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Decision Making Techniques and Tools Based On Decision Support System

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ABSTRACT
Decision Support System (DSS) is a specific class of computerized information system that supports business and organizational decision-making activities. A properly-designed DSS is an interactive software-based system intended to help decision makers collect useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and to make decisions. DSS belong to an environment with multidisciplinary foundations, including database research, artificial intelligence, human computer interaction, simulation methods, software engineering, and telecommunication. In this paper, techniques and tools for decision making based on decision support system are proposed. The techniques and tools are categorized into five types: communications driven DSS, data driven DSS, document driven DSS, knowledge driven DSS and model driven DSS.
Keywords Decision support system, decision makers, computer-based decision support system.

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I. INTRODUCTION

Information system applications that support decision-making processes and problem-solving activities have evolved over the past decades. In the 1970s, these applications were simple and based on spreadsheet technology. During the 1980s, decision-support systems incorporated optimization models, which originated in the operation research and management science.

DSS includes many activities to create solution's alternatives (e.g. analysis, deduction, projection, comparison, simulation, optimization etc.) [1]. In performing these essential activities, DSS utilizes many types of the quantitative models. DSS utilizes linear programming, integer programming, network models, goal programming, simulation, and statistical models. These models are implemented via model management facilities. DSS has recently emerged multiple criteria decision making (MCDM) model embedded DSS and knowledge-based [2].

Many technological and organizational developments have exerted an impact on this evolution. The Web has enabled inter-organizational DSS and has given rise to numerous new applications of existing technology.

Modern DSS provides their users with a broad range of capabilities. Current DSS facilitates a wide variety of decision tasks including information gathering and analysis, model building, sensitivity analysis, collaboration, alternative evaluation, and decision implementation.

Often, DSS is built and used for ad hoc analyses, but increasingly, decision support is integrated into business processes and information systems. Most existing computer systems such as expert systems, decision support systems, and simulation systems, have built-in functionalities and cannot reflect the changing environment and possibilities for negotiation [3].

One of the problems facing DSS is that the quality of interaction and the degree of integration between human and computer activities, is affected very slowly, if at all, by technological advance.

1. TYPES OF DECISION SUPPORT SYSTEMS

There are several decision support systems [4, 5, 6]. These can be categorized into five types: communications driven DSS, data driven DSS, document driven DSS, knowledge driven DSS, and model driven DSS.

1.1 Communication-driven DSS

This kind of DSS is to help conduct a meeting or for a group of users to collaborate. The most common technology used to deploy the DSS is a web or a client-server. The examples are charts and instant messaging software and online collaboration. A communication driven DSS supports more than one person working on a shared task. Many collaborators work together to come up with a series of decision to set in motion a solution or strategy. Most communications driven DSSs are targeted at internal teams, including partners. The most common technology used to deploy the DSS is a web or a client-server. In general, groupware, bulletin boards, audio and video conferencing are the primary technologies for communication driven decision support.

1.2 Data-driven DSS

It is mostly used by managers, staff, and suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes. It is deployed via a main frame system, or client-Server. Some examples are computer-based databases that have a query system including the incorporation of data to add value to existing databases. It puts its emphasis on collected data that is then manipulated to fit the decision maker's needs. This data can be internal, external and in a variety of formats. This model emphasizes access to and manipulation of a time series of internal company data and sometimes external and real time data. Simple file systems accessed by query and retrieval tools provide the most elementary level of functionality. Most data driven DSSs are targeted at managers, staff and product / service suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes. It is deployed via a main frame system, or a client-server.

1.3 Document-driven DSS

This is the most common type of DSS and targeted at a broad base of users. It is useful when search web pages and find documents on specific keywords, targeted at a broad base of user groups. The purpose of such a decision support system is to search web pages and find documents on a specific set of keywords or search terms. This model uses computer storage and processing technologies to provide document retrieval and analysis. A document driven DSS model uses documents in a variety of data type such as text documents, spreadsheets and database records to come up with decisions and manipulate the information to refine strategies. The usual technology used to set up such decision support systems are via web or a client-server.

Knowledge driven DSSs are a catch-all category covering a broad range of systems covering users within the organization setting it up but may also include others interacting with the organization. It is essentially used to provide management advice or to choose products or services.

1.4 Knowledge-driven DSS

Broad range of systems covering users within the organization setting it up but may also include others interacting with the organization, for example: consumers of a business. Marketing usually uses it to provide management advice or to choose products/services. Knowledge-driven DSS can suggest or recommend actions to managers. These DSS are person-computer systems with specialized problem-solving expertise. The expertise consists of knowledge about a domain, understanding of problems within that domain, and skill at solving some of these problems. The typical deployment technology used to set up such systems could be client-server systems, the web, or software running on stand-alone PCs.

1.5 Model-driven DSS

Model driven DSSs are complex systems that help analyze decisions or choose between different options. This is a complex DSS because it helps the users to analyze decisions or choose between different options. Managers and staff members use it to provide solutions to queries or problems. A model driven DSS emphasizes access to and manipulation of financial, optimization and / or simulation models. Simple quantitative models provide the most elementary level of functionality. Model-driven DSS uses limited data and parameters provided by decision makers to aid decision makers in analyzing a situation, but in general large data bases are not needed for model-driven DSS. These are used by managers and staff members of a business, or people who interact with the organization, for several purposes depending on how the model is set up. These DSSs can be deployed via software / hardware in stand-alone PCs.

2. DSS ARCHITECTURE

Structurally, a decision support system has four essential components [7, 8]:

- A Language System (LS)
- A Presentation System (PS)
- A Knowledge System (KS)
- A Problem-Processing System (PPS)

A language system consists of all messages the DSS can accept. A presentation system consists of all messages the DSS can emit. A knowledge system consists of all knowledge the DSS has stored and retained. By themselves, these three kinds of systems can do nothing, neither individually nor collectively. They simply represent knowledge, either in the sense of messages that can be passed or representations that have been accumulated for possible future processing.

Although they are merely systems of representation, the KS, LS, and PS are essential elements of a DSS. Each is used by the fourth element: the problem processing system. This system is the active component of a DSS. A problem processing system is the DSS's software engine. As its name suggests, a PPS is what tries to recognize and solve problems (i. e., process problems) during the making of a decision. Figure 2 illustrates how the four subsystems of a DSS are related to each other and to a DSS user. The user is typically a decision maker or a participant in a decision maker.

However, a DSS developer, administrator, some data-entry person, or device could also be a DSS user. In any case, a user makes a request to the DSS by selecting a desired element of its LS. This could be a request to accept knowledge, to clarify previous requests or responses, to solve some problem faced by the decision maker, to detect problems, and so forth. Once the PPS has been requested to process a LS element, it does so. This processing may very well require the PPS to select some portion of the KS contents, acquire some additional knowledge from external sources (e. g., a user), or generate some new knowledge (perhaps using selected or acquired knowledge in doing so).

The processing can change the knowledge held in the KS by assimilating generated or acquired knowledge. The PPS can emit responses to the user by choosing what PS elements to present. Thus, some PPS behaviors are overt (witnessed by the user via PPS emission of PS elements) and others are covert (strictly internal, yielding assimilations of knowledge into the KS). The five knowledge-manipulation abilities depicted in Figure 2 are the primary, front-line abilities that comprise DSS's contributions to the outcome of a decision episode. These abilities are exercised by the PPS as it works to find and/or solve problems within a decision process.

The second-order abilities of a PPS shown in Figure 1 are concerned with oversight and governance of first-order abilities within and/or across decision episodes. These expand on previous characterizations of the generic DSS architecture based on the knowledge-management ontology, which identifies coordination, control, and measurement as important influences on the arrangement and interplay of the five-knowledge manipulation within and across knowledge-management episodes.

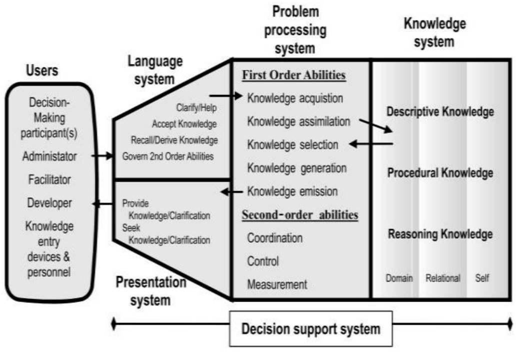

Fig 1: Basic architecture for decision support systems

These influences may be wholly exerted by users; or, as Figure 2 indicates, a decision support system's PPS may be equipped to govern its own exercise of first-order knowledge-manipulation abilities. Coordination refers to a PPS ability of arranging knowledge-manipulation tasks, and the knowledge flows that connect these tasks, into configurations and sequences in the interest of PAIRS results for decision processes. These manipulation tasks and knowledge flows can be performed by the PPS itself, by users of the DSS, or a mixture of both computer and human processors.

In addition to governing processing patterns, the coordination ability also involves the allocation or assignment of processors (computer or human) to knowledge-manipulation tasks. Control refers to the ability to ensure the quality (validity and utility), security, privacy, and sufficiency of knowledge processing that occurs during a decision process in the interest of PAIRS results. Measurement refers to the ability to track processing and outcomes within and across decision-making episodes in terms of desired criteria. Such measurements become a basis for evaluating DSS performance, and perhaps for implementing adaptive DSSs which can improve their behaviors over time based on their decision support experiences.

As Figure 2 illustrates, the generic DSS architecture recognizes that multiple types of knowledge may be accommodated within a DSS's knowledge system. The first is knowledge that describes the state of some world of interest. It could be a past state, present state, future state, expected state, speculative state, and so forth. The world could be actual, potential, hypothetical, symbolic, fixed, dynamic, physical, intellectual, emotive, and so forth. In contrast, procedural knowledge characterizes how to do something (perhaps in one of the worlds of interest). It is a step-wise specification of what to do in order to accomplish some task or explore some direction.

Neither descriptive nor procedural in nature, reasoning knowledge specifies what conclusion is valid when a specific situation is known to exist. It specifies logic that links a premise with a conclusion. The semantics of this linkage can be varied, including causal, correlative, associative, definitional, advisory, or analogical relationships. Knowledge of one or more of the three types will exist in the KS of every DSS. All of this knowledge is susceptible to use by the PPS abilities. The three vertical bars depicted in the knowledge system of Figure 2 indicate three knowledge orientations that cut across the knowledge types: domain, relational, and self.

Knowledge oriented toward a domain is the descriptive, procedural, and/or reasoning knowledge that the PPS uses in grappling with the subject matter of that decision domain. Relational knowledge is what the decision support system knows about those with whom it interacts. This includes such KS contents as profiles of user preferences, capabilities, and behaviors, plus knowledge about interpreting LS elements and picking PS elements. Self-knowledge is what the DSS knows about its own capabilities and behaviors, including KS contents about the structure of the KS itself and characterizations of what are allowed into the KS via the PPS assimilation activity. It is fair to say that most DSSs tend to focus on the treatment of domain knowledge, although the other two knowledge orientations can be very important from a PAIRS viewpoint.

Figure 2 illustrates a way of organizing the LS and PS contents into subsets based on the semantics of messages. Some of these subsets may be quite small or even empty for a particular DSS. Yet another way of categorizing LS requests and PS responses could be based on distinctions in the styles of messages rather than differences in their contents. Stylistic distinctions can be quite pronounced, and a DSS may have requests or responses in more than one stylistic category.

A DSS’s user interface is defined by its LS, its PS, its PPS abilities of knowledge acquisition and emission, and its KS contents that the PPS uses for interpreting LS elements and for packaging knowledge into PS elements. In the generic DSS architecture, we see the crucial and fundamental aspects common to all decision support systems. To fully appreciate the nature of any specific decision support system, we must know about the requests that make up its LS, the responses that make up its PS, the knowledge representations allowed (or existing) in its KS, and the knowledge-processing capabilities of its PPS. If we are ignorant of any of these, then we cannot claim to have a working knowledge of the DSS. Nor are we able to thoroughly compare the DSS with other decision support systems. Developers of DSSs are well advised to pay careful attention to all four components when they design and build decision support systems.

Decision support systems are most entirely different from other systems and require a structure approach. The framework consists of technology levels, people involved, and the developmental approach.

Technology levels are divided into three levels of hardware and software: level 1: specific DSS, level 2: DSS generator, and level 3: DSS tools.

Level 1: specific DSS is the actual application that will be used by the user. This is the part of the application that allows the decision maker to make decisions in a problem area. The user can act upon that problem.

Level 2: DSS generator contains hardware and software environment that allows people to easily develop specific DSS applications. This level makes use of case tools or systems.

Level 3: DSS tools contains lower level hardware and software, DSS generators including special languages function libraries and linking modules.

There are five roles involved in a typical DSS development cycle: the end user, an intermediary, DSS developer, technical supporter, and systems expert.

The developmental approach for a DSS system should be iterative. This will allow for the application to be changed and redesigned at various intervals. The initial problem is used to design the system on and then tested and revised to ensure the desired outcome is achieved.

Decision support systems are classified into six frameworks: text-oriented DSS, database-oriented DSS, solver-oriented DSS, rule-oriented DSS, and compound DSS. The most popular classification for a DSS is the compound DSS.

A decision support system consists of two major sub-systems: human decision makers and computer systems. The function of a human decision maker as a component of DSS is to exercise judgment or intuition throughout the entire decision-making process.

The first step of a decision-making process begins with the creation of a decision support model, using and integrated DSS program such as Microsoft Excel, Lotus 1-2-3, and Interactive Financial Planning Systems. The user interface sub-system is the gateway to both database management systems and model-based management systems. Database management systems are a set of computer programs that create and manage the database, as well as control access to the data stored within it. The DNMS can be either an independent program or embedded within a DSS generator to allow users to create a database file that is to be used as an input to the DSS. Model based management system is a set of computer programs embedded within a DSS generator that allows users to create, edit, update, and / or delete a model.

Today, most of the DSS [9] in use are developed to generate and evaluate decision alternatives via "what-if" analysis and "goal-seeking" analysis in the design and choice stages. Accounting models facilitate planning by calculating the consequences of planned actions on estimate of income statements, balance sheets, and other financial statements. Representational models estimate the future consequences of actions based on partially non-definitional models, including all simulation models. Optimization models generate the optimal solutions.

Suggestion models leads to a specific suggested decision for a structured task. Such systems perform mechanical calculations and leave little role for managerial judgment. A DSS has several fundamental components. The Database Management System (DMS) is a software package, which is responsible for data access and manipulates and manages internal as well as external stored data in databases. Second, the Model Management System (MMS) uses various kinds of mathematical and analytical models, or simulations to represent and analyze complex data and the user interface component which handles the interaction of the user with the system. Figure 2 gives a conceptual overview of the architecture of a DSS and the components mentioned above.

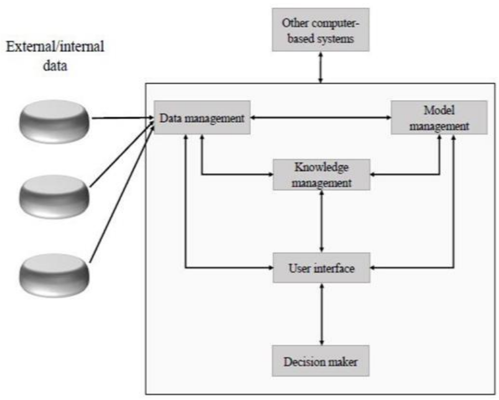

Fig 2: Schematic of DSS components

Subsequent to this architecture, the literature names relevant applications of DSS: Model-driven DSS, data-driven DSS, communication-driven DSS, document-driven DSS, and knowledge-driven DSS. These applications consist of diverse sub technologies and decision support techniques for decision making.

Techniques and Tools Of Dss For Decision Maker

This study adopted an experimental method, based on within-subject design approach. Dashboard and task complexity are within-subject variables and decision style is between-subject variable. The experiment examined the lengths of dashboard and two types of tasks (fact-finding and problem-solving). In post experimental questionnaire, each decision maker subject answered their decision styles and assigned extents of

- Strongly Disagree
- Disagree,
- Some What Agree,
- Agree, and
- Strongly Agree

To all questions (factors) of the evaluation from. The questionnaire data is processed through related descriptive statistics using tools (Web Application and Desktop Application).

II. VISUAL USER INTERFACE TOOLS

The graphical user interface was designed with the objective to encourage strictly guided and freewheeling interaction modes. Most decision processes require combination of both approaches. The decision maker would first use analytical tool to explore the facts using color map technique for assuring problem areas then apply visualized model for prediction and optimization using knobs, dials, levers, and sliders techniques. The inputs of system are filters that recognize sets of relevant features, and every set of such features associates with a set of available actions and outcomes associated with the actions. The set of input features form context and event significance (that something happened and what it means).

2.1 Comparison between website application and desktop application

There are lots of apps floating around in the world today. Desktop applications are installed on a personal or work computer desktop. Web applications can be accessed through the Internet (or through an Intranet). While both types of applications are software-based, there are fundamental difference between desktop and web applications.

Some people argue that web applications are superior for various reasons. Other people argue that desktop applications will always reign supreme. Several people use both types of applications. The truth is that both web apps and desktop apps have their place within the app world. The trick is knowing when to use one type of program versus the other.

2.2 Web Application Advantages

The biggest, and most obvious, advantage to using a web application is flexibility. A web application can be accessed from any computer no matter where you are. This is since a web application only exists online. Some people believe that this advantage is one that cannot be passed up.

Of course, constant accessibility depends on your current internet connection. Should you lose your connection, you will not be able to access a web program. There are other disadvantages to web applications that we will discuss them.

2.3 Desktop Application Advantages

Desktop applications are reliable and trustworthy. You can access a desktop app if you have your computer within reach. These applications do not rely on internet connection in most instances. One unfortunate drawback to a desktop application is that you cannot access this type of app if you do not have your computer handy.

2.4 User interface for Web application

Figure 3 shows the registration form and figure 4 shows the login form for a user. In the registration form the user can register in website as a new user. The login form for administrator is presented in Figure 5. In this form, the administrator can access the web. Figure 6 shows the form for adding add new question by the administrator. Figure 7 shows the form for deleting questions. In this form, the administrator can delete any question he or she chooses it. Vote page is shown in figure 8. In this form the user can vote for questions. Figure 9 shows the result's form. In this form, the administrator can view the result of the vote. Figure 10 shows the vote page in Arabic language. In this form, the user can vote for questions. Figure 11 shows two result's forms in Arabic language. In this form, the administrator can observe the result of the vote.

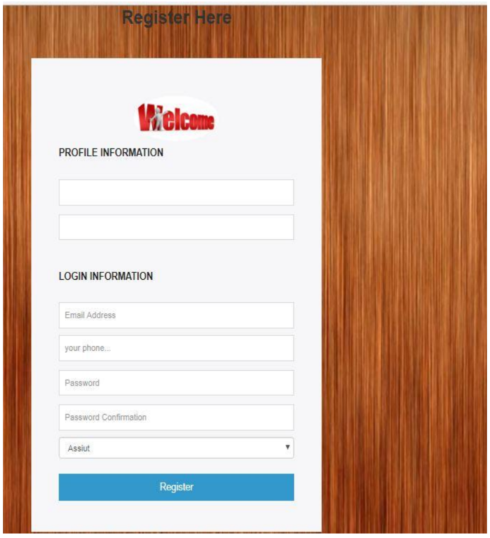

Fig 3: registration form

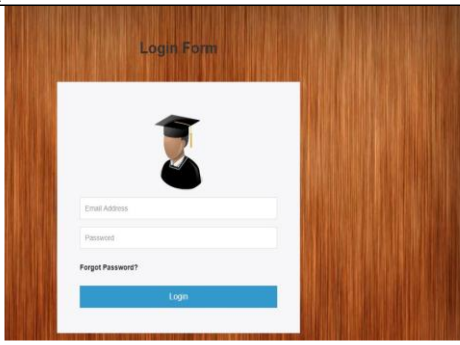

Fig 4: login form, in this form the user login to the website

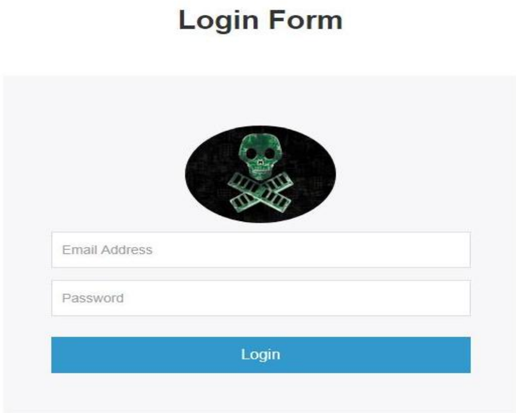

Fig 5: login form for administrator

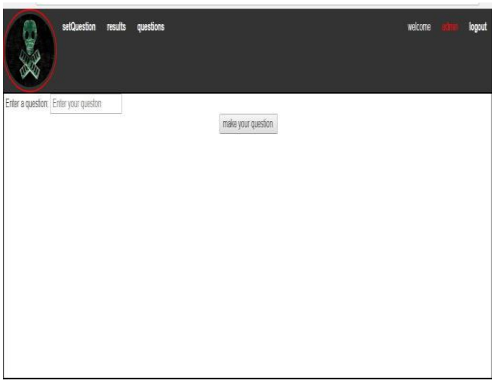

Fig 6: form for adding new question

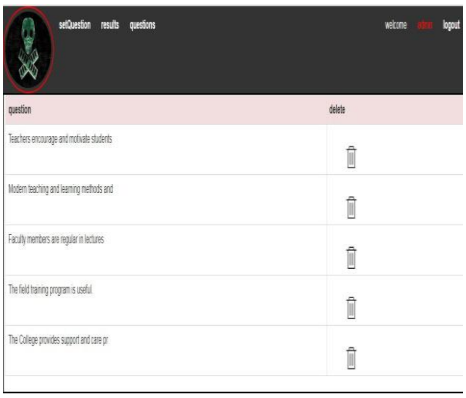

Fig 7: form for deleting questions

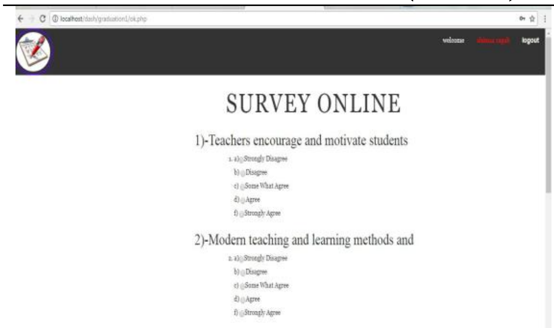

Fig 8: vote page

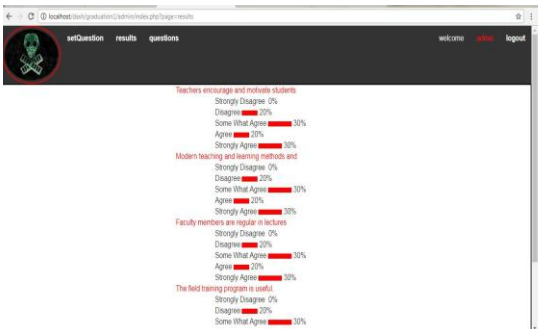

Fig 9: result's form

Fig 10: vote page in Arabic language

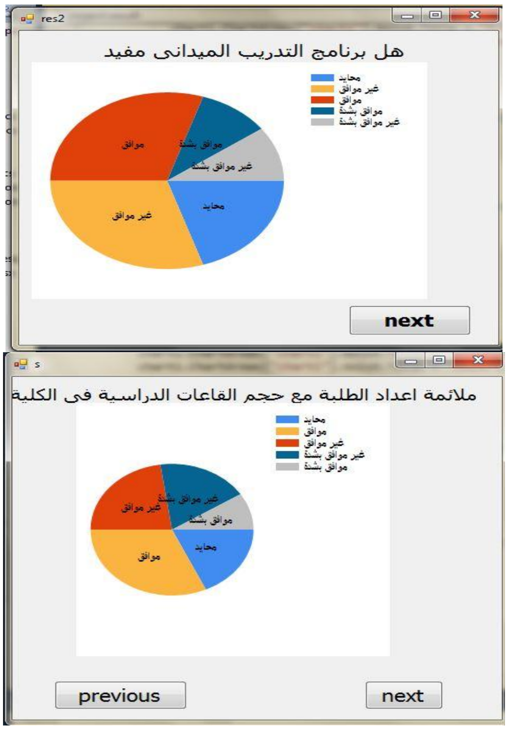

Fig 11: two result's forms in Arabic language

III. CONCLUSIONS AND FUTURE WORK

Techniques and tools for decision making based on decision support system are presented in this study. The techniques and tools are categorized into five types: communications driven DSS, data driven DSS, document driven DSS, knowledge driven DSS and model driven DSS. The study was concerned with the actual extent of introduced the DASH-DSS, a novel interactive multi criteria decision support system that based on Dashboard technology.

The DASH-DSS key features are intelligent tools that are used to assist decision-makers answer "what if', questions examine numerous alternatives very quickly and find the value of the inputs to achieve a desired level of output. It would be interesting for future research to investigate about what type of decision purposes dashboards are used for, assess the effects of using dashboard technology on decision making, how dashboards are used in organizations to deal with unstructured information sources. Even though the context of this study is limited to higher education, the results of this study could be generalized to other areas.

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