



A SYSTEMS ENGINEERING APPROACH TO SUSTAINABILITY DECISION SUPPORT SYSTEM BASED ON HESI

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Abstract

Climate change and global sustainability demands are prompting universities to integrate sustainable principles into all academic and non-academic activities. This research led to the design and implementation of a Sustainability Decision Support System (SDSS) at Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC), using the System Engineering Process (SEP) and the Higher Education Sustainability Initiative (HESI) framework. The SDSS uses Multi-Criteria Decision Making (MCDM) and interactive data visualization to assess sustainability across four dimensions: environmental, social, economic, and governance. Initial pilot testing showed an overall sustainability index of 74/100, with the highest score in the environmental dimension (82/100) and the lowest in governance (68/100). User Acceptance Testing (UAT) reported a 91% satisfaction rate among staff, lecturers, and campus leaders. Although the system relies on annual data and some manual inputs, the SDSS shows potential for adoption by similar institutions and supports Sustainable Development Goals (SDGs) in higher education.

Keywords: Sustainability, Decision Support System, HESI, System Engineering, Higher Education.

INTRODUCTION

Change in the global climate and stress on the source of power have pushed institutions to adopt education as a strategic role in applying sustainability principles (Ankareddy et al., 2025). As a center of knowledge and innovation, the college tall like Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) aims not only to integrate sustainability issues in the curriculum, but also to ensure that the operational campus is in harmony with the Sustainable Development Goals (SDGs) (United Nations, 2015). However, the implementation of sustainability initiatives in education is often hampered by a lack of system support for structured and data-driven decisions (Leal Filho et al., 2021).

The study by Cubas et al. (2025) in Project Quality demonstrates that the university is successfully integrating the practice of sustainability into its Work Integrated Learning framework, encompassing education, research, community service, societal engagement, and campus management. Meanwhile, Ribeiro et al. (2021) emphasized the importance of involving students in Green Campus Initiatives (GCI) as a catalyst for change. However, challenges such as limited funding, fragmented policies, and the lack of

tool monitoring remain significant barriers, especially in developing countries.

Various study previous has develop framework Work innovative For support taking decision sustainable Among them, Holst et al. (2025) and Marques (2025) emphasize the need for whole-school sustainability and the role strategic institution education tall in support the SDGs, even though faced with limitations structural and internal resistance. Portuguese-Castro & Ramirez-Montoya (2025) and Jillani et al. (2025) highlight effectiveness methodology innovative and digital media in increase competence sustainability students, with findings important related difference gender response. While that, Pambudi et al. (2025) revealed that knowledge Not yet Enough For to form pro sustainability behavior without approach education participatory. Spada et al. (2025) strengthens importance harmonization policy green and development competence cross discipline through NLP analysis, confirms the need approach holistic between education and labor market Work in face challenge transition sustainability.

Then study development system Supporter decision support system (DSS) for support sustainability in various sector. Niloofar et al. (2023)

highlighted the need approach holistic SAFA-FAO based in livestock DSS, because Lots system Still ignore aspect social and governance. Approach multicriteria is also used by Jefroudi & Darestani (2024) in selection Supplier sustainable, as well as by Kaheel et al. (2025) in production hydrogen, which emphasizes efficiency and impact environment. Li et al. (2024) combined digital twin and fuzzy evaluation to increase toughness chain supply energy renewable. DSS for sector textile and paper recycle repeat developed by Callychurn (2023) and Yousefi et al. (2023), with focus on the material alternative, efficiency energy, as well as planning adaptive production. Innovation in data processing and retrieval decision complex was also demonstrated by Razzaq et al. (2025) via integration of m-polar picture fuzzy sets, blockchain, and IoT, as well as by Scholz et al. (2023) with application of AHP and fuzzy logic, although Still faced with challenges technical data input. In overall, trend This show evolution of DSS towards more system intelligent, integrated and oriented sustainability cross sector.

Additionally, Poli et al. (2024) and Kumar et al. (2025) emphasized the importance of public participation in DSS based on MCDA, GIS, and AHP for sustainable area and waste management in a city. Adu et al. (2025) criticized the global DSS mismatch with the needs of local communities in Ghana, encouraging the development of a system based on IoT and blockchain. Uzair & Kazmi (2023) demonstrate the effectiveness of IoT-based BEMS in reducing emissions and lowering energy costs on campus. An approach based on non-linear growth models, as used by Divu et al. (2023) for lobster cultivation, was employed. Meanwhile, Nakhaei et al. (2023) applied ANFIS and PESTEL in power plant water management for electricity, achieving high accuracy. In the food industry, Gopal and Panchal (2023) employed fuzzy optimization methods to enhance the reliability of the boiler system. Overall, DSS is evolving to integrate the latest technology and approaches, providing participatory use of adaptive, precise, and sustainable solutions.

Study this to design an SDSS based on system engineering, aiming to strengthen ITBA-DCC capacity in reaching commitment sustainability, while simultaneously filling the gap in the literature about a systematic implementation approach in colleges across Indonesia.

This study encompasses three aspects of novelty, the primary factor that distinguishes it from previous studies. First, how to design a System SDGs-based Sustainable Decision Support System (SDSS) with a systems engineering approach at ITBA-DCC. Second, factors that only affect the effectiveness of the System Decision Support System (DSS) in supporting decision-making related to sustainability. Third, how to measure the impact of SDSS implementation using the

Higher Education Sustainability Initiative (HESI) in the campus environment. With Thus, research This aiming For developing an integrated DSS model based on Higher Education Sustainability Initiative (HESI) with system engineering approach, Analyzing connection dynamic between indicator Higher Education Sustainability Initiative (HESI) and policies campus through modeling system, as well as Evaluate SDSS performance in increase transparency and accountability sustainability at ITBA-DCC. The new study lies in the merger of system engineering approach, multi-criteria decision making (MCDM), and data analytics in SDSS to achieve a tall college.

RESEARCH METHODOLOGY

The development of the Sustainability Decision Support System (SDSS) at Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) adopted a System Engineering Process (SEP) approach based on the Higher Education Sustainability Initiative (HESI). The process consists of six main phases: Requirements Analysis, System Design, Implementation, Testing, Deployment, and Maintenance. To improve clarity, these phases are summarized in Table 1.

Table 1. Engineering Process Methodology for SDSS Development at ITBA-DCC

Phase	Main Activities	Key Outputs	HESI Integration
Requirements Analysis	Stakeholder interviews, needs assessment, review of sustainability policies	System requirement specification	Mapping institutional goals to HESI social, economic, and governance indicators
System Design	Develop architecture, UI wireframes, data flow diagrams	System architecture, prototype design	Dashboard and database design to support HESI indicator reporting
Implementation	Coding modules (reporting, dashboards, MCDM processing), database integration	Functional SDSS prototype	Embedded calculations and visualizations for HESI metrics
Testing	Unit, integration, and UAT with staff, lecturers, and management	Test reports, bug fixes	Validation of data accuracy for each HESI indicator
Deployment	Installation on production server, user training, initial data migration	Live SDSS system	Real-time monitoring of HESI indicators

Phase	Main Activities	Key Outputs	HESI Integration
Maintenance	Bug fixes, feature updates, adaptation to new regulations	Updated system versions	Alignment with updated HESI frameworks and institutional needs

Prototype and System Architecture

The SDSS was implemented as a web-based platform integrated with the institutional database. The architecture (Figure 1) consists of:

- Data Collection Layer: Inputs from institutional reports, sensors, and surveys.
- Processing Layer: MCDM engine for scoring sustainability performance.
- Application Layer: Interactive dashboards, report generation, and user management.
- Presentation Layer: Web interface accessible to stakeholders.

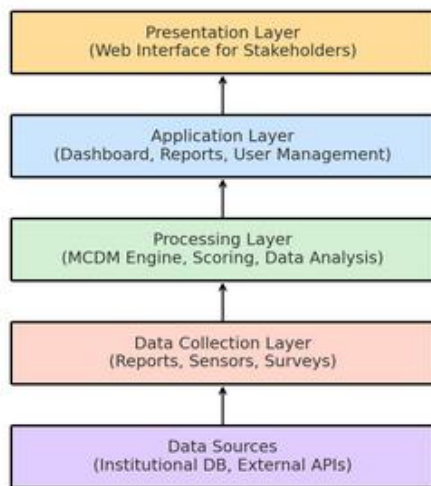


Figure 1: System Architecture of Sustainability Decision Support System (SDSS)

RESULT AND DISCUSSION

The process of processing and analyzing sustainability data at ITBA-DCC is carried out in a systematic manner, starting from data collection and culminating in the compilation of a strategic report. Data collected from three primary sources, namely the Vice Chancellor of Academic and Student Affairs, the Vice Chancellor of Finance, Resources, Power, Humans, and Cooperation, as well as campus operators on duty, are input into the system's data management. The information collected encompasses performance, academics, finance, human resource management, and work. The same institutional Good is also available in and abroad. The accuracy of the input data becomes crucial in ensuring valid information that will be later analyzed to support decision-making.

After the data is collected, it is processed and analyzed using the Higher Education Sustainability

Initiative (HESI) framework, combined with the Multi-Criteria Decision Making (MCDM) method. HESI is used to evaluate aspects of sustainability from various dimensions, including social, economic, environmental, and governance, by assigning a score based on relevant indicators. While that, MCDM is used for setting priority actions with consideration of a balance between criteria. Analysis results are then visualized in the form of interactive graphs, diagrams, or dashboards to enable easy understanding by stakeholders, including the rector, and to identify strengths and areas for improvement.

The next step is to evaluate the compilation report, which summarizes the results analysis and visualization. Report: This load evaluation of the achievement sustainability campus, challenges faced, and the need for development at the front. In the section end report, compiled recommendations for strategic improvements, which include concrete steps for improvements in various sectors, including academics, governance, finance, work, and human resource management. Report this to the rector as the basis for formulating strategic policy and planning terms, including determining priority and supporting budget sustainability for the institution in a comprehensive manner.

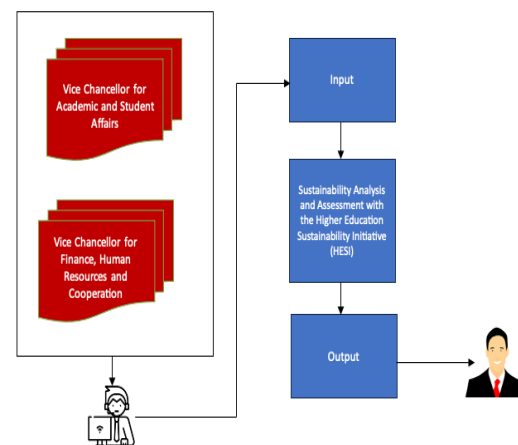


Figure 2. Reporting process sustainability at ITBA DCC with System Engineering Process methodology SEP using the HESI.

Based on the matter, the required tool helps to utilize a system based on a computer, which is a medium that can help power medical work in the clinical field. This creates a Sustainability Decision Support System (SDSS) at ITBA-DCC using the System Engineering Process (SEP) methodology, which necessitates a comprehensive design. The System Engineering Process (SEP) is an approach that is systematic in the development, operation, and maintenance of complex systems. The System Engineering Process (SEP) is a methodology that focuses on in-depth analysis, modeling, and testing within a development cycle, aiming to ensure the system fulfills user needs and

functions optimally. The System Engineering Process (SEP) is well-suited for projects that require coordination between elements, ensuring the system fulfills both technical and operational needs. Methodology involves several stages that focus on understanding, designing, testing, and maintaining a system.

1. Requirements Analysis

Requirements Analysis, based on methodology engineering system with Higher Education Sustainability Initiative (HESI) approach, which is applied in the development of Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) :

Table 2. Requirements Analysis

Component	Explanation
main purpose	Identify and formulate need functional and non- functional from SDSS system that supports sustainability institution education .
Approach	Based on <i>Higher Education Sustainability Initiative</i> (HESI), which includes aspect environmental , social , economic and governance campus . - Interview with leaders , lecturers , and staff - Questionnaire For students and staff education - Business process observation campus
Data collection technique	- Regulation government related education sustainable - Campus internal policies - HESI Guidelines - Practices best other institutions - Reporting indicator sustainability - Data visualization (dashboard) - Data comparison and trend features - System notification decision
Source Need	- Data security- Convenience Usage (user-friendly)- Accessibility various Device - Fast and stable system performance Specification Need The system (System Requirement Specification/SRS) which is reference For stage design and implementation system furthermore .
Need Functional	Involving all stakeholders interests (rectorate , academic bureau , laboratory , students , guarantee unit quality , and team campus SDGs implementers).
Non- Functional Requirements	Provide a strong and focused foundation For development supporting system taking decision based on sustainability in college tall .
Result Document	
Stakeholder Engagement	
Final destination	

2. System Design

System Design, based on methodology engineering system, for the development of Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) with the Higher Education Sustainability Initiative (HESI) approach :

Table 3. System Design

Component	Explanation
main purpose	Designing structure and elements technical from SDSS which is capable support taking decision based on sustainability in accordance HESI principles .
Design Approach	Use approach <i>modular</i> and <i>layered architecture</i> so that the system flexible , easy developed , and can integrated with system other .
Architecture System	- <i>Client-server architecture</i> - Consists from layer interface user , logic applications , and databases Sustainability visual dashboard - Campus SDGs reporting module - Indicator monitoring system performance - Data management - <i>User-friendly</i> and responsive - Navigation simple - Data visualization in the form of graphs , tables and diagrams
Main Components of the System	- Relational (MySQL/PostgreSQL)- Structured based on category indicator sustainability : environmental , social , economic , and governance
Interface Design Users	- System authentication and authorization users - Sensitive data encryption - Data backup and recovery
Database	- Connected with system information academic , financial , and assurance quality For obtain data in automatic
Security System	- Report sustainability interactive - Recommendations data- based- Notifications automatic to deviant indicators
System Integration	- <i>System Design Document</i> (SDD) which includes flowcharts system , ERD diagram, DFD, and design interface user
Output Generated	- Transparency , participation stakeholders interests , and support to objective development sustainable development (TPB/SDGs) in the environment campus
Result Document	
Integrated HESI Principles	

3. Implementation

Implementation, in the context of the development of the Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC), uses the Higher Education Sustainability Initiative (HESI) approach :

Table 4. Implementation

Component	Explanation
main purpose	Realize SDSS system in general real based on design that has been designed , so that it can used For support sustainability institution in a way practical.
Coding Process	Development program code for every module system based on specification design , including dashboard, SDGs reporting , data management , and user interface.
Technology Used	Programming language : PHP, Python, or JavaScript-Framework: Laravel, Django, or Node.js- Database: MySQL or PostgreSQL
Environment Implementation	- Local server or cloud (e.g. AWS or Google Cloud)- System Operations : Linux- Supporting tools : GitHub, Docker, CI/CD pipeline
Implementation of Key Features	- Reporting automatic indicator sustainability - Interactive dashboard web- based- System real-time notification and monitoring
System Integration	- System connected with academic , financial and environmental databases campus For pulling relevant data in a way automatic and real-time
Internal Testing	- <i>Unit testing</i> performed on each module - <i>Integration testing</i> For ensure connectivity between module functioning with Good
Technical Documentation	Installation and configuration guide system - Documentation program code and database structure- Notes testing and changes (changelog)
Development Team Involvement	Development team consists of from analyst systems , programmers, and database administrators working collaborative in accordance roles and schedules implementation
HESI Principles Applied	System built For facilitate TPB/SDGs reporting, efficiency digital energy , involvement of academics , and monitoring impact sustainability .
The final result	SDSS system has been can run and tested try internally by the institution For Then enter to stage <i>Testing</i> and <i>Deployment</i> .

4. Testing

Testing, in context development of Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) with Higher Education Sustainability Initiative (HESI) approach :

Table 5. Testing

Component	Explanation
main purpose	Ensure that SDSS system running in accordance with specifications that have been designed and functioning with Good in support sustainability institution .
Type Testing	- <i>Unit Testing</i> : Testing function of each module in a way separate - <i>Integration Testing</i> : Testing channel between Module - <i>System Testing</i> : Testing system in a way overall - <i>User Acceptance Testing</i> (UAT): Involving user end For validation need
Testing Techniques	- Manual testing for interface User - Testing automatic use script (if available)- Simulation scenario user
Tested Aspects	- System performance (performance) - Security (security) - Ease of use Usability - Data accuracy and logic calculation
Stakeholder Engagement	- IT Team - Lecturers and staff guarantee quality - Campus SDGs data manager - Leadership faculty or institution
Test Result Documentation	- Bug and error reports system - Report UAT results- Testing checklist in accordance Specifications - Recommendations repair
Adjustment Based on Test	- Repair module that is not walk with good - Adjustment features to make it more in accordance need user
HESI Principles Tested	- Compliance reporting with SDGs indicators- Ease sustainability data access - Engagement participatory user
Final destination	Ensure SDSS system ready used in a way real by institutions in support taking decision based on sustainability
Result of Stage This	Stable system , can reliable , and accepted by users , and Ready enter to stage <i>Deployment</i>

5. Deployment

Deployment, in the context of the development of the Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) with the use of the Higher Education Sustainability Initiative (HESI) approach :

Table 6. Deployment

Component	Explanation
main purpose	Implementing SDSS to environment operational institutions in order to be able to used by users For support policies and decisions decision sustainable .

Deployment Preparation	- Finalization configuration system - Test data cleaning and real data fitting - Verification end from results testing
Environment Production	- Local server or cloud (AWS, Google Cloud, etc .)- System operation stable (e.g. Linux Ubuntu Server)- Database ready use and safe
Deployment Method	- <i>Direct installation</i> on institutional servers - <i>Continuous Integration/Deployment (CI/CD)</i> For automation and efficiency Updates system
Documentation Supporters	Installation and usage guide - Administrator and user manuals - Data backup and recovery procedures (disaster recovery)
Training Users	- Workshop for staff and lecturers - Session training technical for IT administrators- Visual guide/ user manual end
Post -Deploy Monitoring	- Observation to performance system in real-time- Bug reporting or user issues - Response technical to problem beginning post-deploy
HESI Principles Applied	- Access open and fair For all academics - Transparency in sustainability data reporting - Support towards SDGs and engagement community
Stakeholder Engagement	- Campus IT Team - Leadership institution - Lecturer guardian sustainability - Assurance unit SDGs quality and reporting
Result of Stage This	Official SDSS system used in the environment campus , ready utilized For reporting , monitoring and decision making decision strategic based on sustainability .

	Prevention to potential problem future system
Main Activities	- Monitoring performance system in a way periodic - Improvement security and data protection- Updates Features and content - Error log management and system audit
Team Involved	IT development team - System administrator - Assurance team quality - Reporting unit sustainability (SDGs Center) campus)
Frequency Maintenance	- Maintenance routine monthly - System update quarterly or in accordance needs - Emergency measures if happen disturbance operational
Tools and Technology Supporters	- System monitoring performance (monitoring tools)- System management bug reporting (issue tracker)- Automatic and manual backups
System Performance Evaluation	- User feedback in a way periodic - Internal audit of reliability system - Evaluation effectiveness feature in support reporting and analysis sustainability
Accommodated HESI Principles	- Repair continuous improvement - Participation stakeholders interest in development system - Responsive to latest SDGs indicators
Maintenance Documentation	Fix and update logs system - Bug notes and solutions - Plans maintenance term long
Result of Stage This	SDSS system remains reliable , safe and relevant in term long For support taking decision strategic based on sustainability in the environment college tall .

6. Maintenance

Maintenance, as part of the methodology engineering system, for the development of the Sustainability Decision Support System (SDSS) at the Institut Teknologi Bisnis dan Bahasa Dian Cipta Cendikia (ITBA-DCC) with the Higher Education Sustainability Initiative (HESI) approach :

Table 7. Maintenance

Component	Explanation
main purpose	Guard SDSS system remains functioning optimally , responsively to change needs , and able to adapt with development technology and policy sustainability .
Type Maintenance	- <i>Corrective Maintenance</i> : Repair to error or bugs found - <i>Adaptive Maintenance</i> : Adjustments with policies and needs new - <i>Perfective Maintenance</i> : Improvement feature based on input user - <i>Preventive Maintenance</i> :

Performance Evaluation of HESI Indicators Using SDSS

The developed Sustainability Decision Support System (SDSS) integrates the Higher Education Sustainability Initiative (HESI) framework to evaluate the sustainability performance of ITBA-DCC across four key dimensions: Environmental, Social, Economic, and Governance. Each dimension is assessed using specific measurement methods and metrics (Table 8), processed through a Multi-Criteria

Decision-Making (MCDM) model to generate performance scores.

The SDSS dashboard provides an interactive visualization that allows stakeholders to monitor and analyze sustainability data in real-time. For instance:

- Environmental scores are derived from energy consumption per capita, waste reduction percentage, and water use efficiency.
- Social scores are based on survey results from students and staff, as well as participation in community engagement programs.
- Economic scores reflect the proportion of budget allocated for sustainability and efficiency in cost management.
- Governance scores evaluate transparency in reporting, policy compliance rates, and leadership diversity.

Table 8. HESI Indicators and Measurement Methods

HESI Indicator	Measurement Method	Unit / Metric	Example SDSS Output
Environmental	Energy consumption per capita, waste reduction %, water use efficiency	kWh/person/year, %, liters/person/year	82/100
Social	Student and staff satisfaction surveys, community engagement programs	Survey score (1–5), # programs/year	76/100
Economic	Budget allocation for sustainability, cost efficiency metrics	% budget, savings in IDR	73/100
Governance	Transparency in reporting, policy compliance, leadership diversity	Compliance %, diversity index	68/100

Pilot Testing Results

The SDSS prototype underwent functional testing, user acceptance testing (UAT), and pilot implementation with key stakeholders.

Table 2. Pilot Testing Results

Indicator Category	Score (0–100)	Remarks
Environmental	82	High performance in renewable energy use and waste recycling
Social	76	Strong community engagement; potential for improved inclusion programs
Economic	73	Stable budget allocation for sustainability; further cost efficiency possible
Governance	68	Transparency in reporting; needs greater stakeholder participation

Figure 3 presents a prototype of the SDSS dashboard generated during the pilot testing phase at ITBA-DCC. The bar chart displays each HESI indicator’s performance score (0–100 scale), while the pie chart illustrates the proportional contribution of each indicator to the overall sustainability index. This visualization enables decision-makers to quickly identify areas requiring improvement and track progress toward institutional sustainability goals aligned with the Sustainable Development Goals (SDGs).

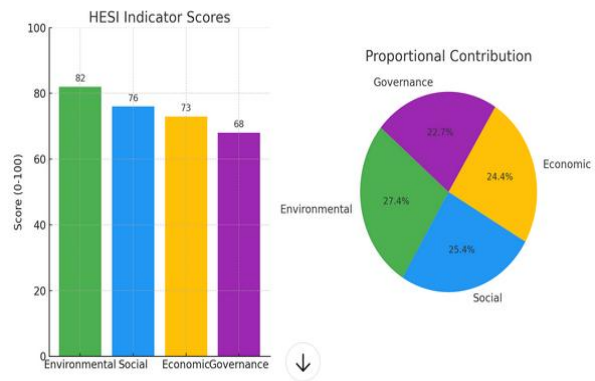


Figure 3: SDSS Dashboard - Sustainability Performance

CONCLUSION

This research achieved the core goal of designing and implementing a Sustainability Decision Support System (SDSS) at ITBA-DCC, guided by the Systems Engineering Process and HESI principles. The SDSS integrates Multi-Criteria Decision Making and interactive data visualization, providing clear measurement of sustainability performance across environmental, social, economic, and governance areas. The system proved both effective—with a pilot sustainability score of 74/100—and well-received, earning a 91% user satisfaction rating.

This success was driven by active user involvement at every stage of development, enhancing the system's relevance and accountability. However, limitations remain, particularly related to the reliance on annual data and manual input processes. Future research recommends integrating real-time data and expanding the scope of HESI indicators to create more dynamic and comprehensive analyses. With these advantages, SDSS benefits not only ITBA-DCC but also has the potential to be replicated at other universities to accelerate the achievement of the Sustainable Development Goals (SDGs) in the higher education sector.

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REFERENCES

- Adu , T.F., Mensah, L.D., Rockson , MAD, & Kemausuor , F. (2025). Decision support systems for waste-to-energy technologies: A systematic literature review of methods and future directions for sustainable implementation in Ghana. *Heliyon* , 11, e42353. <https://doi.org/10.1016/j.heliyon.2025.e42353>
- Ankareddy , S., Dorfleitner , G., Zhang, L., & Ok, Y.S. (2025). Embedding sustainability in higher education institutions: A review of practices and challenges. *Cleaner Environmental Systems*, 17, 100279. <https://doi.org/10.1016/j.cesys.2025.100279>
- Callychurn , D. S. (2023). A decision support system for environmentally-sustainable strategies for the Mauritian textile and apparel industry using system dynamics: The materials and land perspectives. *Heliyon* , 9, e12939. <https://doi.org/10.1016/j.heliyon.2023.e12939>
- Cubas , ALV, Provin , AP, Dutra, ARA, Guerra, JBSOA, & Mussi , CC (2025). From education to management: A study of the sustainability practices of universities participating in the Qualenv Project. *Journal of Environmental Management*, 377, 124575. <https://doi.org/10.1016/j.jenvman.2025.124575>
- Divu , D.N., Mojjada , S.K., Dash, G., Sundaram, SLP, Menon, M., Tade , M.S., Mojjada , R.K., Bhint , H.M., Bhardwaj, J., Subramanian, A., Suresh, V.R., & Gopalakrishnan, A. (2023). A novel decision-support system for augmenting sustainable lobster production through comparison of mariculture systems at increasing stages of technological development. *Journal of Cleaner Production*, 401, 136759. <https://doi.org/10.1016/j.jclepro.2023.136759>
- Gopal, N., & Panchal, D. (2023). Fuzzy decision support system for sustainable operational performance optimization for boiler units in milk process industry. *Applied Soft Computing*, 135, 109983. <https://doi.org/10.1016/j.asoc.2023.109983>
- Holst, J., Brock, A., Grund , J., Schlieszus , A.-K., & Singer- Brodowski , M. (2025). Whole-school sustainability at the core of quality education: Wished for by principals but requiring collective and structural action. *Journal of Cleaner Production*, 519, 145897. <https://doi.org/10.1016/j.jclepro.2025.145897>
- Jefroudi , M.T., & Darestani , S.A. (2024). A decision support system for sustainable supplier selection problem: Evidence from a radiator manufacturing industry. *Journal of Engineering Research*, 12, 867–877. <https://doi.org/10.1016/j.jer.2024.03.014>
- Jillani , H., Chaudhry, M.N., Jafri, S.R., & Zahid, H. (2025). The impact of social media on knowledge, attitude, and practices (KAP) towards sustainable consumption in higher education institutions. *Cleaner and Responsible Consumption*, 17, 100284. <https://doi.org/10.1016/j.circ.2025.100284>
- Kaheel , S., Fallatah , G., Luk , P., Ibrahim, K.A., & Luo, Z. (2025). Decision support system for sustainable hydrogen production: Case study of Saudi Arabia. *Energy for Sustainable Development*, 84, 101603. <https://doi.org/10.1016/j.esd.2024.101603>
- Kumar, P., Singh, D. J., & John, S. (2025). Multi-criteria decision support system for sustainable municipal solid waste management: A case study of Chandigarh, India. *Environmental Development*, 55, 101228. <https://doi.org/10.1016/j.envdev.2025.101228>
- Leal Filho, W., Amaro, N., Avila, LV, et al. (2021). Mapping sustainability initiatives in higher education institutions in Latin America. *Journal of Cleaner Production*, 315, 128093. <https://doi.org/10.1016/j.jclepro.2021.128093>
- Li, Y.L., Tsang, Y.P., Wu, C.H., & Lee, C.K.M. (2024). A multi-agent digital twin-enabled decision support system for sustainable and resilient supplier management. *Computers & Industrial Engineering*, 187, 109838. <https://doi.org/10.1016/j.cie.2023.109838>
- Marques, M. da C. da C. (2025). The Management of Higher Education Institutions in Portugal From a Sustainable Perspective. *Procedia Computer Science*, 256, 706–717. <https://doi.org/10.1016/j.procs.2025.02.170>
- Nakhaei , M., Ahmadi, A., Gheibi , M., Chahkandi , B., Hajiaghahi-Keshteli , M., & Behzadian , K. (2023). A smart sustainable decision support system for water management of power plants in water stress regions. *Expert Systems With Applications*, 230, 120752. <https://doi.org/10.1016/j.eswa.2023.120752>
- Niloofer , P., Lazarova -Molnar, S., Thumba , D.A., & Shahin, K.I. (2023). A conceptual framework for holistic assessment of decision support systems for sustainable livestock farming. *Ecological Indicators*, 155, 111029. <https://doi.org/10.1016/j.ecolind.2023.111029>
- Pambudi , NA, Nanda, IR, Wahyudi , & Suharno . (2025). Understanding knowledge, perception,

- and acceptance of geothermal energy among Indonesian students: Implications for sustainable renewable energy initiatives. *Sustainable Energy Technologies and Assessments*, 79, 104357. <https://doi.org/10.1016/j.seta.2025.104357>
- Poli, G., Cuntò, S., Muccio, E., & Cerreta, M. (2024). A spatial decision support system for multi-dimensional sustainability assessment of river basin districts: The case study of Sarno River, Italy. *Land Use Policy*, 141, 107123. <https://doi.org/10.1016/j.landusepol.2024.107123>
- Portuguez -Castro, M., & Ramírez-Montoya, M. S. (2025). Transformative Economies and Complex Thinking: Enhancing Sustainability Competencies in Business Education. *The International Journal of Management Education*, 23, 101223. <https://doi.org/10.1016/j.ijme.2025.101223>
- Razzaq, A., Khan, Z.A., Riaz, M., & Pamucar, D. (2025). Sustainable decision support system in Industry 4.0 under uncertainty with m-polar picture fuzzy information aggregation. *Alexandria Engineering Journal*, 116, 271-295. <https://doi.org/10.1016/j.aej.2024.11.104>
- Ribeiro, J. M. P., et al. (2021). Green Campus Initiatives as sustainable development dissemination at higher education institutions: Students' perceptions. *Journal of Cleaner Production*, 312, 127671. <https://doi.org/10.1016/j.jclepro.2021.127671>
- Scholz, J., Dilger, L. J., Friedmann, M., & Fleischer, J. (2023). A methodology for sustainability assessment and decision support for sustainable handling systems. *Procedia CIRP*, 116, 47-52. <https://doi.org/10.1016/j.procir.2023.02.009>
- Spada, I., Giordano, V., Chiarello, F., Martini, A., & Fantoni, G. (2025). Text Mining on Green Policies for Integrating Sustainability in Higher Education. *The International Journal of Management Education*, 23, 101126. <https://doi.org/10.1016/j.ijme.2024.101126>
- United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. <https://sdgs.un.org/2030agenda>
- Uzair, M., & Kazmi, S.A.A. (2023). A multi-criteria decision model to support sustainable building energy management systems with intelligent automation. *Energy and Buildings*, 301, 113687. <https://doi.org/10.1016/j.enbuild.2023.113687>
- Yousefi, S., Baqeri, M., Tosarkani, BM, Amin, SH, & Zolfagharinia, H. (2023). A decision support framework for sustainable production planning of paper recycling systems. *Computers & Industrial Engineering*, 183, 109500. <https://doi.org/10.1016/j.cie.2023.109500>