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## *Decision Support Systems and its Applications in different sectors: Literature Review*

Waghmode M. L.<sup>1</sup>  
BVDU, I/M/R/D/A,  
Sangli - India

Dr. P.P. Jamsandekar<sup>2</sup>  
BVDU, I/M/R/D/A,  
Sangli - India

**Abstract:** *Decision Support System (DSS) is one of the information systems useful for making decisions. It is an integrated set of computer tool that allows a decision- maker to interact directly with computers to create information and is useful in making decisions. This computer based system is useful in many areas for supporting decisions. DSS have been built for approximately 40 years and it is useful in most of the sectors. This paper explores applications of DSS in different sectors and its use. DSS is used in many fields like agriculture, medicine, business, education, railway etc. DSS provides easy interface so that it is easy to use and we can take complicated decision using DSS. It is observed that most of the DSS applications are used in medical sector for diagnosing different diseases. CDSS is commonly used DSS in medical sector for clinical decisions.*

**Keywords:** *DSS, CDS.*

### I. INTRODUCTION

A Decision Support System (DSS) is a collection of integrated software applications and hardware that form the backbone of an organization's decision making process. DSS is supported by different tools viz; DB query, Graphics, editor, OLAP, Statistical data analysis packages MS-Excel, Crystal, Analytica and iThink. These tools has wide variety of applicability in Industries rely on decision support tools, techniques, and models to assess and resolve today business questions. The decision support system is data-driven, as the entire process feeds off of the collection and availability of data to analyse. Business Intelligence (BI) reporting tools, processes, and methodologies are key components to any decision support system and provide end users with rich reporting, monitoring, and data analysis.

DSS is an approach or methodology for supporting decision making. It uses an interactive, flexible, adaptable computer-based information system (CBIS) easily developed to supporting the solution to a specific unstructured management problem. [8] There are different components of DSS such as Database management, Model management, Knowledge base management and user interface.

### II. APPLICATIONS OF DSS

DSS can be applied in many knowledge domains, such as business, medicine, agriculture, education.

#### A. Agriculture

DSS system named ADSS Agricultural Decision support system was designed by author. He foresees/ predicts improved capability for seasonal crop prediction, opportunity to forward plan in response to climate forecasts to influence productivity at field & regional scales. [10] Techniques used: - Natural Language Processing.

DSSAT4 package, developed through financial support of USAID during the 80's and 90's, has allowed rapid assessment of several agricultural production systems around the world to facilitate decision-making at the farm and policy levels

It is being used as a teaching and training tool by providing interactive responses to "what if" questions related to improved understanding of the influence of season (weather), location (site and soil) and management on growth processes of plants [19]

NatureServe Vista® is a powerful, flexible, and free decision-support system that helps users integrate conservation with land use and resource planning of all types [21]

ProDEX: It is a software tool used in environmental protection, air and soil pollution control & has been developed by University of Ljubljana, Slovenia. This is developed in Python & is dedicated to complex environment pollution issues, integrates with relational distributed databases and uses GIS in its architecture [12]

#### B. Banking

Banking DSS: MAPP (Managerial Analysis for profit planning) is a DSS developed by city bank. It was designed to support decisions involved in the financial planning, budgeting costing and pricing of bank products. It helps bank executives define banking products and services and identify the cost incurred in providing them. It also helps determine how resources should be shifted among bank products and services, and it prepares budgets for the bank departments producing each banking product. [20]

#### C. Education

Higher Education Decision support system (HEDSS) presents design of the Student, Teaching and Research modules of the DSS [17]

Author presented various issues on state of art DSS and outline of a DSS Teaching module, involving the results and activities were presented [18]

A prototype version of software support tool for tutors has been constructed which was helpful for predicting students performance.

Techniques used: M5 algorithm, Classification and Regression algorithm, Association rules, sequential pattern analysis, clustering, Data mining algorithms. [14]

Author was proposed DSS for Secondary School "leaving students" who are likely to have a problem with their choice of carriers as they intend to study in at tertiary institutions of their choice. Here in this study DSS consists of DBMS, Model Management Subsystem, Knowledge Base Subsystem, and user. Career decision is selected based on basic parameters like subject combination, IQ test, hobby, friend's suggestions, and parent's suggestions. The system was designed for the desktop of the counsellors to enhance the duty of choosing the best and most appropriate discipline for clients. [16]

Author presents the design and development of a proposed rule based Decision Support System that will help students in selecting the best suitable faculty/major decision while taking admission in Gomal University. They designed a model for testing and measuring the student capabilities like intelligence, understanding, comprehension, mathematical concepts plus his/her past academic record plus his/her intelligence level, and applying the module results to a rule-based decision support system to determine the compatibility of those capabilities with the available faculties/majors in Gomal University. This DSS identify the most suitable faculty or major for the student based on his abilities and capabilities extracted from the test module results. DSS is a rule based system, and they used CLIPS language to store knowledge base. Using abilities test and intelligence test and their past academic record, can measure some student capabilities and abilities and determine which faculty/major is suitable for him/her.[13]

#### D. Flood

In Italy, the “Dipartimento di Informatica” (the Department of Informatics), at the “La Sapienza” University in Rome, have developed a DSS for flood control and prevention, based on Web technologies. The computer system has a distributed architecture, collecting data from distant sources. The decisional system simulates scenarios using the collected data and makes quantitative and qualitative predictions. The system also provides a decision risk analysis for flooded areas. The DSS integrates an expert system in its architecture which uses experience and data accumulated from previous similar situations to make decisions [24]

#### E. Government

A government DSS GADS (Geodata Analysis and Display System) was developed by IBM. It constructs and displays maps and other graphics display that support decisions affecting the geographic distribution of people and other resources. E.g. it can analyse and display the geographic distribution of crimes and thus help decide how to assign police to geographic areas of a city. It has also been used for urban growth studies defining school district boundaries, and fire department inspection and equipment deployment. [20]

#### F. Marketing

Trend forecasting, Promotion Management, Retail: DSS help as diagnostic tool, accuracy of records and in billing, & smooth operations. Majority of operational decisions like inventory management, CRM, campaign management were handled by ERP or Point of Sale. A marketing DSS Brandaid is a DSS used for marketing planning especially in the packaged goods industries. It helps brand managers make pricing, sales effort, promotion, advertising, and budgeting decisions for products, product lines and brands of products. It produces sales forecasts and profitability estimates using internal and external data about customers, competitor’s retailers, and other economic and demographic information. [20]

Web based DSS architecture has provided an efficient mechanism for collaborative demand planning and help create the maximum profit for the supply chain. [15]

#### G. Medical

Fuzzy DSS was used to Guide the doctors for the risk stratification of breast cancer, which is expected to have a great impact on treatment decision and to minimize individual variations in selecting the optimal treatment for a particular case. [1]

Tools used: Mamdani inference, simulation in MATLABR2009b.

Author formulate a DSS that integrates a multitude of heterogeneous data (clinical, imaging, and genomic), framing all manifestations of the disease [13]

CDSS was used for determining diagnosis of patient data. Generally it consists of Knowledge base, inference engine and mechanism to communicate. [9]

Clinical decision support system for detection and respiratory isolation of tuberculosis patients: To automate the detection and respiratory isolation of patients with positive cultures and chest x-rays suspicious for TB [11].

(CDSSs) are computer systems designed to support clinicians’ decision making about individual patients at the point of care when these decisions are being made [7]. Wyatt and Spiegelhalter proposed a more specific definition of CDSS: they stated that a CDSS is an active knowledge system that uses two or more items of patient data to generate case-specific advice [2]. A CDSS brings existing knowledge and relevant patient data to the point of care. CDSSs have the potential to aid clinicians in collecting relevant data, making clinical decisions, managing medical actions more effectively, and thereby making fewer practice errors, achieving a higher standard of care and reduced costs [14, 16].

Some examples of CDSS are CADUCEUS, DiagnosisPro, Dxplain, MYCIN, and RODIA

**DERMIS:** This system was used to provide a differential diagnosis of skin lesions. [3]

**DXplain:** Includes 2,400 diseases and 5,000 symptoms in its knowledge base. It can provide a comprehensive description and selected references for over 2,400 different diseases, emphasizing the signs and symptoms that occur in each disease. DXplain acts on a set of clinical findings (signs, symptoms, laboratory data) to produce a ranked list of diagnoses which might explain (or be associated with) the clinical manifestations. DXplain provides justification for why each of these diseases might be considered, suggests what further clinical information would be useful to collect for each disease, and lists what clinical manifestations, if any, would be unusual or atypical for each of the specific diseases.

A web-enabled version of DXplain, providing unlimited Internet access for a modest royalty is now available to medical schools and hospitals developed by Laboratory of Computer Science, Massachusetts General Hospital, and Harvard Medical School. [22]

**Intelligent Decision Support System (IDSS) [1970]:** Uses AI techniques and behaves like a human consultant, supporting decision makers by gathering and analysing evidence, identifying and diagnosing problems, proposing possible courses of action and evaluating the proposed actions. Its performance can be poor when novel or uncertain circumstances arise [9]

**INTERNIST I (1974):** Pople and Myers begin work on INTERNIST, one of the first clinical decision support systems, designed to support diagnosis, in 1970.

**INTERNIST-I** was a rule-based expert system designed at the University of Pittsburgh in 1974 for the diagnosis of complex problems in general medicine. It uses patient observations to deduce a list of compatible disease states (based on a tree-structured database that links diseases with symptoms). By the early 1980s, it was recognized that the most valuable product of the system was its medical knowledge base. This was used as a basis for successor systems including CADUCEUS and Quick Medical Reference (QMR), a commercialized diagnostic DSS for internists. [23]

**ONCOCIN:** A rule-based medical expert system for oncology protocol management developed at Stanford University. ONCOCIN was designed to assist physicians with the treatment of cancer patients receiving chemotherapy. ONCOCIN was one of the first DSS which attempted to model decisions and sequencing actions over time, using a customized flowchart language. It extended the skeletal-planning technique to an application area where the history of past events and the duration of actions are important [23]

**PNEUMON-IA:** This system was used to diagnose community-acquired pneumonia from clinical, radiologic and laboratory data [20]

**QMR [1972]:** "A diagnostic decision-support system with a knowledge base of diseases, diagnoses, findings, disease associations and lab information. From primary medical literature information on almost 700 diseases and more than 5,000 symptoms, signs, and labs are identified. QMR was designed for 3 types of use: "as an electronic textbook; as an intermediate level spreadsheet for the combination and exploration of simple diagnostic concepts; as an expert consultant program" [23]

**Texas Infectious Disease Diagnostic DSS:** This system was used to provide a weighted differential diagnosis based on manually entered patient information [7]

#### H. Railway

**(ROMA)** Solves expected route conflicts, provides dynamic use of platform tracks in a station or alternative paths in a corridor between stations [10]

**Southern Railway:** Train dispatching and routing

## 2.8 Business (Spreadsheet-based DSS)

DSS creation in Excel facilitates the accessibility and the easiness of use for customer, Excel offer a great number of statistical, financial, math and other functions. Excel can be useful as DSS generator. Excel is useful for lot of analysis optimization, simulation, sensitivity analysis, what if analysis.

Excel add-ins: @Risk, Precision Tree, TopRank, RiskOptimizer, Evolver, Treeplan, SensIt, RiskSim, CrystalBall, and RiskSolver. [24]

### I. Tourism

Statistical Forecasting and Tourism Information System (SFTIS) used for forecasting, data analysis, effective use of tourism data.

Commercial Forecasting packages - Autobox, Decision Pro, Forecast PRO, EvIEWS4, PSI planner, SCA Forecasting & modelling Package. Statistical: Minitab, SAS, SPSS, S-Plus, EvIEWS. Mathematical: Matlab, Mathcad, Mathematica, Tourism Navigator (GNT) [4]

### J. Water Supply

NRWS aids in the process of identifying key issues in selecting sustainable sources, and systematically guides the user through various methodologies to quantify the potential water sources. The DSS is divided into six modules that represent different criteria used to evaluate potential water sources: water source yield, capital costs, cost and ease of operation and maintenance, impact of development, political and legal constraints, and water quality. [6]

### Tools Used: Ms-Excel, VB

RWS DSS was developed by the Institute for Water Research at Rhodes University in South Africa. It is a planning and design tool for sustainable Rural Water Supply which covers technical, social, environmental, and economic factors. It is a tool for planning and evaluating future rural water supply projects [5]

## III. CONCLUSION

Decision Support System (DSS) is useful information system in different fields. Here we observed that DSS is built and used in major sectors like agriculture, banking, food, marketing, medical, railway, business, tourism, education, water supply etc., it is observed that DSS are designed using different tools known as DSS generators. Using excel we can design DSS due to its analytical support. For designing DSS we can use visual basic, web applications, fuzzy tools, etc. DSS is used in agriculture sector for seasonal crop prediction, in medical is it used for diagnosis of different diseases, in education it is used for predicting admission and student academic performance.

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