

SUPPORT MANAGEMENT DECISIONS IN SMALL AND MEDIUM COMPANIES

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Abstract: *A system built to support management decisions and not only needs to be accurate and well adapted to the requirements of the decision and the variables involved in it, and this happens because a decision is still a human act in any type of business and institution. We can say that a decision support system has a part in it that cannot be determined by any software: the human decision which is not a determinist act. It depends on a lot of variables but also still involves the decision maker intuition and experience. This is why an important problem emerged to be discussed in this paper: the need to implement and develop an in house solution to help management decisions and not only, using existing tools and this with no additional fees. This can be a good opportunity to discover models and solutions. An identified solution using Microsoft Excel and Access is discussed in this paper and a model applied on a case study will be presented. The results of the case study showed a real support in making decisions and a better transparency in manipulating the data, improving also the time needed to collect, transform and present data. The model can be applied in any type of problem that needs a visual presentation of data as well as in situations that need working with a large amount of data, but especially in small and medium size companies.*

Keywords: *Decision Support Systems, Modern information systems, Decision making, Microsoft Access and Excel 2013, DSS model*

1. INTRODUCTION

A decision support system is a complex concept used to describe all the resources involved in the decision making process. The term resources involves physical, human and software capital. When the company or institution needs a

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tool for decision making, in many cases, the most used resources are the financial or statistical numbers, accounting figures or just some numbers in tables. The visual representation of data is very important in helping management or other types of decisions, because based on this, any decision can be improved. Historical data and comparisons are also helpful in improving any type of decisions in institutions or companies.

The road from a Decision Support System to Business Intelligence is in many cases a narrow one and needs more funds and fineness. Technically speaking, business intelligence is a broad category of applications and technologies for gathering, storing, analyzing, and providing access to data to help clients make better business decisions. The recognized functions of business intelligence technologies are: reporting, online analytical processing, analytics, data mining, business performance management, benchmarking, text mining, and predictive analytics (Airinei, Homocianu, 2010).

Getting performance when generating financial reports and doing auditing work currently require a real time management of multiple data formats and dimensions of analysis but also processing speed, flexibility, portability, automation and power of suggestion (Homocianu, 2015).

The most common problems in small and sometimes also in medium companies appear when:

- the company or institution has built in tools for different tasks and it does not own a single software solution like an Enterprise Resource Planning (ERP) or a dedicated Decision Support System (DSS), and needs specialized dashboards for business and economic decisions (Dospinescu,2013);
- the company or institution has a single tool to work with, but has no resources to pay or to build specialized software solutions to support business decisions;
- data privacy is very important for the company so in house solutions are more suitable for a DSS.

Nowadays almost every tool or software solution for data handling offers the possibility to export data in popular formats like text, csv or xls. This is a great opportunity to use the data and to transform it into powerful tools suited for a system that can support decisions.

This identified opportunity allowed our study to use the package Office 2013, importing data from an Excel file into an Access database (Melton, 2013) and to build complex dashboards to help management decisions and not only. The dashboards are built using pivot tables having charts attached to them. Pivot tables are a great way to summarize, analyze, explore and present data. But they are not enough to make data visible and help management decisions (Druzdzet, 2002). We also need charts, which are one of the main characteristics of a DSS and they are a powerful tool to make a decision if they are chosen in a suitable manner. A good decision for a chart can improve the decision. Depending on the situation, bar charts, line charts, or pie charts, trend lines and others are the best tools on our hands to make data visible.

Finally we can conclude that often in companies we have a large or medium amount of data in text, csv or xls format and we need to make it really visible in a suitable manner to support management decisions and not only. The solution for this problem, in our opinion, is one that does not need too much technical background, because in most cases the managers have a non IT profile. Therefore, taking into account all these restrictions related to resources, fees and technical skills, the purpose of this paper is to identify a model for a system that can be implemented successfully to help and support management decisions, using Microsoft Office 2013 Package and specifically using Access and Excel.

2. LITERATURE REVIEW

Decision Support Systems (DSS) have been in existence since the proliferation of computers and they have been used as an enabler for business decision-making (Wilson, 1994).

A Decision Support System (DSS) is an interactive, flexible, and adaptable computer based information system that utilizes decision rules, models, and model base coupled with a comprehensive database and the decision maker's own insights, leading to specific, implementable decisions in solving problems that would not be amenable to management science models (Tripathi, 2011). DSS serve the management, operations and planning levels of an organization and help to make decisions, which may be rapidly changing and are not easily specified in advance (Krishnaiyer, Chen, 2015).

In the specialized literature, the main components (Druzdzel, 2002) of a system designed to support decision making are:

- The database, also known as Database Management System (DBMS) is the knowledge base or the data bank of the DSS. It stores large quantities of data that are relevant to the problem for which the DSS has been conceived.
- The model, known as Model-base Management System (MBMS), has the role to transform data from the DBMS into information that is useful in decision making.
- The user interface also known as Dialog Generation and Management System (DGMS)

The general architecture of a DSS is represented in the figure below.



Figure 1: *DSS Architecture*

The model and the database communicate with the user interface to help the user visualize the data and make decisions suited to the problem that needs to be solved with the help of those decisions. Although the arrow only goes from DBMS and MBMS to DGMS, this does not mean that the communication is only in one way. When any action is done using the user interface, the data that need to be shown are changed using the new selection/action, the DBMS returns the data with the help of MBMS.

Although the classifications of these systems are various, the most suited classification for this paper is the one using the mode of assistance as a criterion, and Power (Power, 2001) identified five types of DSS:

- Communication-driven DSS: are targeted at internal teams and are used to facilitate communication between team member in order to help them make better decisions;
- Data-driven DSS: are targeted on managers and staff and are used to search for data by querying a database or a data warehouse to seek for specific answers in the decision making process;

- Document-driven DSS: are based on finding documents on a specific set of keywords or search terms and are targeted on a broad base of user groups;
- Knowledge-driven DSS: represents specialized knowledge and supports decision making in a particular domain;
- Model-driven DSS: are targeting managers and staff members of a business and are complex systems that help analyze decisions or choose between different options.

Spreadsheet packages can be used as DSS generators because: they offer instruments for building a variety of models (statistical, financial, optimization, simulation, representational), they offer graphic capabilities for data representation, can perform what-if analysis and can be used to develop quickly and easily a specific DSS. Spreadsheets can be used to build model – driven, data – driven and solver – based DSS and they are appropriate for building a DSS with small models, for building a DSS prototype or for testing the DSS models. This is why we have another type of DSS called spreadsheet – based DSS (Rus, Toader, 2008).

This classification is useful because it highlights the fact that the model of the DSS designed in this paper is not only based on DSS architecture, but also based on the purpose that the model serves for or the mode of assistance.

3. DATA AND METHODOLOGY

The data used to investigate and to develop this spreadsheet-based model was gathered for a period of 5 months, tested in many stages and analyzed to identify a possibility to standardize some operations in developing reports and dashboards useful in management decision making and not only. Large amounts of data were processed in different situations to observe the behavior of the emerging system. After failure or latency in most of the cases in loading, processing or representing the data, the solutions identified to solve the issues helped us to standardize the model steps and to apply it successfully for different subjects.

3.1. Microsoft Office 2013 DSS model for small and medium companies

The focus of this paper is to enumerate the development and successful implementation of a decision support systems encompassing quality, customer service and warehouse operations. The model was designed to fit the needs especially of small or medium companies.

The proposed model consists of data imported into a database from different sources, processed and loaded into an Excel file with the purpose of improving management decisions with attractive interactive dashboards. The final goal of the paper is to design a model that can work with large amounts of data and to load it fast enough into dashboards specialized on different domains.

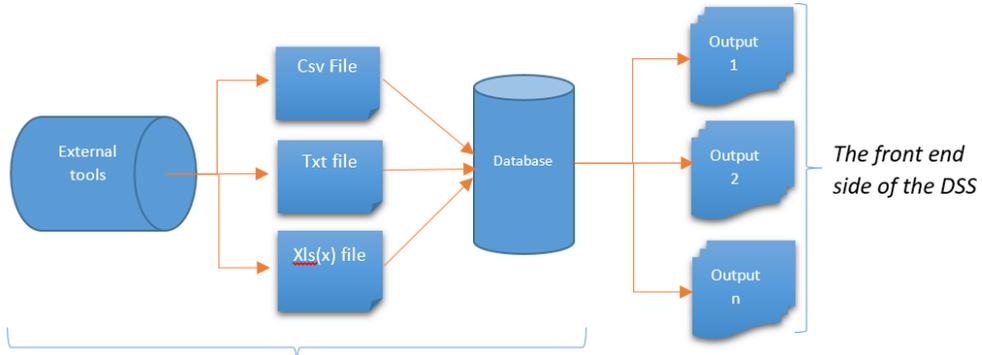


Figure 2: *Proposed DSS model for small and medium companies*

The model is presented in Figure 2 above and it represents an extension of the classical architecture of a DSS. The Database in our case is implemented using Access being the main DMBS and the user interface is contained in each output, using Excel. The external tools can be also included into DBMS as the file generated with their help is the main source of data. The MBMS is represented by all data processing operations that can be done in any stage of the workflow.

3.2. Model description

We know now that the most important resource in any field is knowledge. But to obtain it, we must process the increasing amount of data in information and after that, to transform it into knowledge. The data come now in different forms and formats, but inside an organization most data reside into a database or data warehouse and it can be visualized using different tools, most common being the web pages when the information needs to be accessed by multiple users. There are also systems that allow data exports (and this should be mandatory in our case) in formats that can be reused for other operations over those data. This need for export is given by the fact that the systems used by organizations work with incompatible database systems or technologies to manipulate the data. This

possibility to export data in simple formats like csv, txt and xls is also an opportunity to reuse data to create complex dashboards to help users' decisions.

The technologies used to create the model are the popular Excel and Access programs from Microsoft Office 2013 package. These applications are suitable for data manipulation and easy calculations (Hurbean, Fotache, Pavaloaia, Dospinescu, 2013). Excel is the most common tool used to manipulate and visualize small and medium amount of data. Excel 2013 has some notable improvements that help us build the model:

- recommended charts options;
- the possibility to create slicers for a simpler way to manipulate and visualize data in charts;
- the possibility to name the tables to better organize data;
- the possibility to import data from an external database;
- the possibility to create relationships between tables without using VLOOKUP or LOOKUP functions which are not all the time accurate.

Because Excel cannot work with large amounts of data (the maximum number of lines is 1.048.576), we included in our case study a database technology such as Access. The data used in our model and in DSS especially, needs most of the times to be aggregated. This, in Excel, can be done by using pivot tables which can work with small or large levels of data granularity. But when a table in Excel exceeds 100.000 lines this produces a delay in opening the file, especially when the specified file has some formulas in it, pivot tables and charts. It can also damage the file, making it unusable, although Office has implemented auto-backup facilities.

3.3. Methodology

The scientific approach that we have chosen for this article is the case study. Because many articles from the reviewed literature only presented tools or case studies based on Excel and VBA (Tatnall, Burgess, 2007) or just Excel (Palocsay, Markham, Markham, 2010) (Montondon, Marsh, 2006), some of them just describing the tools that Microsoft Office offers to help us build a DSS (Rus, Toader, 2008), we decided to encompass this science, to apply it and to develop a concrete model. In addition, many examples presented in the specialized literature used spreadsheets only to manipulate small amounts of data. The problem appears when large amounts of data need to be transformed and represented to help

management decisions. So while Microsoft Office 2013 has the economic advantage of being affordable and ubiquitous (Wang, Wang, 2014), it can also be used to solve this problem.

Our research has had several steps:

- Develop and test a model using only data pasted in Excel;
- Develop and test a model using data and Excel specific functions;
- Develop and test a model using Excel functions for specific needs and using a large amount of data, charts and pivot tables;
- Develop and test a model using Excel functions for specific needs and using a large amount of data, charts and pivot tables and specific lookup functions in other spreadsheets.

After many observations we noticed the following issues:

- the files were in some cases damaged by the action of the end user;
- each time we add a new feature into an Excel file, and the file grows in size, there can be the risk of failure and data loss;
- the bigger the file, the longer the time of response to end user actions;
- the file can be affected by human errors (over data) or network failures if it is stored on a shared folder.

In the end, we identified 3 types of issues related to:

- end user issues;
- speed issues;
- size issues.

Finally these models failed, because the needs were growing and the data were more complex. So we decided that we need a solution to build models with less data, but using the same initial information. This led us to our research questions:

1. How can we make a spreadsheet – based DSS, more efficient, rapid and safe in the sense of keeping the file healthy, away from crashes and also keeping the historical data?
2. Another important question was how to keep data safe from the end user actions?
3. What standard steps can we identify to implement the same model successfully in any other case?

The solution (represented in Figure 2 above) identified after the prior stages of the research needs the data to be stored locally or on a network location (and not

online), because network connections can fail when the system may be necessary. The main goal was to separate the data from its graphical representation and to transform the Excel file into a container for our data, as well as into a front end interface to manipulate and model the data. The backend of the DSS can only be manipulated by persons with technical background (or by a specialized interface for end users), while the front end of the DSS can be built by a technical person and handled by persons with basic knowledge of Excel.

This separation of data from the visual representation was very helpful in achieving the separation of the end user activities from the technical user activity. In addition, this separation was necessary because most managers in small companies but also in many medium companies (and the people that use DSS) are not all the time technical users, they are only end users. End user refers to the ultimate operator of an IT product. Precisely, an end user is a non-technical person who uses IT for his or her own needs but does not develop or maintain IT products for others (Wang, Wang, 2014).

3.4. Model Application and Results

Our main DBMS is represented by an Access database which allows us to make aggregations over large amounts of data, because not all the data are all the time necessary. In a decision support system sometimes we only need to count or sum some values and doing this inside the database, improves the performance and speed of the visual representation and presentation of data.

The DGMS used in our model will be represented by Excel charts, graphs, pivot tables and slicers. Those elements will be used to represent data in a visual and attractive way and in the same time interactive with the help of the new slicers.

We will build a model using the elements described before. We have a file containing the data that will be imported into the database. The file can be text or an excel file if we need to apply some Excel functions over the data we want to import. The file will represent the source data for our model. Starting with it, we decide what aggregated functions we need to apply using an Access database.

Our source in this model is represented by weekly data exported from another external source. The number of rows imported weekly start from 10.000 rows and grow to 12.000 from week 15 of the year until week 41. This means a minimum number of 26 weeks x 10.000 rows = 260.000 and a maximum number

of 26 weeks x 12.000 rows = 312.000 rows into an Excel file. If we want to apply some Excel functions over those data and after that to use it to represent data using pivots and charts, the file will load and represent data very slowly. A simple filter applied to this number of records on a laptop Intel Core I5 dual core processor with 4 GB RAM memory, lasts over 5 minutes. This is why the data are appended into a database, aggregated using queries and the new query is imported (Melton, 2013) into an Excel file that will represent a dashboard for assisting users and managers.

Our database is organized in three distinct sections:

- Imports: contains the files for imports (linked tables in Access);
- Queries: is used to create links with aggregated Access queries that we can use in our DSS;
- The physical database: contains the tables and the queries.

We can import our weekly data for the year 2015 into the database by using an appended query. The action of data import is useful to increase the speed on accessing the data from the Excel file and to create aggregated queries. The source of data for our dashboard will be built by creating a linked table to the external data source (weekly imports 2015.xlsx) and appending the data into a local table from the database, with the same structure as the linked table. The file for import contains 304.104 rows which will be appended using a Week parameter into our database, and it has the last 4 columns calculated using Excel dedicated functions such as Weeknum() and Year().

To import an Excel file into an Access database and to use it as a linked table, we will use in Access main menu External Data tab and we will choose the Excel option and try to locate the file for import. An important step is to select “Link to the data source by creating a linked table” option as the first step of the import.

Once we linked the file into the database, we can append the data into the database into the local table with the same structure as the linked file. This will be performed with the help of a dedicated appended query in Access. Once the data are appended into the local table, we can start to think about what functions we can apply to aggregate data or what other local tables we can use to complete the data into our query.

The data that we appended into the local table, called test data imported, are not aggregated, so we have 304.104 records into the local table. For management

decisions we do not need for example the code of the product and the review code fields (Figure3) therefore we will use a group by clause and a count function to aggregate data by the rest of the fields to find the number of classified items by user, category and complexity.

As we can see from the Select query, our local table (Test data imported) is related with two other tables into the database and the scheme of the query is shown in the figure 3 below.

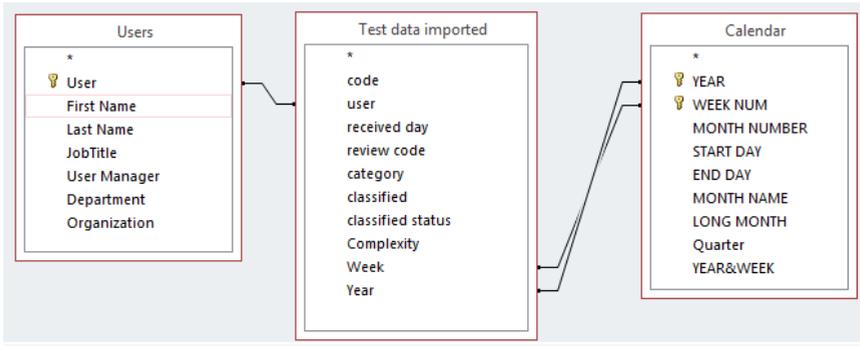


Figure3: Relations inside the database

In Access, every query has a name, so we will name the query that extracts the aggregated data from *Test data imported* table, *test_data_query*. The *test_data_query* uses a *Count SQL function* and a *GROUP BY clause*. This helps us gain some space, leading us to a result of 11.005 rows extracted from this query, instead of 304.104 records from the original table. This query will be imported into an Excel file that will become our dashboard.

The main file containing the dashboard is also organized into three sections: *Dashboard*, *Database Query* and *Pivots*. Those will become worksheets into an Excel file and each of them will play a different role in the decision system architecture:

- The *Dashboard* sheet will contain all the visual elements of the DSS;
- The *Database Query* sheet will contain the aggregated data from our Access query (*test_data_query*);
- The *Pivots* sheet is used to be the back end for the charts. It will use the *Database Query* sheet to create pivots which will be linked with charts contained in the *Dashboard* sheet.

The first step to build the system is to import our data from test_data_query into Database Query sheet. This will be done using in Excel the Data menu and selecting From Access option. This option will let us decide if we want to import a Table or a Query into our Excel file. As we discussed before, we will choose the query with fewer lines.

The second step will be to build the pivot tables using the data from our query. Now it is time to decide which data we need into our system that will support users and management decisions. We will build as many pivot tables as the number of charts necessary in this case of dashboard. We will build two pivot charts to show: the number of classified items by user and complexity and how many items from each category a user has classified.

In the end, we use Insert option in Excel menu to add our charts. The design and interaction elements such as slicers and a title bar, will be added in our dashboard to create visibility and accuracy in presenting the data. The slicers work like extensions for filters in Excel 2013. They can be connected to one or more pivot tables located in the same workbook and they create the impression of interactivity, by refreshing more pivot tables at the same time. Our dashboard and implicitly our DSS will have a DGMS presented in Figure 4 below.



Figure 4: DGMS of the DSS represented by an interactive Dashboard

The Excel file containing the dashboard has a simple workflow. It uses the query with the aggregated data from the database. It summarizes the data using pivot tables. It uses charts to show the data and slicers to create interactive responses for the user. This is very helpful because the user does not need to have a technical background to use the dashboard. The user will only see the graphical

interface if we will choose to hide the other worksheets and lock the workbook, so that no one will know what is behind that design.

At the end of this representation we can identify the following steps in creating an Office 2013 DSS model:

1. Identify the data source(s) or the subject we need to represent;
2. Define/decide the format for the selected data;
3. Import the data from external source(s) into the database;
4. Aggregate data and create relations, if there is the case, into the database;
5. Import the processed data into an excel file;
6. Create the necessary pivot tables;
7. Insert charts and slicers and create the connections.

These steps are closing our research subject, because they give us an answer to the third question of our research, by identifying the standard steps to use when one wants to create a safe and efficient DSS using this technology. From the presentation of these steps it can be easily noticed that the data source is separated from its visual representation. The dashboards are the front end part of the DSS model, while the database and data source are the backend of this discussed model.

When implementing the model, we did not identify any issue from those presented above. The data loaded faster, the data were safe from the user's actions, and none of the files used crashed.

The most important contribution of this work is the original implementation of a type of Spreadsheet-based decision support system on a high variety of small and medium companies from all economic environments.

4. CONCLUSIONS

The advantage of this design is the fact that we can separate the data from the visual representation. Operations over large amounts of data are done via Access queries. Data summarizing is achieved using pivot tables and the visualization is built using an interactive design with the help of charts and slicers. In this manner the file containing the dashboard is smaller (its size on disk), it opens faster and it operates faster on large amounts of data.

The model can be applied and duplicated on many numbers of cases. The database can be as complex as we need and it can use more tables in relationships to show information from different sources unified in one single query. Small and

medium companies can use this model successfully because historical data can be imported and stored into a single place, from multiple sources with controlled dimensions. The historical data and imports must be designed to help the decision making and the model, starting with what data we need to show or aggregate, to support management decisions.

One of the major disadvantages appears when the number of rows that we need to process into our Access database is so big that the RAM memory is completely used, or the database size overcomes the database limitations, so the queries do not work, even if we need to work with one single table. This is why the model can be successfully applied to small and medium companies where the amount of processed data is not very high.

Granularity of data based on time factor is very helpful to split the imported data from our model, so that the resources of the PC that uses the data will not be overloaded.

Another important aspect to solve the resource disadvantages of this model is the possibility to develop small DSS based on a specific subject, to avoid Access Database limitations and this way the number of rows to be processed or stored by Access Database may increase.

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