A Contribution to the Development of an Information System in the Function of Improving Decision-Making in Business

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Abstract— In this paper, the most important elements of software development are presented, with the aim of improving decision making in business. The considered example has practically been implemented in a company engaged in the transportation and storage of petroleum products. The results of the presented software indicate a significant improvement in the collection of large amounts of data and available information. The software support has essentially been focused on the improvement of data visualization for different aspects of the business decision-making process and the business cost reduction. The paper presents the methodological aspects of software development in the key segments. The paper is illustrated with different types of reports with the aim to support managers in business decision making in the specified segment.

I. INTRODUCTION

The company "Obilić-Petrol", with its seat in Gračanica, is a company for the transport of petroleum products [1]. Within the company, there are five points of sale, i.e. petrol stations, used for the distribution of these goods (Gračanica, Prilužje, Štrpce, Ranilug and Goraždevac). Petroleum products which are sold are recorded through fiscal cash registers. The company has encountered difficulties in collecting and managing information [2]. The company needs software that would help further business decision-making and be of crucial importance for the development and improvement of the quality of the service. In addition, the company would like to be able to import a large amount of data in order to facilitate the processing of integrated data in a correct and uniform manner [3].

Moreover, there is a need for the management of the logistics processes and, consequently, for a possibility of monitoring products' route from suppliers to customers, which is opposed to a bad business organization, a lack of true, accurate and timely information for decision making as well as outdated technologies [4]. All these failures in the company Obilić-Petrol, among other things, have led to a huge deficit in the inventory, adequate control over employees and supplies, a slow flow of information in the enterprise, slow work in the warehouse, which has then also prevented a prompt response to customer complaints, the use of transport routes, the optimal movement of transport means, the optimal storage of huge amounts of paper documents and the like [5]. The current situation in the company makes it impossible for complaints to resolve quickly and the employees to be controlled at the warehouse. The result is reflected in large differences in supplies and a large amount of complaints coming from dissatisfied customers etc.

The information system has resulted in the need for the improvement of the business decision-making process through the reduction of operating costs by creating various types of reports that would assist the management in their making business decisions [6]. Also, data visualization in the company provides greater usability or easier dealing with tasks such as a data analysis, patterns detection and trends prediction. [7] Visualization is helpful in understanding data by summarizing and allowing a faster identification of important parameters, a qualitative review of large and complex databases and a better alignment of the analysis.[8].

The efficiency and effectiveness of small and medium-sized enterprises is improving depending on the quality of processes, and the processes are corrected for improvement efficiency and effectiveness [9]. The visual representation of abstract data is very important in the company when the process of business decision-making is concerned, which increases human understanding (Card, Mackinlay and Shneiderman, 199) [10]. Visualization helps people with large amounts of data and complex problems to obtain relevant information more easily and more quickly [11]. The importance of visualization in the business decision-making process is reflected in the fact that it helps to identify the problem, because it allows the extracting of information from data, a faster insight into the structure of forms and a complete overview of complex information [12]. Decision support systems are of crucial importance for the survival and development of a company, as well as the application of the concepts of information technology in them is [13].

- The development and implementation of a system for multicriteria decision making in business systems [14]
- The improvement of decision-making efficiency by software support [15]
- The improvement of an information system in the function of a business quality [16]
- The application of the modern concepts of management information systems [17]
- The implementation of a broad spectrum of information technology in business [18]

- The implementation of the decision-making system in production planning etc. [19], [20]

The company "Obilić-Petrol" of Gračanica has prepared a thorough analysis of the existing complex processes in the enterprise. Table 1 presents a tabular overview of the existing analysis of costs on a monthly basis, which will form comparative data after the application of software for the improvement of business decision making [21]. Based on the analysis, we can conclude that the company encounters a lack of information for the decision-making process in its operations and that it is one of the key factors of the disorganization and disorder of the storage of oil and oil products. The status quo will result in a negative impact on the relationship between the business partner and the company. Therefore, it was necessary to start the project of the computerization of the enterprises and the storage process as well as the overall logistics process and the renewal of the technological processes that will both ensure the customer's satisfaction with quality services and reduce the cost of the services within its business units [22].

TABLE I.
REVIEW OF THE COST OF THE PREVIOUS SYSTEM [23]

Monthly realization of costs	EUR
Labor costs	18,637
Transportation costs	22,700
Material costs	3,197
Costs of inventories	2,300
Other costs	500
Overall costing	**47,334**

The investments necessary for the introduction of software for the improvement of the company "Obilić-Petrol", which include complete IT equipment (hardware, the server, computer, a printer, licenses etc.) amounted to 44,000 EUR for this purpose.

II.   DATABASE IMPLEMENTATION

The relational database model is based on the interconnectedness of data stored in tables. In relation to the requirements of the software, the following tables can be defined and will be created:

- The table containing data about the type of fuel, i.e. the petroleum product which is sold at the petrol station
- The table containing data about the workers engaged in the filling of the fuel
- The table containing information on the petrol stations of "Obilić-Petrol Gračanica" and their locations
- The tables containing information on the fuel sold, with supporting data, such as the exact date and time of the sale, the type of the fuel, the petrol station at which it was filled and the name of the worker who filled the fuel.

Based on this, the **Fuel Table** can be defined, containing the following fields:

- **Fuel_ID** – The primary key of the table, which will be auto-incremented and cannot have a NULL value.

- **Fuel_name** - It contains the exact name of the petroleum product.
- **Manufacturer** – It contains the exact name of the manufacturer.

The **Gas_station Table** is also defined and contains the following fields:

- **PStation_ID** – The primary key of the table, which will be auto-incremented and cannot have a NULL value.
- **Station_name** – It contains the exact name of the petrol station.
- **Address** – It contains the exact address of the petrol station.

After that, the **Worker Table** is defined and includes the following fields:

- **Worker_ID** – The primary key of the table, which will be auto-incremented and cannot have a NULL value.
- **Name** – It contains the personal name of the workers.
- **Surname** – It contains the surname of the workers.
- **Birth_date** – It contains the date of birth of the workers.

At the end, the central table – **Petrol_sales Table** – is defined, containing information about the sale of petroleum products:

- **Transaction_ID** – The primary key of the table, which will be auto-incremented and cannot have a NULL value.
- **Fuel_Fuel_ID** – The foreign key of the **Fuel Table**
- **Worker_worker_ID** – The foreign key of the **Worker Table.**
- **Petrol_station_PStation_ID** – The foreign key of the **Petrol Station Table**
- **Sold_litres** – It contains the integral value of the sold litres of petroleum products.
- **Date_time** – It contains information about the exact date and time of the sale.

The relations between the created tables are established, which forms the basis of the relational database model, Fig. 1.
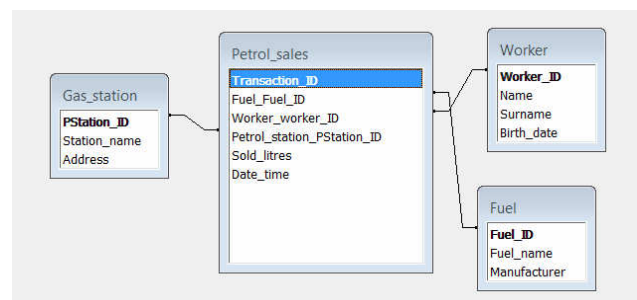

Figure 1. The relational database model [23]

In this way, the tables are successfully created in the database and the relationships between the tables themselves are established. The importance of information management in the organization is assessed by analyzing the ways of using it for the sake of achieving the company's goals. Marchand [24] asserts that, if an organization uses information for management, it can

achieve the following: adding value to products and/or services, improving the operation of risk management, a cost reduction for the business process and for providing goods and/or services to customers and the creation of new opportunities through innovation. If data are organized in different dimensions, i.e. sequences, one can adopt and process larger amounts of information much more easily than when they are not adequately organized and presented [25].

III. GRAPHICAL USER INTERFACE

The primary function of a graphical user interface is the interaction between users and computers by using various graphic elements and text message notifications. When opening the application, the user comes to the main form which gives him the ability to [26]:

- Administer data in the Fuel, Worker and Petrol_Station tables;
- Import the bulk of fuel sales data in the Fuel Sales Table;
- Generate reports required for the management decision support;
- Get basic information about the software; and
- thebe offered a possibility of shutting down the software and exiting the graphic user interface.

The organizational chart of the graphical user interface window and the main interaction of the user interface window itself are shown in Fig. 2.
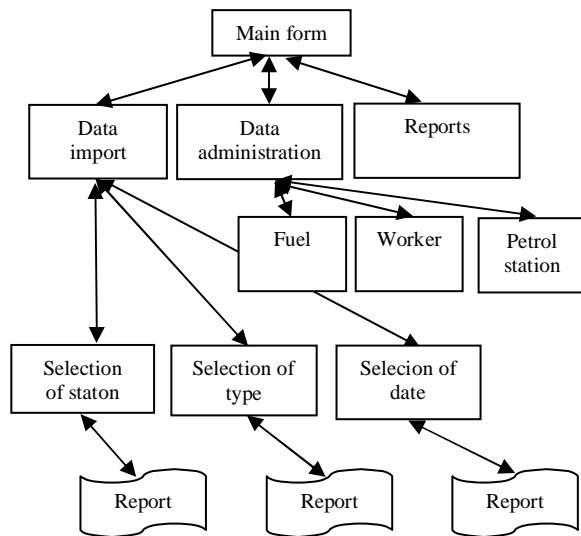

Figure 2. The organizational chart of the user interface [23]

The main form has been designed as an initial screen at the start-up, which has the ability to add and modify data in a database in order to perform a mass import of data into the database and generate reports. [27]

The main form can be seen in Fig. 3.

Figure 3. The main form [23]

The form intended for the administration of data allows the selection of the table in which one wants to add or modify data. On the basis of the above-defined table, it is possible to:

- Administrate information about the Petrol Station,
- Administrate information on the type of the fuel, and
- Administrate data about the workers.

IV. THE MASSIVE DATA IMPORT

As the software will manipulate large amounts of data or, more precisely, manipulate each transaction, where transaction represents the retail sale of petroleum products, it is necessary to adjust the software and the database to the mass import of data [12].

Data will primarily be imported from cash registers, so a flexible way is needed in order have such data transformed from fiscal cash registers into a format easily recognizable to databases and imported into the Fuel Sales Table. For this purpose, the transformation of data from fiscal cash registers into the CSV (Comma-Separated Values) format text will be used so that later it could be possible to import them into a particular database table from the textual CSV format.

The CSV is a batch file where tabular data (numbers and text) in the plain text format are stored. The plain text format represents a string; no data could be interpreted as a binary number. The CSV file consists of a number of production records, where each record stands for a single line; each record consists of fields, and each field is separated from adjacent fields in a certain way – a comma (,) or a tab are most often used to separate the character. Usually, all records have the same field order.

An example of the CSV file that was used to import data into the Fuel Sale Table is displayed in Fig. 4.

```
Sold_Liters, Date_and_time, PStationID, FuelID, WorkerID
98,9/6/2012,2,2,4
126,5/24/2012,2,5,3
122,5/6/2,12,3,2,4
39,9/12/2012,3,5,2
4,4/13/2012,4,4,1
5,10/11/2011,3,6,1
109,12/26/2011,2,2,4
```

Figure 4. An example of the CSV file: [23]

In the form for a massive import data, there is a textual field impossible to edit. This field will get the value of the path to a particular CSV file, where data are imported into the database.

The first step towards an import of data is the selection of the CSV file via the Windows Browse Dialog Box (Figure 9).

By using this option within the VBA code in the onClick event, the next software routine will be applied:

```
Private Sub cmdPath_Click()
Dim FormDialog As FileDialog, vrtSelestedItem As Variant
Dim strSelectedFile As String
Const CSVFAJL = "CSV Files"
Const CSVTIP = "*.csv"
 Set FormDialog =
Application.FileDialog(msoFileDialogFilePicker)
 With FormaDijaloga
  .AllowMultiSelect = False
  .InitialView = msoFileDialogViewDetails
  .Filters.Clear
  .Filters.Add CSVFAJL, CSVTIP
  If .Show = -1 Then
    For Each vrtSelestedItem In .SelectedItems
     strSelectedFile = vrtSelestedItem
    Next vrtSelestedItem
    Me![txtPath] = strSelectedFile
   Else
   End If
 End With
  Set fdg = Nothing
 End Sub
```

With this software routine, the *ppSelectedFile-of-the String-Type-initialized* variable is located next to the path of the CSV file, with a limitation that only files with the CSV extension can be selected. After that, out of the ppSelectedFile variable, which at a given moment contains information about the path to the CSV file, those values are assigned by the tkt Path, which in this case represents a text box on a form for a mass data import. After selecting the file, the following VBA programming routine is executed:

```
Private Sub Command4_Click()
Dim strSelectedFile As String
strSelectedFile = Me![txtPath]
DoCmd.TransferText acImportDelim, , "FuelSale",
strSelectedFile, True
 MsgBox "Data are succesfully imported."
```

In this case, the value is taken from the text field where the data on the location of the CSV file was previously stored. That data is assigned to the variable ppSelectedFile, after which theDoCmd TransferText procedure is started, transferring the data from the database on the given path, recognized as the CSV file data, into the selected Fuel Sales Table. At the end of this process, the user should be shown a brief piece of information that the correct import of data has token place.

V. REPORTS FOR DECISION-MAKING SUPPORT

Changes that can be caused by high-quality information can easily be limited by the manner of their implementation within a specific decision-making process. [27] When selecting options for reports for decision support in the General Form, the software will open a form where the user is offered to generate six various reports.

Few (2007) argues that a visual display of data is very important because it can, for example, easily differentiate the forms presented in a certain way from other, different patterns displayed. [28]

When selecting options for data processing and report generation, the user will be allowed to enter input parameters for a particular report, after which he/she will receive a generated report.

Eppler and Burkhard (2004) suggest that visual information combines the visual presentation of information and the dynamic technique of receiving and analyzing information by the user. Input data organized in different dimensions make it possible for one to accept and process a larger amount of information than if they were not organized. [25]

A Report on Fuel Sold in a given period of time provides information on the basis of input parameters, such as the start and the end dates, the quantity of the fuel sorted according to the type sold each day between the entered start and end dates.

A Graphic Report on Fuel Sold in a given period of time provides us with information in the form of graphical charts based on input parameters, such as the start and the end dates, the quantity of the fuel that, according to its type, has participated in the total sales of petroleum products between the entered start and end dates.

Valle (2006) states that visualization allows the detection of otherwise imperceptible things – in this argument, we can conclude that the higher the quality of visualization, the easier it is to perceive otherwise unnoticeable parameters and to quickly become aware of the essence, while in the case of low-quality visualization, the user is not provided with an insight into the essence or the existence of information [29].

A Report on Fuel Sold Per Employee on the basis of the entered quantity in a given period of time provides information on how the worker has sold the fuel on the basis of input parameters, such as the start and the end date, as well as the minimum amount of the fuel that will appear in the report. A Graphic Report on Fuel Sold is based on the type of fuel at the petrol station and provides information on the participation of each petrol station in the sale of a certain type of petroleum product on the basis of input parameters, namely the type of the fuel.

A Report on Fuel Sold is based on the definition of the type of the fuel and provides information on how much of a certain type of oil derivative the worker has sold in a certain period of time based on input parameters, such as the start and the end dates and the type of the fuel. A Graphic Report on the Average Amount of Fuel Sold at a petrol station reveals information on the average amount of filled litres per transaction for each type of the fuel sold at the petrol station based on input parameters namely the name of the actual station.

The software used in actual implementation supports the generation of different types of reports:

Report on Fuel Sold in a Given Period of Time: The report gives detailed information on how much of any type of fuel is sold each day within input parameters such as the start and the end dates. A concrete example of this report can be seen in Fig. 5.

Figure 5. A Graphical Report on Fuel Sold in a Given Period of Time [23]

Report on Fuel Sold Per Employee on the Basis of the Entered Quantity in a Given Period of Time: The report is generated for a certain period of time, which time is defined by the start and the end dates and is based on the minimum quantity entered in the form of data in litres, the number of petroleum products sold by each worker, the minimal amount of such data being defined by the user in the form of an input parameter. A concrete example of this report can be seen in Fig. 6.

Figure 6. Report on Fuel Sold per Employee on the Basis of the Entered Quantity in a given Period of Time [23]

Report on Fuel Sold by Employees on the Basis of Defining the Type of Fuel: The report is generated for a certain period of time, which time is defined by the start and the end dates and is based on the type of a petroleum product and the quantity of a particular type of petroleum product sold by each of the registered workers. A concrete example of this report can be seen in Fig. 7.

Figure 7. Report on Fuel Sold by Employees on the Basis of Defining the Type of Fuel [23]

Table 2 accounts for the results of a specific measurable impact on improving the business software in the company "Obilić-Petrol" Gračanica through the improvement of the business decision-making process and a display of the reduction of operating costs.

TABLE II
Display of the costs and measurable results of the software application for business improvement [17]

Monthly realization of costs	EUR
Labor costs	14,800
Transportation costs	23,000
Material costs	3,100
Inventory costs	200
Other costs	500
Total costs	**41,600**

VI. CONCLUSION

In the context of the global economic crisis and the more open world market, companies in Serbia are faced with extremely strong competition. Customer requirements are more demanding, seeking quality services, requiring shorter delivery deadlines, the accurate delivery of goods and the fulfillment of contractual obligations in full. In addition to solving the aforementioned problems, the company "Obilić-Petrol" is making efforts to have its overall business improved by applying software solutions through the improvement of the business decision-making process in order to minimize its labor costs, accomplish the optimal distribution of goods, ensure the adequate quality of its services and increase work efficiency. For this purpose, the company "Obilić-Petrol" has decided to use the concept of the development of information systems for decision support, which, among other things, allows the complete reengineering of the entire logistics process, stressing that in the future, we will not be able to monitor market changes without the use of modern technology and sophisticated tools for managing logistics processes.

After having performed a fundamental analysis, using the concepts of intelligent decision support systems, the reorganization has been conducted in the procurement and distribution of the assortment, changes in transportation have been made and refuelling for particular petrol stations has been done (on the basis of demand and fuel sales); also, a redistribution of the employees has been performed according to the needs of a particular petrol station (workplace).

Having applied the concepts of intelligent decision support systems in such an exact manner, upon receiving the financial report, and after the implementation of the IS, the company for fuel trading "Obilić-Petrol Gračanica" has increased its sales of fuel and additional items, reduced the number of the working hours of employees, i.e. increased the company's profits and improved the quality of the services provided.

Some of the key advantages of this model are:
- Reduction of the cost of storage and distribution.
- Reduction of the time of delivery.
- Increased accuracy of receipt and dispatch of goods.
- Increased worker productivity.
- Increased utilization of office space.

- Improvement of inventory control.
- Management of modern standards of supply chains.
- Customer satisfaction.

The cost and value analysis of the total investment shows that the total return of investment is mostly affected by the reduction in the share of labor costs (the reduction of the employees from 15 to 12) and by a significant reduction in the cost of inventory shortages. The total investment in information technology indicates that the investment itself is fully justified. That is clearly evident through the tabular and graphical reports showing revenue growth, earnings growth, lower interest rates and amortization and net earnings growth in the enterprise "Obilić-Petrol Gračanica" compared to the previous year.

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