UCD Michael Smurfit Graduate Business School

MSc Business Analytics

MIS41040 - Business Decision Support System

Case Study Report

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Under the guidance of

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Group 15

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Medical decision support system for cancer treatment in precision medicine in developing countries

The medical decision support system analyzed in this report focuses on cancer treatment, particularly for non-small cell lung cancer (NSCLC). Beneficial in resource-limited settings, it enhances healthcare by providing personalized treatment recommendations.

Type of Decision

This DSS facilitates semi-structured and unstructured decision-making in oncology. Physicians rely on both empirical data and expert judgment to determine the most effective drug therapy. The system aids in treatment selection by predicting drug efficacy based on patient-specific characteristics, making it a prescriptive and predictive decision support system.

Type of User

The primary users include oncologists and medical practitioners, who rely on it to optimize treatment decisions for NSCLC patients. Medical researchers utilize the system to study drug efficacy and enhance treatment protocols, while healthcare administrators use it for resource planning and efficient drug allocation.

Type of System

The DSS is a model-driven system that incorporates machine learning algorithms for predictive analytics. It employs deep learning models, such as Stacked Denoising Autoencoders (SDAEs) and collaborative filtering techniques, to analyze historical patient-medication interactions and predict drug efficacy.

What Support is Provided?

The system enhances medical decision-making through predictive analytics, forecasting drug effectiveness for individual patients. It provides personalized treatment recommendations by generating customized medication schemes and leverages data-driven insights to assist in secondary diagnosis. Additionally, it improves efficiency by reducing the time required for evaluating treatment options.

How Was It Built?

This DSS was developed using a combination of machine learning techniques, including neural networks and deep learning models, which were trained on historical patient data to improve predictive accuracy. Big data analytics enabled the collection and analysis of patient information from multiple hospitals, ensuring a comprehensive dataset. Additionally, collaborative filtering was applied to predict treatment outcomes by identifying patterns in similar cases, further refining personalized treatment recommendations.

How Was It Tested?

The system was rigorously tested using an 8-fold cross-validation method on real-world patient data to ensure its reliability and effectiveness. The evaluation process involved training models on past patient-drug interactions and validating predictions against known treatment outcomes. Its performance was then compared with existing deep learning approaches to assess improvements in accuracy. Key metrics such as accuracy, precision, and recall were measured to evaluate the system's ability to predict drug efficacy, ensuring robust and data-driven decision support for medical practitioners.

How Was It Implemented?

The system is designed for seamless integration with hospital information systems (HIS), electronic medical records (EMR), and picture archiving and communication systems (PACS) to efficiently collect and process patient data. It leverages cloud-based decision-making modules to analyze medical records, ensuring fast and accurate treatment recommendations. Additionally, it features a user-friendly interface that enables medical professionals to easily access insights and make informed decisions, enhancing overall workflow and patient care.

Was It a Success?

It significantly enhanced treatment accuracy by improving the precision of drug therapy predictions, ensuring more effective patient care. Additionally, it reduced decision-making time, allowing for faster and more efficient treatment planning. Its scalability further highlighted its potential for broader applications beyond NSCLC, making it a valuable tool for advancing personalized medicine in various medical fields.

The analyzed system is a true DSS, explicitly designed to support medical professionals in making data-driven decisions for cancer treatment. It successfully incorporates AI-driven analytics, patient data extraction, and expert knowledge to optimize drug selection and improve patient outcomes. Its structured approach to evaluating treatment efficacy and offering personalized recommendations aligns with the core principles of a model-driven decision support system (DSS).

Using crowd-sourced traffic data and open-source tools for urban congestion analysis

The implementation of crowd-sourced traffic data and open-source tools for urban congestion analysis presents a novel approach to tackling transportation challenges. The study aims to offer a cost-effective and reliable solution for traffic management, highlighting the potential of open-source tools and real-time data in informing traffic regulations and urban planning decisions.

Type of Decision

The system primarily supports operational and tactical decision-making related to traffic management and congestion reduction. The insights derived from real-time traffic data enable decision-makers to adjust infrastructure policies, optimize traffic flow, and enhance urban mobility planning.

Type of User

The primary users of this system include:

- Urban Planners & City Administrators: Utilize the insights for long-term transportation planning.
- Traffic Management Authorities: Apply data to implement real-time traffic control measures.
- Researchers & Data Analysts: Use the system for studying traffic congestion trends and modeling future scenarios.
- Policy Makers: Leverage findings to inform regulatory changes and infrastructure development.

Type of System

The system is data-driven, relying on real-time crowd-sourced traffic information from platforms like Google Maps and HERE. The system integrates and visualizes this data to provide actionable insights.

Support Provided

The system provides real-time traffic insights for continuous monitoring of congestion levels. Faster data processing automates data collection and analysis, eliminating the need for manual traffic surveys. Improved accuracy is achieved through multiple data sources, enhancing traffic condition assessments. Additionally, visualization capabilities generate geospatial representations of congestion trends to assist in urban planning.

How was it built?(Generators/Tools Used)

- Programming Language: Developed using R programming language for data processing and analysis.
- Data Collection: Google Maps API and HERE API for real-time traffic flow data.
- GIS Tools: Used for mapping and spatial analysis.
- Methodology: It involved setting up virtual bounding boxes, extracting traffic data, and visualizing it using R.

How was it tested?

It provides real-time traffic insights for continuous monitoring of congestion levels. Faster data processing automates data collection and analysis, eliminating the need for manual traffic surveys. Improved accuracy is achieved through multiple data sources, enhancing traffic condition assessments. Additionally, visualization capabilities generate geospatial

How was it implemented?

The system was initially tested in Al Ain, UAE, with potential scalability to other urban areas. It was integrated with existing traffic systems to complement smart traffic management solutions. Data exporting features allowed integration with spreadsheets and GIS platforms for further analysis, enhancing usability for diverse stakeholders.

Was it a success?

The system demonstrated high confidence levels in real-time traffic data and effectively identified traffic congestion patterns. It provided a replicable methodology for global adoption. However, limitations included the lack of vehicle classification data, which affected precision in traffic composition analysis. The absence of road infrastructure details, such as lane width and number of lanes, limited comprehensive assessments. Additionally, the system did not incorporate traffic signal phase data, making it difficult to analyze congestion at signalized intersections.

This system successfully functions as an urban congestion DSS despite not explicitly being labeled as one. It enables faster, more accurate decision-making for traffic management but requires further enhancements, such as integrating additional infrastructure data and incorporating AI-based predictive analytics, to maximize its effectiveness.

A Dynamic Decision Support System for Sustainable Supplier Selection in Circular Economy

The article applies multi-criteria decision-making (MCDM) and dynamic modeling to assess suppliers based on economic, environmental, and social factors. Its effectiveness is tested by applying it to a case study in real procurement. The research highlights how DSS improves supply chain management's sustainability-focused decision-making.

Type of Decision
The system addresses the multi-criteria decision-making process in the selection of suppliers that meet sustainable and circular economy principles. This involves suppliers' evaluation based on various criteria such as environmental sustainability, economic performance, and social responsibility.

Type of User
The potential users are procurement and supply chain management decision-makers in organizations that aim to implement sustainable practices. These users make decisions regarding the selection of suppliers that must meet some sustainability criteria.

Type of System
The DSS is model-driven, in the sense that it utilizes mathematical and computational models for analyzing and comparing suppliers based on a number of criteria. It makes use of dynamic modeling to account for changes over time so that supplier ratings do not become obsolete under changing market conditions.

Support Provided
The system offers comprehensive support by:

- Comprehensive Data Analysis: Integrates various data sources for assessing the performance of suppliers based on various sustainability criteria.
- Dynamic Evaluation: Considers temporal changes, allowing for continuous assessment and adaptation to new information or changing conditions.
- Multi-Criteria Decision Analysis (MCDA): Utilizes MCDA techniques to balance and prioritize different sustainability factors, facilitating well-informed decision-making.

How was it built?(Generators/Tools Used)
The DSS was developed with the assistance of advanced operations research techniques and decision analysis methodologies. Specific tools or computer software used in the development are not mentioned in the given information.

How was it tested?
The system was tested through the application of a case study, demonstrating its real-life feasibility and practicability in real-world application. The case study approach allowed for the testing of the functionality of the system and its ability to support sustainable supplier selection decisions.

How was it implemented?
Implementation issues are not extensively addressed in the information presented. The case study, however, demonstrates that the system is implementable within organizational decision-making to support sustainable supplier selection.

Was it a success?
The findings of the case study demonstrate that the DSS performed well in assisting decision-makers in the selection of suppliers according to circular economy criteria. The system's dynamic and multi-criteria evaluation functionality provided valuable insights, leading to more sustainable and informed decisions in supplier selection.
The case study confirms its real-world use, showing its practicability in real supply chain management. This DSS provides a structured, fact-based approach, helping organizations align procurement with sustainability goals. The study substantiates the role of DSS in encouraging circular economy practices, responsible sourcing, and long-term environmental benefits.

References

1. Yu, G., Chen, Z., Wu, J. and Tan, Y., 2021. Medical decision support system for cancer treatment in precision medicine in developing countries. Expert Systems with Applications, 186, p.115725.
2. Alkaabi, K., Raza, M., Qasemi, E., Alderei, H., Alderei, M. and Almheiri, S., 2024. Using crowd-sourced traffic data and open-source tools for urban congestion analysis. Transportation Research Interdisciplinary Perspectives, 28, p.101261.
3. Alavi, B., Tavana, M. and Mina, H., 2021. A dynamic decision support system for sustainable supplier selection in a circular economy. Sustainable Production and Consumption, 27, pp.905-920.

Search Strategy

1. Case Study 1(*excellentDSS*)
   Platform Used: Science Direct
   Search String: “Model-driven DSS application”
   Filters for Timeline: 2021-2022
   Article Type: Research article
   Subject areas: Medicine and dentistry

2. Case Study 2(*notcalledDSS*)
   Platform Used: Science Direct
   Search String: “data analysis tool”
   Filters for Timeline: 2024-2025
   Article Type: Research article

3. Case Study 3(*notDSS*)
   Platform Used :Science Direct
   Search String: “Decision support system but isn’t”
   Filters For Timeline : 2021-2025
   Article Type : Research Article

4. We primarily used ScienceDirect to search for relevant papers for three cases, as it features a highlights section that provides a quick overview of each paper. The highlights helped us identify papers that matched our interests and the characteristics of each DSS case. Afterward, we thoroughly reviewed those papers.

5. Usage of ChatGPT was done for the following purposes -
   a. To get clarity on distinguishing parameters of all the cases
      Prompt 1: “State the difference in the excellent case of DSS, a case which is DSS but not called so, a case which claims to be DSS but isn’t. DSS means Decision Support System”
      Prompt 2: “State characteristics/features in a tabular form for better understanding”

   b. To confirm the correctness of the cases for all searched articles
      Prompt 1: “I have attached an article from ScienceDirect. According to my study and understanding it is an example of excellent DSS. Check if the case matches all the characteristics of an excellent DSS”
      Prompt 2: “I have attached an article from ScienceDirect. According to my study and understanding it is an example of not called DSS. Check if the case matches all the characteristics of a DSS”
      Prompt 3: “I have attached an article from ScienceDirect. According to my study and understanding it is an example of not DSS. Check if the case matches all the characteristics of a DSS”