amount of service demand or the goods by customers, Or the amount of response to demands or non-fulfillment, customer satisfaction with the product or service provided, etc., in different days or intervals.

- Analyze and accurately review reports and information from the first stage by one or more analytics and identify unusual and abnormal points and times. At this stage, the implicit information contained in the sales charts and the analytical reports like abnormal points in the graphs are reviewed and archived and stored in a knowledge-based database. Unusual points from graphs and charts, taking into account the parameters of time, place, climate, human and social events, unexpected events, etc., are detected, identified and evaluated accurately so that the causes and reasons for them can be obtained. The main objective of this phase is to analyze information and business process historical records to determine the

external and environmental reasons influencing the efficiency and effectiveness of the process as well as total income.

As illustrated in Figure 6, in details the system is made up of two parts:

- Analyst and Computational Section of the proposed system (Analyzer):
  - Receive and review information on sales and services for the past days in the form of reports, charts, tables from the business process management system
  - Measuring and estimating the average sales and service rates on similar days in the past from step one's information through analytical auxiliary programs
  - Detecting abnormal days in sales and services (abnormal day is a day that the difference in sales and service is significant with the other days)
  - Extracting the features of each of the abnormal days such as weather, holidays, social events or festivals in such events as Black Friday, etc., and measure the impact of external factors.
  - Save this information as an empirical knowledge-base and manage it
- Listener section of the proposed system:
  - Receive accurate and real-time information from trusted and reliable resources such as the Meteorological Organization website about the typical or special features of the coming days
  - The classification of external factors affecting the sales and service of the coming days according to the output of the analyzer section

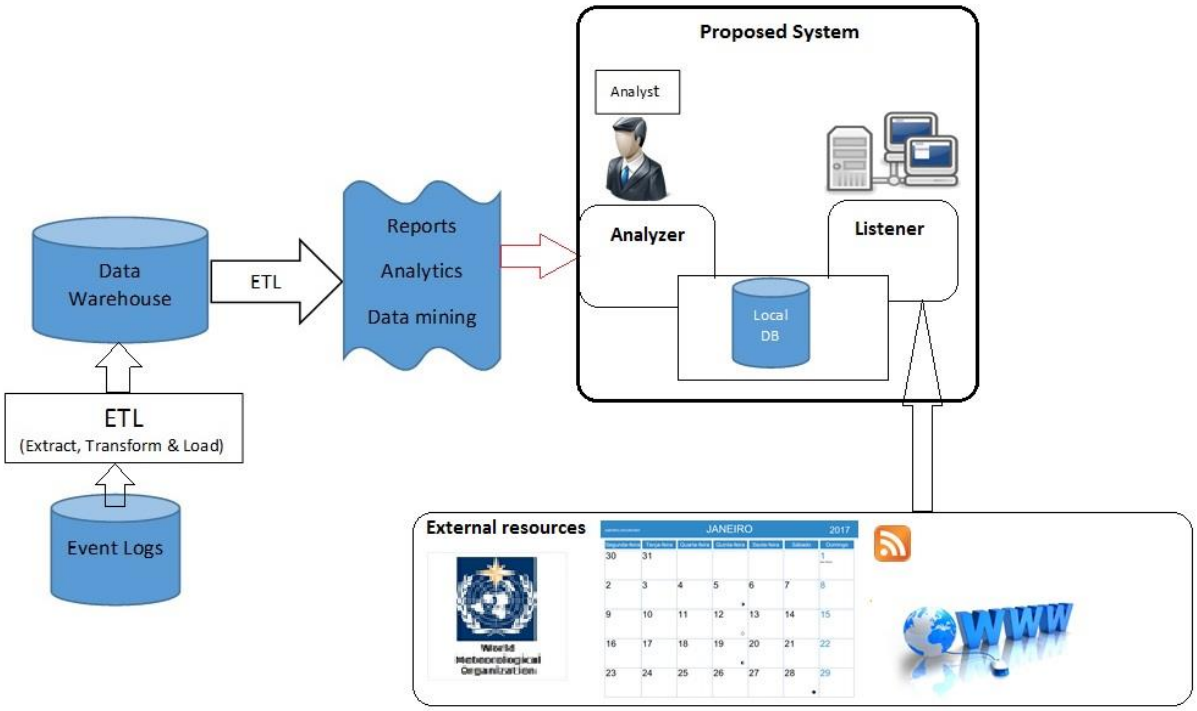

Figure 6: An abstract view of the final system

During the empirical observation and analysis of the anomalous points and comparing similar days, external factors affecting sales can be identified. Some of these factors have a positive impact and some have a negative impact on sales, in either case, we will import them into a database and then use them as useful knowledge to predict sales in the coming days.

Obviously, the sudden increase or decrease in the volume of sales of each business depends on a number of factors that can be divided into two categories of internal factors and external factors. For example, the weather conditions are considered to be external factors, but the amount of advertising business is an internal factor. Which both have their own impact on sales.

Effective factors on sales:

- External: e.g. Weather conditions, Holidays, Gathering people in an event, Season conditions, Inflation or economic prosperity of the people
- Internal: Internal factors affecting sales that are not addressed in this research such as increasing the service/product quality

As illustrated in figure above, there is a section include external resources. Examples of external information resources:

- Google services
- Online news services
- Weather forecast services
- Online calendars, …

A major component is devoted to continuously build and collect the log files. Due to the volume and velocity of creating these files that contain valuable information about the history of the process involved, it is so recommended to use of big data technology and cloud storage services. By analyzing this information, using statistical methods, it can be seen that sales volumes, or elsewhere, increase customer demand in some business days with a significant positive or negative fluctuation. Certainly, these fluctuations and changes are due to their particular reasons. Otherwise, sales in one day in the coming days will be approximately the same as the average calculated for each day. These causes are identified and their impact on the sales and demand of the customer is measurable, which is different for the various business processes. Therefore, a specific module is designed as a listener. This module is on standby. Therefore, at any moment it can reveal information about the occurrence of the mentioned factors in future days from the predetermined external resources.

The system has a local database that stores and manages information about abnormal days. We also have a table in this database that contains information about the factors affecting sales. In Figure 7 the diagram of the aforementioned database has been illustrated.

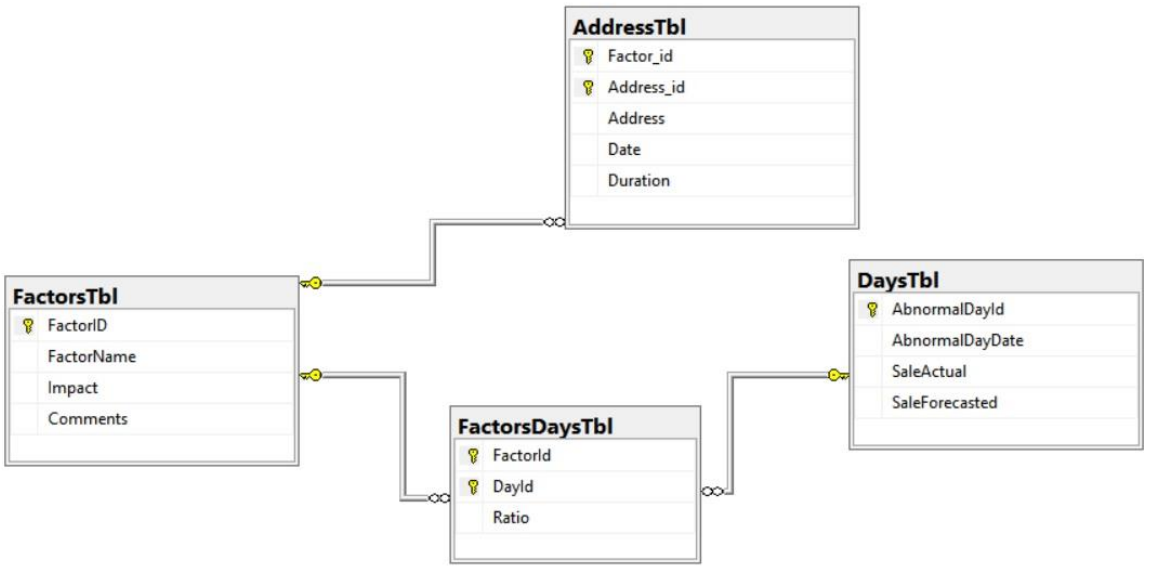

Figure 7: Logical diagram of local database

4.3. OBJECTIVES OF FRAMEWORK

It is necessary to give an introduction before mentioning the goals in the research. One of the concerns of today's business is to improve the business process model, as was seen in the study of articles and literature. Most scientists and researchers in this field, such as (Van Der Aalst, 2011) believe that changing the model of a process is aimed at improving its efficiency and effectiveness, which includes three basic approaches to model description, model prediction, and the prescription for the model's future. Although we have been inspired by the business process model improvement concept in the proposed system, the aim is to improve the efficiency of a business process by forecasting sales in the coming days rather than changing and improving the model.

When changing a process model, one or more of the activities or sub-processes are added or deleted, in order to achieve the ideal process model in different situations. In the context of our proposal in this research, it is assumed that there is no need to remove or add activity or sub-process. In a practical implementation of activities, sometimes, the desired process requires an out-of-process data. For example, the condition for the termination of a loop in a process is dependent on the data to be provided from external resources. Of course, process designers often try to minimize this type of dependency or provide the required data from a very secure external resource. Sometimes the value of this process may increase by changing a parameter or a quantity in a process.

For example, in our proposal, the sales forecast item is very important, although knowing the amount of this item in the coming days does not affect how our process works, but ultimately leads to the proper management of the raw materials and stocks of production and to obtain more customer satisfaction and, in general, improves performance.

In the techniques for improving the business process model, an initial process model is defined, designed and implemented. Then, implementing this model with various instances and conditions, the data related to the activities is inserted into the files called event logs, such as the start and end time of an activity. Due to the volume and velocity of the data produced as log files, it is better to use the NO-SQL method and the cloud service to manage the resulting big data.

In general, the objectives of the proposed framework in this research can be summarized as follows:

- Design a conceptual framework to forecast sales in those businesses dependent on customers' presence in order to accurately allocate resources and prevent their wasting and thus more income.
- Investigating the feasibility of providing a service for sale forecast to improve performance of the business without changing its model (process mining).
- Study about the feasibility of using Big-data technology and Cloud service at the same time to manage Event log files and analyzing them to generate a knowledge base system.
- Investigating and finding a precise and secure method for collecting information from external resources

4.4. Features and Benefits of Framework

Today, with the advancement of cyberspace and Internet technologies, the sale of goods and the provision of various services to customers is online, but nonetheless, in many business processes and the provision of services, the physical presence of the customer is indispensable at the place of service or sale of the goods. Such as providing food to customers in restaurants or providing a service to visit museums or participating in festivals, celebrations, live music or cinema concerts, as well as providing health services in clinics and selling goods in physical stores and services such as makeup salons, sports and gyms, etc., require the physical presence of the customer in the geographical location of the service, unless the goods or service is providing at the customer's place.
To provide better customer service or more product sales, and thus gain more money, it is vital to provide the initial resources, raw materials and stocks of the business process, which is one of the most important fields of studies at these days, especially in the small and medium enterprises.
It requires an analysis of what was going on in the business process and the accurate prediction of what will happen in the coming days. So, for this purpose, you can refer to the history of the process in the past. It is obvious that most of the business processes that use accounting and auditing software to monitor, control, and evaluate sales can have recordings. However, most of the business processes have the Event Logs files to store and retrieve some crucial information about the process.

According to (Delen & Demirkan, 2013), most of the business processes in the operating mode of their ideal model may be failing or dropping efficiency.

For example, in a business process, due to an unexpected external factor, the cost of executing a business process may increase, thereby reducing the final earnings of the business process.

Some of these unexpected factors are not recognizable during process definition and design, and can only be detected over time in an executable mode, which is done by a specialist and analyst of the desired process.

To overcome these unexpected factors, whose existence and impact on the final process efficiency cannot be ignored, alternative process model solutions are needed.

In order to create these alternative solutions, one or more external resources of information are needed to inform the system of the time and place and the probability of unexpected factors.

Today, significant information resources are available online in the form of applications and websites and web services that can be used to gather information about unexpected factors affecting processes.

The task of knowing the best resources of providing this information about the external factors affecting the business process can be vital, so the information and output of these services and information resources can be a supplement to our system.

Identifying, analyzing and evaluating the unexpected factors affecting the performance of a typical business process model and embedding a proper and accurate reaction in the business process model will increase the efficiency of the business process model, for example, increasing the amount of production of a business process of a producer due to increased customer demand due to special event leads to more sales and higher income.

On the other hand, the knowledge gained from the effects of unusual factors on the business process and the storage and organization of this knowledge is a valuable spiritual asset.

Because this service can structurally be transactional, sharing knowledge and experiences of similar processes in different organizations, regardless of the confidentiality of information organizations can be very useful.

Over time, and repeating the unusual phenomena affecting the process, the internal data source of the system, which contains instances of the business process in unusual situations, is richer resulting in more accurate analysis and more accurate prescription of the solution.

5. CASE STUDY

As previously mentioned, despite significant advances in online shopping, many small businesses need to the presence of their customers at geographical location of the service or sale. Some of them are listed:

Providing health services in clinics

Entertainment clubs:

Movies, theaters, libraries

Relaxing and massage clubs

Casino and game clubs

Bars and dancing clubs

Amusement parks and zoo

Gyms

Make up and beauty salons

Hypermarkets and shopping centers (most people prefer to see physically then buy)

Restaurants, coffee shops

Case study in this research is a restaurant with 100 capacity to serve dinner in Lisbon. As shown in Figure 8, the customer demand chart of a business service over a month, broken down by different days of the week. Each day of the week is characterized by a colored bar. Points a, b, c and d are unusual points of the service demand graph. For example, point **a** represents the amount of customer demand for the service on Monday, the second week of the month that it is less than expected, point **b** illustrates the amount of customer demand for the service on Saturday, the last week of the month that it is more than expected.

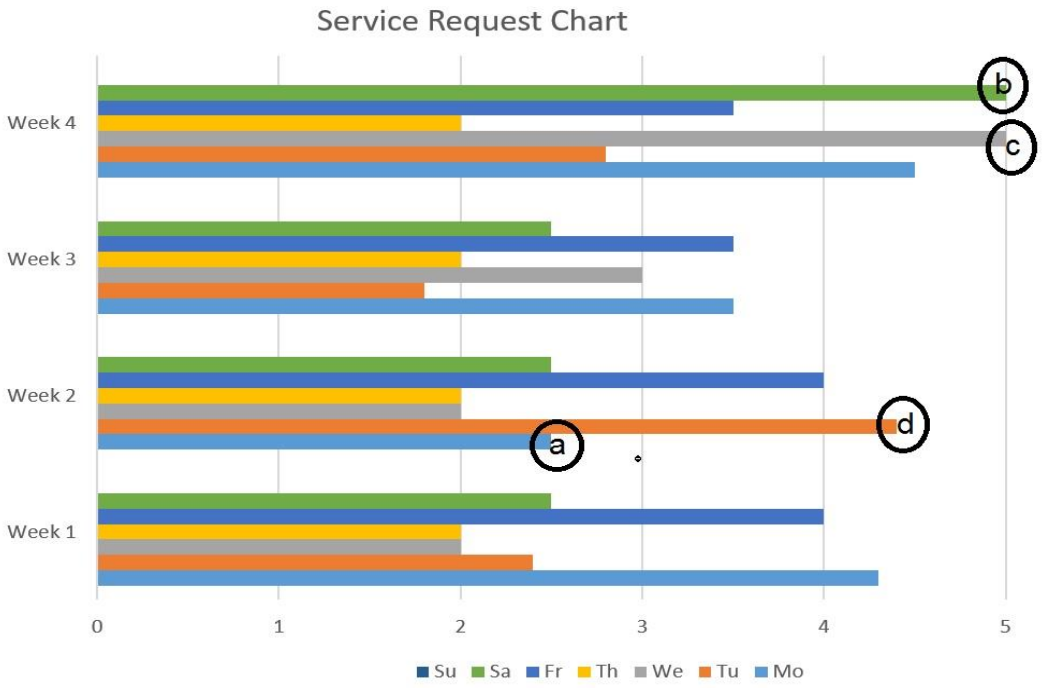

Figure 8: A bar-chart of a historical sales as input to analyze part

Suppose we want to predict the number of service demands or demands for the purchase of goods by customers for a specific day, such as d in the future. First, you need to know if d is a normal day or contains effective factors. Each of these factors, such as the temperature of that day, can affect the number of customers on that day. The kind and number of these effective factors can be uncertain so it's better to store their information in a database. It's easy to get the temperature of d from information resources such as the Meteorological Organization website, or you can get information about any kind of event on d from the news website such as sports, cinema, social events, celebrations, festivals, etc. Due to the amount of impact, these factors can be grouped (Table 1), for example each factor in group $\{\alpha_1, \alpha_2\ldots\}$ change Rd by 10%

Table 1 : Category table of external factors as KPI

Factors category	Impact rate
$\{\alpha_1, \alpha_2\ldots\}$	±10%
$\{\beta_1, \beta_2\ldots\}$	±20%
$\{\gamma_1, \gamma_2\ldots\}$	±30%
…	…

$F = \{\alpha_1, \alpha_2\ldots, \beta_1, \beta_2\ldots, \gamma_1, \gamma_2\ldots, \ldots\}$ is the set of all identified factors by an analyst in our database as our valuable knowledge.

A team of professional analysts who have enough knowledge and experience in the business process can easily identify the influential factors by examining unusual days in the life of a process in the past and gaining their impact with statistical formulas.

If day d has no unusual factor, the number of demands in a normal day d can be obtained from the history data stored in the system and the process records approximately that if there are many different values, we can compute a certain amount with statistical formulas, such as the mean or the average, which called S_n otherwise the number of demands in the day d that is abnormal, called S_d

$S_d = S_n * R_d$ (1)

$R_d = 1 + \Delta r$ (2)

The goal is the calculating amount of R_d.

If $\Delta r=0$ then $R_d = 1$

Else $\exists f_i \in F \mid \Delta r = \sum_{i=1}^{n} r(f_i)$ $r(f_i)$ = impact rate of factor f_i

In order to best serve, provision of the primary resources needed for the business process. Of course, it should be noted that nobody can claim that R is precise and definitive because it is based on the experiences and observations of the analyst and the previous data and statistical models of the business process.

In a case study of a restaurant in Lisbon[4]. We looked at interesting points by reviewing the past sale chart. For example, customer demand for dinner at the restaurant in the nights before the holidays was higher than the expected average. There are, of course, exceptions that we found out that they had their own reasons. The demand for dinner almost every Saturday is roughly 20% higher than the average of other normal days, so it's possible to consider a 20% positive indicator on Saturdays. The demand for service on Thursday, 4th of October has a high level of abnormality. Referring to the calendar, (Figure 9), we found that Friday, 5th of October is the official holiday in Portugal called Republic Implantation.

[4]http://www.1001nights.pt/en_GB/

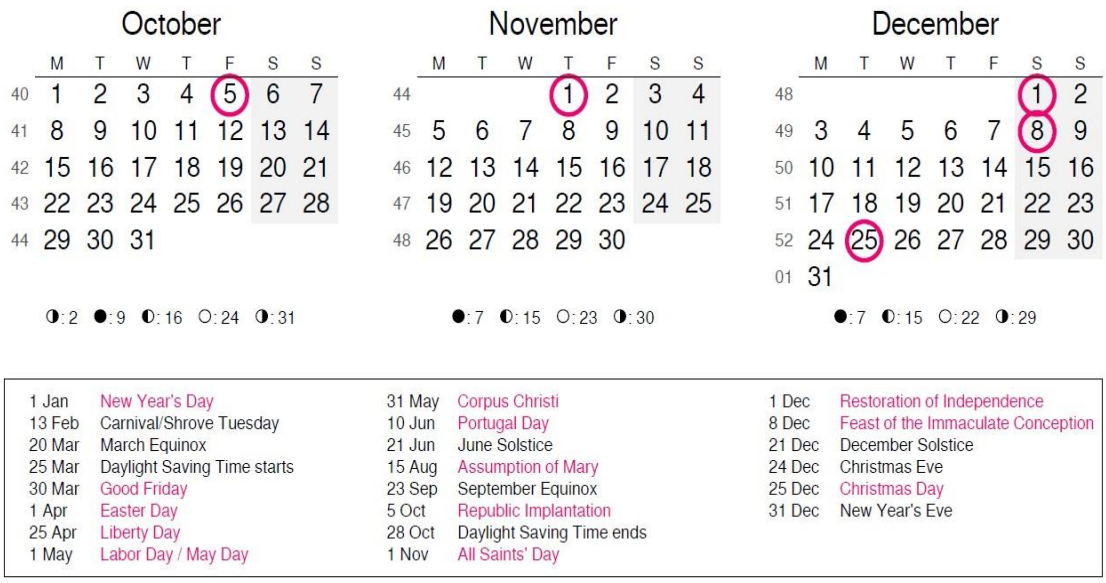

Figure 9: Calendar of Portugal in 2018

Another important indicator in this case that was considered was weather conditions, which was found by reviewing and manually analyzing past sales data, which in days with bad weather, service demand was lower than the expected average. For example, on Monday, December 11, 2017, the number of casual customers is much lower than expected. By referring to the weather conditions and other indicators, as seen in Figure 10, on this day, rain and bad weather conditions were observed, and as a result, most people preferred to stay home.

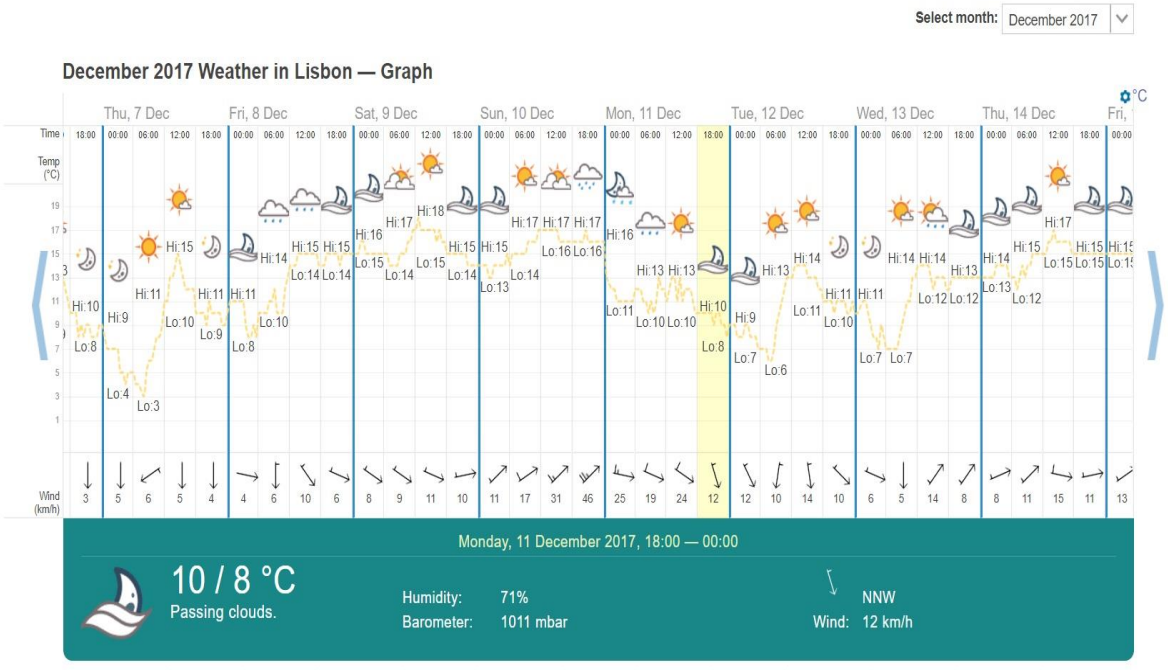

Figure 10: Shows bad weather conditions in 11th Dec 2017 in Lisbon

To test the case study in this study, we examined the unusual points in the sales charts and the analysis was discrete. For example, as shown in Figure 11, the sales chart is for all Mondays of the third quarter of 2018 which is extracted from the database of sales accounting records and carefully examined.

The results show that every point of the chart, which has an unusual sale, means that the sales have a significant difference with its similar days. Here we have a Monday that is different from other similar Mondays in the same season with the same conditions, which is 10th December of 2018.

Figure 11: Illustrates how to analyze and detect an abnormal day by manual testing

By scrutinizing this day, we found that an important annual festival was held near our restaurant, and a number of participants at the festival went to the restaurant for dinner, but without prior reservation.

After ensuring that the festival takes place near the service location, it is obvious that it can be considered as an external factor affecting sales and service, with a certain amount of impact, on the table containing external influential factors in the system database.

In the table, which contains external factors affecting sales and service in the database, we refer to the table containing the address of the sources of information about items such as this, which is shown in Figure 7.

In fact, Listener module informs the main module of the program as soon as it receives a signal that any effective factor occurs in the coming days. Then, the effectiveness of this factor (Ratio in table

FactorDaysTbl) is extracted or evaluated. Lastly, the sale of that day in the future will be estimated by its own formulas and will be included in the field of SaleForcasted of the table DaysTbl. That the business user can view it with an appropriate UI (User Interface). As shown in Figure 7, the abnormal day's table contains columns for real sales (SaleActual) and sales forecasts (SaleForecasted). By the end of that day, the real sales' field is null.

If the Listener module does not receive any signal from external resources that it is likely to have a factor affecting on a particular day in the future, that day will be as a normal day, so its sale forecast is normal which is calculated by the analytics module of the system from the past system data (sales in past days) by statistical formulas.

The system analyzer module generally has two functions:

First, every few days at regular intervals, the amount of sales of normal restaurant days is calculated and saved using statistical formulas. The input of this function is data about past business days, which can easily be retrieved from the sales system.

The second function is constantly updating the table FactorDaysTbl in the database. As soon as a record is added to the table DaysTbl, the field Ratio is obtained from the knowledge bank. Then the sum of fields Ratio of an abnormal day in table FactorDaysTbl is calculated and according to that, the field SaleForecasted is updated in the table DaysTbl.

It is noteworthy that the knowledge bank mentioned above does not have any knowledge at the beginning of the system about the average amount of business sales, etc. Therefore, with more work days and experience, the system can strengthen the bank and make it richer, according to past business data and with the help of statistical formulas and other necessary equations as mentioned above. Because the value of one day's sales (without any effecting factors) is extracted from the system's past data and it is obvious that at the beginning of the system there is no data and information about the business's past, so a hypothetical amount is assumed for the normal sales value by the user. Unfortunately, this is one of the weak points of the proposed system. In this case study, we used sales system files to correctly estimate these values and initialize the bank tables, manually.

As illustrated in Figure 12, the sales chart for October 2018 of case study, the restaurant management section has a preset amount for preparing and producing food per day of the week, which is displayed with a bold blue line (allocated resources). They provide food for 80 customers on Mondays, Tuesdays, Wednesdays, and Thursdays, 90 customers on Fridays, and 100 customers on Saturdays. All Sundays is off. This month, a Friday, the fifth of October is Republic Implantation date, although the restaurant is closed only on Sundays. The gray line shows the maximum capacity of service in this restaurant that is 100. The light blue line shows the actual sales in various days of October 2018. The orange line shows the forecasted sales by our method, and the yellow line shows the customer demands.

After calculating the difference between actual sales (light blue line) and sales forecasts (orange line), as well as between the predetermined capacity of service (bold blue line) and actual sales (light blue line), according to (3), it can be concluded that If the restaurant management used the proposed method of forecasting, it would only save up to 175 customers in October 2018, If it's assumed the

money gained from any customer is equal about 25€, thus this restaurant lost about 4375€, just in October 2018, and this is a notable amount.

$$\sum \left| \text{Forecasted sales} - \text{Actual sales} \right| = \text{deviation of Forecast} \quad (3)$$

$$\sum \left| \text{Allocated resources} - \text{Actual sales} \right| = \#\ \text{missed customers}$$

day	Actual sales	Forecasted sales	Max capacity	Customer demands	Allocated resources
1	75	75	100	75	80
2	75	75	100	75	80
3	70	75	100	70	80
4	80	100	100	120	80
5	80	80	100	80	90
6	90	90	100	90	100
8	75	75	100	75	80
9	70	75	100	70	80
10	75	75	100	75	80
11	80	75	100	80	80
12	80	80	100	80	90
13	90	90	100	90	100
15	80	75	100	80	80
16	50	55	100	60	80
17	80	75	100	80	80
18	80	75	100	80	80
19	90	80	100	90	90
20	90	90	100	90	100
22	75	75	100	75	80
23	70	75	100	70	80
24	70	70	100	70	80
25	60	70	100	60	80
26	65	75	100	65	90
27	80	85	100	85	100
29	70	70	100	70	80
30	65	70	100	75	80
31	45	50	100	50	80

Figure 12: The table of values

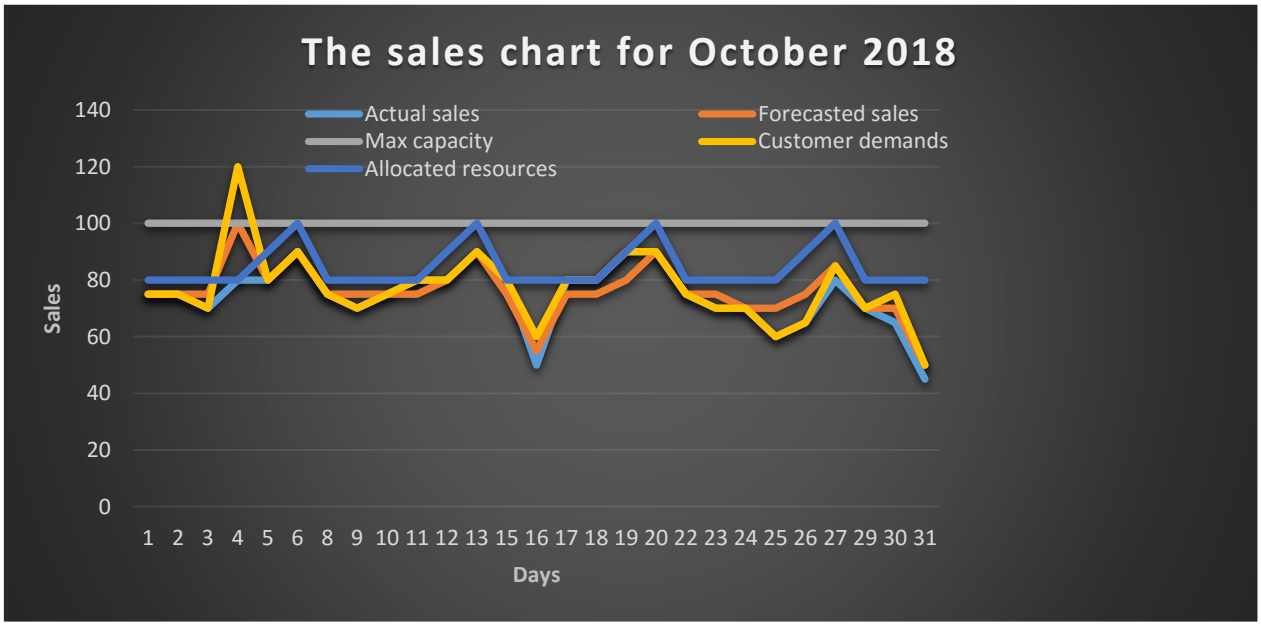

Figure 13: Sales chart for October 2018 of the case study

6. CONCLUSIONS

6.1. SYNTHESIS OF THE PROPOSED FRAMEWORK

After studying resources related to BPM, Process mining, New Technologies for Managing Big Data and serving with Cloud Technology, and their combined method for managing transaction and event log files resulting from the implementation of processes, as well as using statistical methods and BI algorithms in retail processes In order to forecast sales, we achieved an interesting idea.

In section 4.2, the initial abstract framework is presented with inspiration from BPI techniques. Then, according to the methodology described, we have got the framework proposed in that section. Subsequently, the required work was divided to form of units and modules were identified. Because the method used is a structured and modulated method.

In general, we have three main steps to create this system:

- Planning and feasibility
- Implementation, testing and documentation
- Installation and maintenance of the system

In this research, the focus is on planning and feasibility of the idea. And the second and third stages are underway with the presentation of this research.

Finally, we designed the idea and evaluated and tested in a real environment. The real environment mentioned was a business based on the physical presence of the customer in the service location.

By conducting this research and observing the results of hand-made studies, it can be said in retail and service businesses with the requirement of customer presence, by using historical data such as event logs and extracting information from them, a detailed description of the current process can be obtained. Subsequently, by identifying abnormalities in the process and identifying effective factors as indicators, in addition to benefiting from the knowledge of experienced analysts and managing this knowledge in a knowledge-based database, and at the same time, receiving relevant information from online and trusted resources about the conditions in future days, with regard to the indicators discovered, and continuously feeding them to the proposed system, we can make proper predictions, including forecasting sales in the coming days.

The result of a good description is a good prediction and the output of a good prediction will be definitely a good prescription for our business. For example in our study case a proper sales forecasting leads to prevent from losing the human resources and raw materials that results the high returns, and customer satisfaction and survival in a competitive market.

6.2. Limitations and Recommendation about Future Works

In the design and implementation of a hybrid system, the existence of difficulty and problems is inevitable.

Because the value of one day's sales (without any effecting factors) is extracted from the system's past data and it is obvious that at the beginning of the system there is no data and information about the business's past, so a hypothetical amount is assumed for the normal sales value by the user. Unfortunately, this is one of the weak points of the proposed system.

In general speaking, in this system and any other system in which sales of business processes are forecasted, nobody can assert that the forecasting is quite accurate and this is one of the inherent disadvantages of such systems.

As we have seen in the case study section, it can be said that each particular business has its own factors of selling and servicing itself. As well as the method and formulas for calculating the effect of these factors on sales in various business models are different.

Meanwhile, it is not easy to determine what factors affect the sale of the business, and require a very detailed analysis of that day's situation (abnormal in terms of sales) in its geographical and calendar range. In the early days of the life of the system, this is done by an experienced and expert analyst and entered into system settings. Over time, with increasing knowledge of the system relative to the factors affecting sales, the intelligent system of the system can automatically perform the required calculations.

The analysis and design of a new process model for the unusual state of the proposed system are to some extent based on the skill and accuracy of the human analyst, which will be in error. As a result, there is the possibility of a false decision and failure of the business process.

The proposed framework can be implemented as an application and engaged in the main computer system of businesses affected by external factors and therefore it ought to be only under technical support and upgrade and maintenance by the provider. However, if it is intended to be provided as a web service, problems and limitations such as the lack of data confidentiality and security concerns about financial information and business auditing will arise.

The other future works:

- Implementation and evaluation of the proposal on other study cases.
- Generalizing the proposed scheme as an engineering project.
- An attempt to remove the human analyst in the proposal and replace it with intelligent algorithms.
- Study the feasibility of providing a service for forecasting sales under cloud technology based on the proposed method

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