Critical Evaluation of Decision Support System Implemented For Career Selection and Comparative Analysis with Expert System

Shaily Thaker, Viral Nagori

Faculty of Computer Applications, GLSICA-GLS University, Ahmedabad, India

Abstract- **The paper presents the evaluation of the existing Decision Support Systems implemented in the domain of career selection. The Decision Support Systems are analyzed and critically reviewed to list the shortcomings of DSS for the domain. In total five Decision Support Systems implemented for career selection are selected for the purpose. The primary objective of the research is to compare the solution provided by the DSS and Expert System for the career selection. The paper identifies the problems associated with the present solution in form of DSS and suggests how Expert Systems can provide the solution. The paper proposes that Expert Systems are in a better position to provide intelligent solutions for the domain of career selection. To justify that, a comparative analysis is provided at the end of the paper. As a secondary objective, the factors affecting the career selection are also retrieved and listed.**

Keywords—**Decision support system, career selection, factors affecting career selection, Expert System**

I. INTRODUCTION

Continuous efforts are being made to develop computer based systems that emulate human thinking. There are many such technologies used for achieving simulation for human thinking. Out of these technologies the two most prominent techniques are Decision support system (DSS) and Expert system (ES). A Decision support system is an interactive computer based system that helps in solving semi-structured or unstructured problems by using data and models [1]. An Expert System is an intelligent computer system that uses knowledge and inference procedures to solve problems that are difficult enough and can otherwise require human expertise for solution [2]. The "expertise" can be considered as of having knowledge about a particular domain, thoughtfully accepting problems by developing an insight within that domain, and having "skill" for answering some of these problems. Both Decision Support System and Expert System help in improving the decision making process, yet there are some distinct applicability of both two different domains.

This paper critically reviews and analyses the decision support system for career selection domain. The analysis presents the shortcomings of each system. At the same time, how the Expert system can help to overcome the mentioned problem is also presented. Finally a comparative analysis between Decision Support System and Expert System is made to find out which is the most suitable option whether Decision Support System or Expert System.

The main objectives of this literature review are:

1. To study and analyze existing decision support system for career selection.
2. To list down the factors that influences the career selection.
3. To list down the problems in each implemented Decision Support System.
4. To decide whether DSS or Expert System is more suitable for career selection domain

II. A STUDY OF DSS IN CAREER SELECTION

In order to fulfill the above stated objectives, the following decision support systems are reviewed.

1. Career Master: A decision support system (DSS) for guidance and counselling in Nigeria.
2. Decision Support system for determining: Right Education Career choice.
3. Analysis and Design of a Web-based decision support system for choosing Higher Education Studies.
4. A web based decision support tool for academic Advising.
5. Choosing a college major: A prototype Decision Support System.

The reasons for selecting these decision support systems for our study area are:

1. All the DSS systems selected here are practically implemented at a university or institutional level. It makes easy for us to study their detailed features and critically analyzing them to find shortcomings in each system and suggest improvised solution.
2. The selected research papers for analysis range from time duration of different generations. Hence, research of different generations of different years can be covered for critical detailed study.
3. As our research is in the domain of career selection all the Decision Support Systems reviewed and analyzed here are of that domain.

A. Career Master: A decision support system (DSS) for guidance and counselling in Nigeria. [3]

This is a standalone system, which provides guidance and counselling to secondary school students; it suggests the list of the best courses that could be selected for further study in the tertiary institution. The factors affecting the career selection decision are intelligence quotient, hobbies, parents and friends' influences. This system consists of subsystems like DSS Data Management System, model subsystem, Knowledge subsystem and dialog subsystem. The first DSS sub system is Data Management System (DMS) which consists of DSS database, Database Management system, Database directory, Query Facility. The DSS database consists of four databases with table names: subject table (all subjects related info.), pass table (password of the administrator form) and course table (all courses studied in universities). Database Management System is of relational type and consists of different details like bio data, class study, I. Q. _status, personal interest, parent's suggestions, and friend's suggestions. The query facility element allows users to access the data. It works based on rules to provide with the suggestions. The directory component consists of data about all the data. It contains various data definitions and its main function is to answer questions about the availability of data items, their origin and their meaning. It also supports managing information on a specific object. It contains another subsystem as model management; it contains models related to routine and special statistical, counselling models, management science and other quantitative models that provide the analysis capabilities for the DSS. The knowledge subsystem is used to solve complex problems of clients. The dialog subsystem provides a user interface between user and DSS. This system is built up in Visual Basic (VB v 6.0). The main features found in this system are anticipation of change, data validity, end-user interface, controlled data access. The future scope of this system is it can be made web based for easy access across the world.

The shortcoming: In this system the output is in the form of the list based on choices filled by friend selection, parent selection, student selection, human counselor's suggestion. Out of these choices the student will decide the best suitable choice by consulting the counselor. Hence, here the system helps the counselors in the decision making process. The drawback of conventional counselling such as 24x7 non-availability of counselor is applicable here. This affects the efficiency of the decision making process. The system will not make decisions on behalf of counselors, but only helps them. The system does not have the facility of dynamic update of knowledge in the database. The system is built using the proprietary programming language so it will not be transferred to other open source operating software. The system does not support object oriented approach.

Decision support system for determining: Right education career choice. [4]

This system named, Career Advice Model is based on machine learning techniques and uses rule based decision support system to generate the knowledge. The system at the end generates the result in the form of advice and proposed career choice. This system is divided into three broad modules like User Interface, Inference Engine and Knowledge Base. The Career Advice Model supports decision making in higher education system. Career Advice Model (CAM) is implemented in Java. The factors found affecting career selection are academic abilities, personal qualities, skills and personality type test data. The first module User Interface consists of three parts Students' skills and personal information, personality analysis and User profile. The second module is Inference engine which is responsible for generating the advice report for that it applies the rules and takes the knowledge base into consideration. To design inference engine modular approach is incorporated so that changes in the system can be easily embedded. The whole inference engine functionality is divided into four other sub modules: Qualification forecasting, personality forecasting, Advice reporting and Additional forecasting. The third module knowledge base is based on four parts 1. Domain expert knowledge. 2. Past feedback collection. 3. Industrial requirements and demand. 4. Past performance of career choices. The main features of this system are it is rule based; it is active learner, which helps to enrich its knowledge base to suggest accurate career option. It uses Instance based learning statistical method. Instance based learning version 3 (IBL) method is used in it. It uses Active learning algorithm to automate the process of predicting result with less obligation of human experts, hence saves time.

The shortcoming: This system is based on machine learning, though a technique of AI, it does not emulate human decision making; it only supports the system to make decisions. This system provides career advice by suggesting the career options available or approves the career choice made by the students. Here the list of all options is given out of which student selects a suitable option with the help of counselors, hence it implies that the system aids in decision making but does not take decisions on behalf of counselors. The system does not automate update facility of knowledge base it is done with the help of domain experts. This system allows selecting the suitable subjects not the courses. The system is made in Java, which has some limitations like security loopholes, performance drawback, and problem of look and feel interface

B. Analysis and design of a web-based decision support system for choosing Higher Education Studies). [5]

The objective of this system is to help users in getting thoroughly informed about Higher Education studies and helps in selecting the most appropriate Higher Education study courses. It has two main goals; one is to support youngsters in their decision making and second is to inform students about their department vocational prospects. This system results in giving information related to the display of

the departments of the specific Higher Education Institution (HEI) and view department details, such as syllabus and employment prospects, it also displays the distance between different cities and HEI departments. In this system GIS is used to help users visualize the location of the Higher Education (HE) departments. This system uses UML in the analysis and design of the proposed web-based DSS. The factors considered for career selection are region of Greece, cities in which Higher Education Institutions (HEI) are located, distances between the city of user and a Higher Education Institution's (HEI), Higher Education Institutions (HEI), department of Higher Education Institutions (HEI), schools that represent a set of departments, subjects of related departments, group of subjects, keywords for each group of subjects. The main feature of this system is its ability to search for information related to job profiles and their relations to higher education studies in Greece by giving numerous search criteria and possibilities to combine them in an easy to fill or compare way. It uses GIS technologies through Google map. The web based DSS is implemented using PHP, MySQL and Java script. AJAX is used to exchange data with the database and Google Map. The future scope of this system is that some additional functionality can be provided like storing historical data to build data warehousing which can be useful for dimensional modeling. Data related to placement of graduates of each higher education speciality should be stored. The tools like Personalization and recommendation should be used to support decisions of youngsters in the future.

The shortcoming: This system is just like a simple system that does not have an inference engine to process the rules. It also does not have a knowledge base to store data from which rules can be applied. It has a database to store data, the user enters search criteria and the result is displayed by firing query on the data stored in the database. Hence the system does not replace the counselor, but instead it just provides a search facility of information related to Higher Education Institutes (HEI) and its connection with the labour market. The system is built using PHP which is an open source software hence it faces security issues. The data of the system are stored on the client side which can create a security issue if some confidential data is stored. The system is not modular in nature, so found hard to maintain. The system does not provide an explanation facility after providing results from the database.

C. A web based decision support tool for academic Advising. [6]

The objective of this system is to provide effective web based decision support tool that improves the student and advisor relationships from not only prescriptive one but also to more engaging one. This system helps the students to plan for the proper courses to be taken, by checking and listing courses, priority wise, based on satisfaction of required criteria. This system also suggests and results in displaying the list of the

courses which can be taken to minimize the amount of time required in completing a degree. The factors that affect the career selection are personal information, the rules for a particular course, the number of credits attained, graduation requirements. The system creates academic schedules, semester to semester and year to year by organizing information from many sources. It provides information needed for course planning in a visually effective manner. The features of this system are it has user friendly interface, the system supports for various search criteria's using which information is pumped out from the database and it also displays recommendation of courses and jobs based on information and criteria entered by users. The future scope of this system found is to increase the security of data managed by the system.

The shortcoming: In this system, the advisor is the main actor. The students are asked to fill the form in starting of the advising process, the advisor discusses with the student based on his personal information and academic record filled by the student in the form. This system does not provide support of natural language processing, which adds an overhead for information collection. Hence the main role of student's career decision is done by the advisor himself. This proves that the online system is not capable to replace human intelligence, it only supports them. The system does not support automatic updates of database and it takes long time to update the details in the database. The system also does not have the automatic storage facility of the student's information. As the system lacks in having an auto storage facility, hence the previous data plans will be overwritten by the new plans.

D. Choosing a college major: A prototype Decision Support System. [7]

The objective of this system is to identify the suitable major of the study for a college student. The system has features like knowledge elicitation, wherein the domain knowledge is taken out from a domain expert or other sources. This phase is accomplished by taking interviews of Expert counselors. The output of this phase results into series of Decision tables of Holland Personality Types (HPT) and college major classification. The college major decision support system was designed to be user friendly and to minimize the input error. The system starts with asking the questions to the users, the response given by user of each question is recorded. Then the responses of each theme is counted and then Holland code in the order of 'R','I', 'A',' S','E','C' is determined. Theme with the highest count is selected. The major courses available with the matching Holland code are displayed. The factors affecting the career selection are student's interests, values and personality traits, psychometric test results. The system can result in determining the Holland categorization of a client's personality type. Based on the client's personality type the system determines feasible college majors. The system has explanation capabilities to help for selection

criteria. It provides help in preparation to become counselors as a profession. The future scope of this system is to enhance by incorporating more counselling knowledge and integration with expert diagnostic knowledge.

The shortcoming: This system gives more emphasis to the client's personality type factor and on that basis displays college majors. The system does not consider much emphasis to other factors that can influence decision making. This system provides support for decision making which is used by human counselors. This can lead to personal biases of the human expert towards the client, which can result in a wrong decision.

III.   ANALYSIS OF ABOVE REVIEWED DSS

It is noted that decision support system is used for providing support in deciding higher secondary, undergraduate's students career option/stream, major or minor course selection.

In order to fulfill the second objective, from the above reviewed systems, different factors affecting career selections are found in each system are listed:

Paper1: intelligence quotient, hobbies, parents and friends' influences.

Paper2: academic abilities, personal qualities, skills and personality type test data.

Paper3: region of Greece, cities in which Higher Education Institutions (HEI) are located, distances between user's city and a Higher Education Institution's (HEI) city, Higher Education Institutions (HEI), department of Higher Education Institutions (HEI), schools that represent a set of departments, subjects of related departments, group of subjects, keywords for each group of subjects.

Paper4: student's personal information, rules for a particular course, the number of credits attained, graduation requirements.

Paper5: interests, values and personality traits, psychometric test results.

IV.   PROBLEMS DERIVED FROM THE ABOVE DSS SYSTEMS

From the analysis and review of above systems it is found that in some or other aspects one or the other system is found lacking behind, the following below is the list of a few of the potential problems found in DSS for career selection.

❖ Problem1: No Automatic Update Facility:

➢ There is no automatic update of the data into the database in any DSS systems. The Manual updating process is very tedious.

❖ Problem2: No Explanation Facility:

➢ The explanation facility with the support of the decision given by the system is not found in most of the above systems.

❖ Problem3: Does not imitate human Intelligence:

➢ Decision system systems cannot work like super-specialist that can imitate human intelligence.

❖ Problem4: DSS just supports for Decision making:

➢ The most of decision support system ends up by just providing support to human experts by providing a list of choices, but the system does not itself take the decision.

❖ Problem5: Method used for problem solving:

➢ The above systems solve the problems by manipulating data & models. But experts are not able to 'teach' computers that use DSS. So the system is not able to support much in the decision making process without the help of expert decision makers.

❖ Problem6: Can result in taking of biased decisions:

➢ The above systems often use some equations to solve problems or update reports immediately. On the basis of information generated, the users make the final decisions. Counselors take decisions using DSS on behalf of users. In this case there are chances of introducing human biases in decision making.

❖ Problem7: Lack of implementing Artificial Intelligence (AI):

➢ The above systems are found lacking in working from a much larger set of modelling rules. It does not use the concepts of Artificial Intelligence, to process and store the knowledge base and to scans base in order to suggest a final decision through inference.

❖ Problem8: Does not apply probability based rules:

➢ The above systems are found lacking in applying a standard set of probability based rules to make a decision in a specific problem setting. The system uses data and specified models to solve the problem.

❖ Problem9: Lack of providing solutions without requirement of further analysis:

➢ The above system design is lacking in providing explicit answers to questions without requirement of any further analysis by the end user.

Thus, there is a requirement of a solution that can address the above stated problems. By exploring alternatives, it is found that expert system can answer the above mentioned problems. In the next section, the how the expert system provides the solution of above mentioned problem is explained.

V.   SOLUTION OF THE ABOVE STATED PROBLEMS

According to [8], [9], from the exploration of expert systems it reveals that the above stated problems can be answered by Expert Systems. The existing Expert Systems for career selection are used to derive alternative solutions to our above stated problems.

It is found in [10], a proposed Online Expert System, that it is useful for higher secondary school students of Pondicherry. The system consists of knowledge base containing details of colleges of Pondicherry; the system provides the facility of automatic update of the knowledge base without manual effort.

It is found in the Expert System for career advisory named-iadvice developed by [11], that it has the facility of providing explanations, alternative solutions, uncertainty and probability measures, questioning ability.

In the Expert system named IS-Advisor developed by [12], it is found that the system is based on knowledge base and reasoning strategies implied by Inference engine. It uses object oriented architecture for database, hence providing quick and easy access for course selection.

In the Rule-based expert system for supporting university students, developed by [13], uses an Oracle Policy Automation (OPA) tool. OPA is capable of reading rules conveniently from spreadsheet and word-processor file formats, where the rules are written in a format similar to natural language. OPA automatically forms problem solving or decision making application based on acquiring rule base.

In the Expert system for automatic academic advising and course schedule planning developed by [14], helps the advisors in accurately and efficiently completing tasks as the system takes the decision.

The above description indicates that the solution to the problems of DSS mentioned can be provided by the use of the expert system. The solutions are given below:

❖ Problem 1: No Automatic Update Facility:

➢ Solution 1: Expert System can provide support for automatic knowledge update of the database so that it improves system efficiency and accuracy as it reduces manual work.

❖ Problem 2: No Explanation Facility:

➢ Solution 2: Expert system can provide support for justification or explanation facility of the given result, so that one can know why a particular decision has been taken.

❖ Problem 3: Does not imitate human Intelligence:

➢ Solution 3: Expert System can imitate human experts as it has own learning process, which can replace human intelligence.

❖ Problem 4: DSS just supports for decision making:

➢ Solution 4: Expert System does not end by just providing a list of choices to support decision makers, but provides higher level accuracy to take efficient decisions on the behalf of human experts.

❖ Problem 5: Method used for problem solving:

➢ Solution 5: Expert System has the capability to learn on its own, so that the system may support for taking good quality decisions with less involvement of expert decision makers.

❖ Problem 6: DSS Can take biased decisions:

➢ Solution6: An Expert System has learning capabilities by inferring various rules on the knowledge stored in the knowledge base. So it can generate efficient results by implying its own reasoning facility without requirement of human counselors.

❖ Problem 7: Lack of implementing Artificial Intelligence:

➢ Solution7: An Expert system is capable to work from a much larger set of modelling rules. It uses concepts from Artificial Intelligence to process and store the knowledge base. It uses the knowledge base to suggest a final decision based on the rules through inference.

❖ Problem 8: Does not apply probability based rules:

➢ Solution8: An Expert system can acquire knowledge from an expert and applies a large, but a standard set of probability based rules so as to make a decision in a specific problem setting.

❖ Problem 9: Lack of providing solutions without requirement of further analysis:

➢ Solution 9: Expert System is designed to provide explicit answers to the questions. The End users doesn't require to probe and do further analysis.

VI.   COMPARISON BETWEEN DSS AND EXPERT SYSTEM

Here the comparison between Decision Support system and Expert system is presented. The comparison is based on the following parameters: method used for solving problems, lack of automatic update, the nature of the query, lack of making decision, lack of applying probabilistic rules, Lack of implementing Artificial Intelligence, Lack of explanation facility. It is given below in tabular format:

The comparison between the problems with DSS and how the Expert System provides solutions for that problem is presented in the table 1.0

TABLE 1.0
PROBLEMS WITH DECISION SUPPORT SYSTEM AND ITS SOLUTION BY EXPERT SYSTEM

Problems	Problems of DSS	Solution by Expert System
Method of problem solving	DSS provides assistance and supports problem solving with the help of data and models available in a particular domain.	The Expert system learns from human experts in a particular domain so that system is capable to take decisions themselves.
Automatic Update	In DSS automatic update facility of knowledge in the database is not possible.	In an Expert system, the automatic update facility of knowledge in database is possible.
Nature of query	Here the human queries the system to get help in taking decisions.	Here the system queries the human users to automate process of decision.
Lack of making decision	Humans take the decision.	The System takes the decision.
Lack of applying probabilistic rules	The database includes factual data.	The database includes procedures and data and uses probability based rules.
Lack of implementing Artificial Intelligence (AI)	The major components of DSS used for helping in the decision are model management, data management and user interface.	It uses concepts from Artificial Intelligence to process and store the knowledge. The major components of Expert System are knowledge base, inference engine, user Interface.
Lack of explanation facility	DSS helps in the decision making process by providing support of analysis in the form of reports or graphs. It does not provide an explanation for the result generated.	Expert systems are intended to provide explicit answers to questions along with explanation facility without requirement of any further analysis of end users.

From the above comparative analysis of Decision Support System and Expert System, it is found that DSS can provide support for decision making, but does not take decisions on behalf of human experts. For career selection domain there is a requirement for an intelligent system that can take decisions like human experts and can replace them. It is found that Expert Systems are capable to fulfill this requirement. Hence Expert System can overcome problems of DSS mentioned earlier and provide a better solution in the form of automated system for the domain of career selection.

VII. CONCLUSION

Based on the above analysis and comparison between Decision Support System and Expert System it can be concluded that Expert System proves to be the better option for the domain of career selection. As Expert System can take intelligent decisions like human experts, they can replace the limitations of human counselors. Expert System replaces the human intelligence with artificial intelligence, which was found lacking in Decision Support System. Apart from this analysis, as a secondary objective, the list of factors affecting the career selection is also retrieved from the paper.

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