Decision Support Systems (DSS) in Higher Education System

Khalid A. Fakeeh, Ph.D
King Abdullaziz University,
Jeddah, Saudi Arabia

ABSTRACT

Decision Support Systems (DSS) are recognized in higher education for manifold reasons, for instance to conjugate data and intelligence, to pull off the unsurpassed and likely elucidations, and to fine-tune decisions under hesitation. Numerous issues has been pointed out here in decision support and decision support systems (DSS), best in class investigate in these fields, moreover their own specific studies in arranging a propelled higher education decision support system. In this research article we have described some of the past dedications in representing the modules of the DSS, taking in the present systems and databases of some institute, results and activities having a spot with its instructing/teaching and examination or research staff, students to help decisions for all the performing craftsmen caught in the procedures, in diverse explicit circumstances or settings.

Keywords

Decision Support System (DSS), Higher Education, Information Systems.

1. INTRODUCTION

Due to greater than before rivalry in higher education settings, the universities espoused modern Information and Communication Technologies (ICT) with the endeavor of carrying out eminence learning processes. They map to utilize more professionally the collected data, build up tools so that to accumulate and direct management information, in order to hold up managerial decision making. The collected data could be brought into play to weigh up superiority, carry out investigation and diagnoses, appraise steadfastness to the principles and practices of curriculum and syllabi, and put forward options in decision processes. Administering workload of faculty staff has constantly been a complicated charge. Their work is autonomous and for that reason not easy to map and determine. To get done that job managers require judicious, consistent and absolute information about allocation of workload to faculty. Managers are accountable to deal out work to faculty in the well-organized manner and to endow faculty with satisfactory reparation. The information about academic workload is more often than not distributed among diverse departments and information systems. Even if this information is shared, it is still somewhat a defy to bring into play it in a manner that can be ready to lend a hand to university administration. Getting around scientific impediments is by and large the easier part. The tricky part is taking on the rules from university regulations and policies, which endow with the absolute synopsis of academic workload for the managers. An assignment of a propelled instruction establishment (Higher Education) is to get prepared

work power to the most hoisted measure of data/knowledge around them in history [Marga 2007]. Educational Institutes and Universities should not be just a fair setting, yet rather the spot in which to make and offer data, an inventive and profitable entertainer regarding the fiscal, administrative, and social environment. The sponsorship got by the decision takers, whether they are top chairmen, executives set on differing levels like Rectors, Deans, specialists and distinctive teammates lies basically in helping them to thrashing the purposes of repression of data/knowledge as to the issue, possible decisions for actions and methodologies for examination brought into play as a piece of the decision [Ghisoiu et al, 2009]. The decision making process in an affiliation or business should be organized and decided in a broad, trustworthy, and clear way [Shimizu et al, 2006]. Executives organized with information about their essential various leveled social orders, interrelated with the data trade, can modify their understanding organization methods to make their affiliations more successful, and to survey and move ICT (Information and Communication Technologies) in suitable systems. Valuable and all that much timed decision making is most important in the accomplishment of any affiliation/organization. They require successful utilization of decision support devices to tastefully exhort the decision method, furthermore other appealing qualities, for instance, imaginative vitality and ingenuity [Ghisoiu et al, 2009]. An affiliation's or an establishment ability to take awesome decisions is for the most part vital despite creating overall competition, and the greater insecurity from presentation to a further number of contenders. Higher Education (H.E) establishments, like the relationship from fiscal/economic locales, are resisted as of late with extending pressure to upgrade the way of education strategies and management, yet with different highlights specific to scholastics. There should be considered the higher education (university) self-sufficiency, even in budgetary issues or diverse structures as showed by open and educational commitments. Appropriately, universities look to apply more the amassed data, put more resources in devices that allow them to assemble and manage information particularly, and incorporate demonstrating staff, students and neighborhood aggregate in decision making strategies. [Bresfelean et al, 2009] is an extension of latest studies and appropriations. Numerous concerns/issues have been obtained in the field of decision support and decision support systems (DSS), and best in class ask about in these fields.

2. DECISION SUPPORT SYSTEMS FOR HIGHER EDUCATION MILIEU

As we make out that education is one of the most significant defies all over the globe. The perspective is an all-inclusive state

of affairs in which institutes struggle for superior enrollment with each other. Now a day's, DSS are the most well-organized tool to deal with any sort of circumstances, where the decisions are mandatory to be in use resourcefully. The task of deciding passes through all secretarial organizations, in particular education. Decision-making is a most important liability of all school managers. Decision-making as an incredibly essential obligation of manager can be defined as the getting and scrutinizing of pertinent information about managerial predicament, for the reason of making the most appropriate selection among alternative choices of actions. An understanding of the decision-making process is critical to all Higher education managers, for the reason that the education sector, like all prescribed organizations, is on the whole a decision-making structure. Even though, the intensity and temperament of decisions may possibly differ in a number of ways, there will for all time be desires to construct precise decisions within a particular state. It appears very important then that every higher education manager makes stipulation for decision making; decisions needs to be rendered incessantly. DSS's is the area of Information Systems (IS) discipline that is paying attention on holding up and civilizing managerial decision-making [Arnott et al, 2005]. DSS has stimulated from a deep-seated progress that altered the way information systems is perceived in higher education's, to a main stream IT progress that all organizations take on. A Decision Support System (DSS) is any tool brought into play to perk up the process of decision making in intricate systems, predominantly where information is indecisive or partial [Michael, 2005]. These systems are intended to lend a hand to mid-level and senior managers construct those complicated decisions about which not every pertinent parameter is identified [Sodiya, 2009]. There are a number of methods to DSS systems, each of which lend a hand to the process in a different ways. A DSS then grants decisions based on algorithms derived from an understanding of the application domain. As a result of a creating competition in cutting edge training circumstances, higher education institutes endeavor to apply frameworks and develop new-fangled instruments so to enhance the way of demonstrating and investigation practices and outfits the gatherings with appropriate knowledge and services. Decision aspects in all fields face dynamically asking for circumstances, over-weight with information, data passed on all through the organization, in regards to peril and unsteadiness. Propelled training establishments or universities experience the need of convincing decision reinforce instruments/tools to definitely prompt them, and help in each and every managerial system. Some informative structures have long had modules for decision backing, yet in a broad sense for the survey examinations of cash related and administrative data. One of the first ventures for the making of a DSS in cutting edge instruction would be to make legitimate academic logical instruments/tools to collect, arrange, and evaluate imperative data and information for capable decision making. Such tools, for case a profitable Management information system (MIS), would have the part to [Ghisoiu et al, 2009]:

2.1 Administer on hand activities

i.   Educational activities,

ii.   Processes,

iii.   Resources which take account of students, demonstrating and assistant staff, curricula, syllabi, and all secretarial services;

- Assemble data on education and investigation frames;

- Develop a cluster circumstance, screen its activities and calculate the accomplishment of its objectives;

- Present basic information to backing steady appraisal, and alternatives for execution;

- Offer feedback for reliable headway/development. Higher education institutes are at the heart of the gathering and similarly a joining bit of them, with key parts in direction, get ready, examination and diverse activities. This is the reason we consider that as a DSS planned for cutting edge training would need to be secured in on all the momentum data of the establishment, on the databases of the each one of its systems (informational, research and endowments, budgetary, accounting, eLearning gateway/portal etc.) [Bresfelean, Lacurezeanu et al, 2009]. In this manner, a coordination of the most latest examination realizes preparing authoritative issues should be basic, meanwhile as considering the significant undertaking of a higher education institute (university) as a generator of knowledge by method for demonstrating and investigation.

A DSS for cutting edge higher education ought to assemble information on each and every educational methodology, offer feedback to their change, and offer decision making sponsorship with high integration and direct association with all the zones of the issue. Propelled training or higher education executives would have tremendously key data and information at their handle, in a clickable structure, for smart examination and access in certain decisional condition. The Higher Education ICT based systems contain general perspectives with the design of fiscal structures, furthermore have different special highlights concerning: [Ghisoiu et al, 2009]

i.   The working and organization of enlightening establishments;

ii.   Academic self-guideline, even in monetary issues or diverse structures as demonstrated by open and educational commitments.

iii.   Universities are components that make novel learning/knowledge and hold up the close-by and overall gatherings.

iv.   Universities have central assignments in education, planning, investigation.

v.   International and close-by specific state of affairs.

A couple of sorts of decision making issues in the education system can be depicted as takes after [Ghisoiu et al, 2009]:

i.   Planning decisions for the ventures of study and curricula, which incite the establishment of curricula for whole deal guideline.

ii.   Strategic decisions:

- The curricula and syllabi clear for each specialization and year of study;

- Requirements for the accomplishments of the syllabi: specific frameworks, indispensable wander, programming, et cetera.

It is similarly crucial to add to an execution appraisal instrument/tools, with parts in the progression of cutting edge instruction establishments' activities, and the use of capable organization [Bresfelean, Lacurezeanu et al, 2009]. Appropriately, it could allow the assignments from the state spending arrangement which cover the crucial needs of the schools to be associated with how these needs are truly met both of the state conveyed trusts and from other income [Ghid privind finanŃarea]. The DSS, on whose layout we work, has 3 essential

modules: Students, Research and Teaching [Bresfelean, ImplicaŃii, 2008]. It is needed to backing in grouped decisional issues for university setup, to be material for its educational mission, planning and academic services offered to the gathering and society. The proposed Students module Figure 2 identifies with the results and activities of students, and serves as the reason for building and giving decisions in decision making on student' issues [Bresfelean, Lacurezeanu et al, 2009]. One of the anticipated Teaching modules has been depicted by [Bresfelean et al, 2009] in subsequent WSEAS published article includes the results and activities of teaching staff. The continue going module is in perspective of the Research practices and consolidates the execution achieved in trial research by the teaching, PhDs research staff and departments etc.
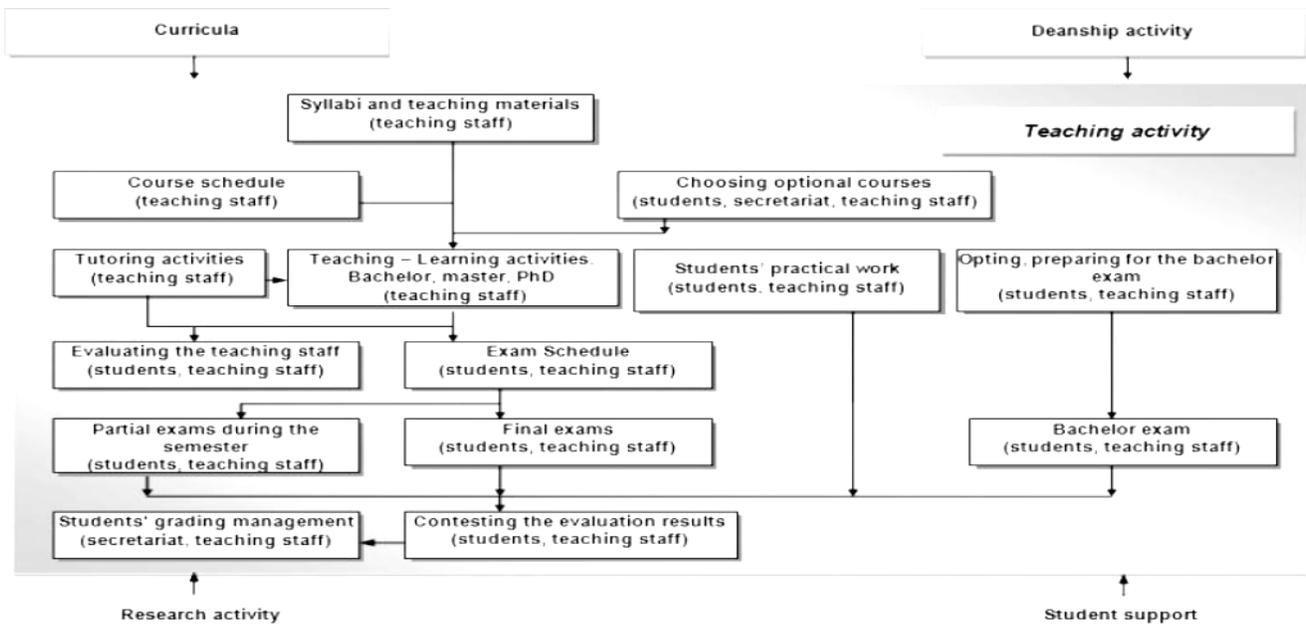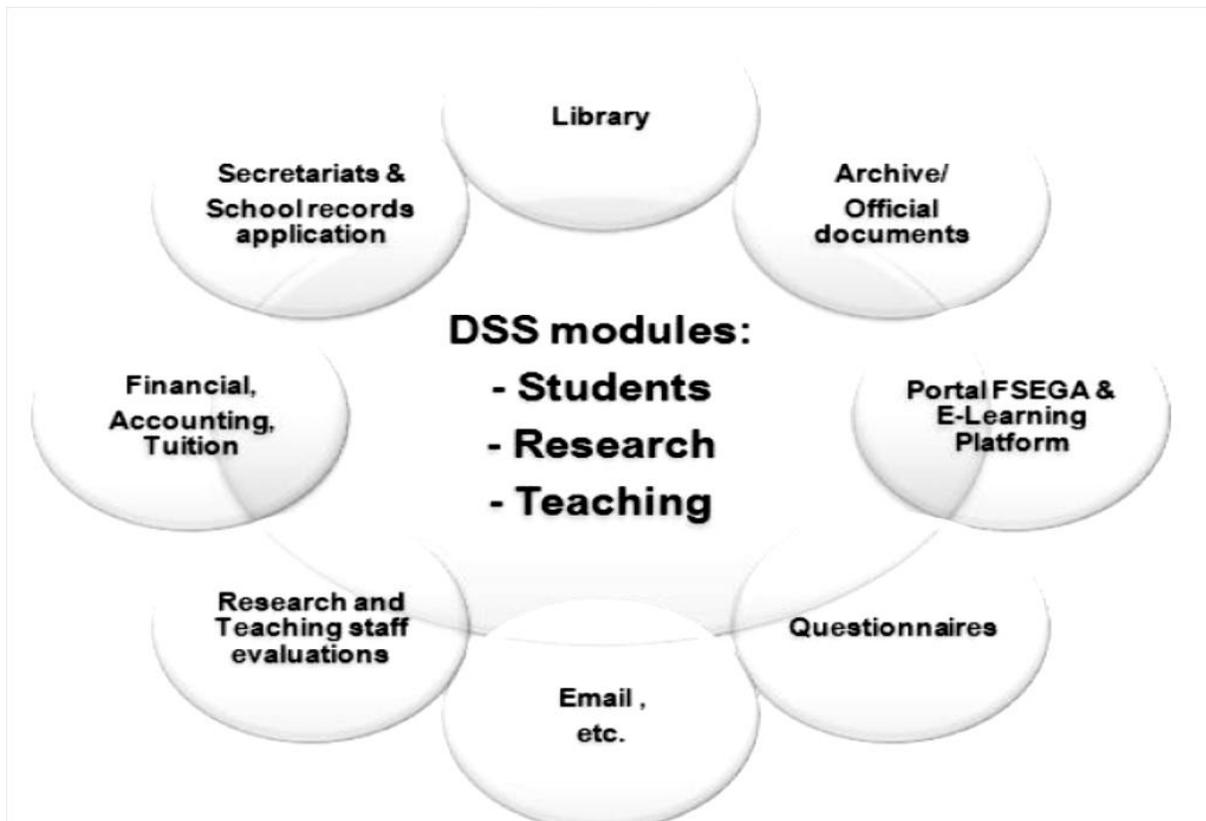

Figure 2: Teaching Activity Module: [Bresfelean et al, Tiron A et al, Vasile P.B et al]

Figure 3: DSS Modules and the on hand systems [Vasile P.B et al]

All modules rely on upon the inside frameworks of the concern institute (FSEGA system), with data differentiated from FSEGA and UBB systems and databases (Fig. 3): [Ghisoiu. et al 2009, Bresfelean, ImplicaŃii 2008]

- UBB and FSEGA systems:

  i. The examination activity management system

  ii. Library activity

  iii. Administrative activities structures (cash related, accounting et cetera.)

  iv. Application of managing school record.

  v. Web based assessment book

  vi. Portal and E-Learning Platform

  vii. Email

  viii. Application of research management

  ix. Application of fee management

  x. online and distance education (ODL)

- Academic quality evaluation from time to time

- Performance versus that of others assets/faculties or over the school/university

- Learning core interests or centers

- Appraisal of Research and lecturing staff

- Performance of research versus teaching

- Questionnaires and investigations of graduates, master degree and PhD understudies, directors, divisions;

- Unusual longitudinal studies et cetera

The fruition data can maybe brought into play for quality examination, to complete judgments and examinations on the demonstrations of the affiliation/organization and in management concerns. An explicit framework for the DSS [Vasile P.B et al, 2010] has been put forwarded so to offer the higher education managers crucial contraptions to help their exercises in decision making activities. These qualities would be accessible through the customer interface, screen outlines, menus, graphs, information and learning consolidated in the DSS. Things being what they are to be a the starting stage for building and giving choices and recommendations in decision making on educating learning, examination, curricula, syllabi, exam-evaluation issues et cetera. Thusly, the data, tables, graphs, outcomes of data extraction systems could be used to help decisions for all the "on-screen characters" (deanship, demonstrating and examination staff, understudies, secretariat, et cetera.) included in the strategies, in the resulting circumstances in the following table.

Table 1: DSS Modules and the on hand systems [Bresfelean et al, Vasile P.B et al]

DSS MODULE	Students Module	Teaching Module	Research Module
DECISIONAL SITUATIONS	• Students' enrollment • Studies reclassification • Tuition • Choosing a Specialization • Scholarships • Students dorms • Issue Certificates • Web information and announcements • Students' transfer • Expelling students • Interruption of studies • Extension of studies • 2nd or more specializations • Diploma exam in other institutions • Tutorial activities • Career Guidance	• Syllabi and teaching materials • Course schedule • Choosing optional courses • Tutoring activities • Teaching-learning activities • Students' practical work • Preparation for the bachelor exam • Evaluation of the teaching staff • Exam schedule • Partial exams during the semester, and final exams • Students' grading management • Contestation of the evaluation results • Bachelor final exam	• Scientific research evaluation, • performance issues and standards • Salary coefficients • Human resources strategy, • Job opening and interviewing for research positions, • PhDs activity and evaluation • Grants' continuation and management, et cetera.

Each modules is proposed to be facilitated with exchange modules of the propelled training DSS, and to go about all things considered. The last DSS framework model is under further change and development, and would be conformed to fit distinctive higher education institutes of adjacent and European and Gulf ranges.

3. DSS PREDICAMENTS

In field of academic or educational planning decision-making comprises far-reaching examination of outsized data volumes started off from manifold systems. Academic or educational workload administration is concerned with distributing teaching resources in order to passably hold up the university's educational agenda or structure (faculties, degrees, courses, admission policies, teaching workload et cetera). In the latest decades, across-the-board researchers' attempts have been made on accepting and formalizing the development of decision making all zones. One of the first portrayals of the structures qualified to support the activity was according to the accompanying [Kryssanov et al]:

• Information retrieval systems - are PC based structures/systems to catch, control, recoup and transmit dealt with data vital to settle a specialist task as demonstrated by bare essential trades described by a customer.

• Decision support systems (DSS) – are learning based (Knowledge-Based) information structures to catch, handle and separate information which impacts or is required to impact decision making performed by people in the degree of a specialist task assigned by a customer;

• Expert systems - are learning based (Knowledge-Based) structures to be utilized as opposed to or together with an individual to settle on decisions in the structure of a specialist undertaking with elucidations for customers.

Late examination on decision support and expert systems has moved from considering these as independently symptomatic gadgets for looking over best decision different options for seeing them as a more careful environment for supporting gainful information changing considering a predominant cognizance of the issue setting [Gupta et al, 2006]. DSS handle distinctive definitions [Filip 2005], yet it is, all things considered, that they are created to bolster decision strategies/process and help to recognize and determine issues [Ghisoiu et al, 2009]. DSS symbolize a specific class of information systems expected to help customers which rely on upon data, in an extent of decision making positions to handle the accomplished issues that matter for the affiliation's or organization affluence [Filip 2005]. A basic point in most ordinary in all DSS definitions is that DSS genuinely insinuate 'applications that are proposed to support, not supplant, decision making' [Bendoly, 2008]. Cutting-edge portrayals of DSS [Power D.J, 2003] are considering the principle advancement that chooses the characteristics of the decision making Some DSS are hybrid structures driven by more than one critical fragment. [Kacprzyk et al, 2007] talk about moreover the Group DSS and Web based and Inter-organizational DSS. They can be immediately depicted as the following:

Data Driven DSS: Accentuate access to and control of inward association data and sometimes outside data, and may be based – from the low to high state – first on fundamental report/file systems with inquiry and retrieval tools, then data ware houses, finally with On-line Analytical Processing (OLAP) or data mining instruments.

Communication Driven DSS: Bring into play framework and exchanges progressions to support collaboration and correspondence.

Group DSS: It is an insightful, PC based structure that support course of action of unstructured issues by a plan of pioneers chipping in as a get-together.

Document Driven DSS: fuse a collection of limit and taking care of progressions for a complete report recuperation and examination; records may contain numbers, text, and media.

Model Driven DSS: Accentuate access to and control of a model, e.g., authentic, cash related, improvement, and/or amusement; use data and parameters, yet are not when in doubt data concentrated.

Knowledge Driven DSS: are smart structures with specific issue understanding authority containing data about a particular space/zone, perception of issues inside that zone, and fitness at handling some of these issues.

Web-Based DSS: is an electronic structure that pass on decision support related information and/or instruments to an executive/master utilizing a "thin client" Web program (Explorer); TCP/IP protocol, et cetera.

A decision issue is accessible when the irregularity between the current situation and the target condition can be diminished and/or overcome through assorted outlines [Grünig et al, 2005]. There are different by and large diverse courses in which the pioneer/maker can make sense of which step should be taken, and how the decision can be moved closer [Grünig et al, 2005]:

- Solely characteristically devoid of minute indication about the issue.

- Through routine reaction to strategies utilized as a part of the past.

- By accepting unquestioningly the plans suggested by pros.

- By picking erratically.

- On the reason of exact sensible thought supported by pertinent information.

The reason of DSS is to give the instructive bolster expected to decrease the effects of cutoff focuses and repressions faced by human pioneer every single through hey works out. Propelled investigation of the decision making systems displays a rate of the variables that can add to productive decisions [Shimizu et al, 2006]:

i.   *Responsibility and Transparency* – there are laws and disciplines to be respected by the individuals or relationship in decision making philosophies.

ii. *Expertise* – each decision should be created in the noteworthy data/knowledge of an expert.

iii. *Coordination* – the best decision options are lacking if there is no synchronization to transmit the solicitations that should be taken after and to manage the decision making process.

iv. *Economy Factor* – a decision can have a negative result or a singular battle can be lost, however broad a conventional sense in decision making can help to make up for the passing of a couple of encounters.

v.   *Time* – a wealth of time acts with an influence like the economy component, allowing decision components to sit tight for perfect open entryways.

vi. *Consensus or negotiation* – when there is a brain boggling level of an issue, a more created examination of the issue and game plan among the get-togethers concerned is mandatory.

Another connecting with approach to manage decision making game plans (Processes) is through intricate instruments/tools that are utilized to dismember decisions and offer senior organization bunches a technique for dispensing parts and including the germane people. RAPID decisional model characterized by [Rogers, 2006] focuses on the going hand in hand with thought: 'The key is to be clear who has information, which gets the chance to pick, and who performs it'. The five letters in RAPID identify with the five unequivocal decision making parts: recommend, agree, perform, input, and decide. The parts are not finished lockstep in a particular request, for the reason that the makers took the flexibility for the purpose of creating a useful acronym.
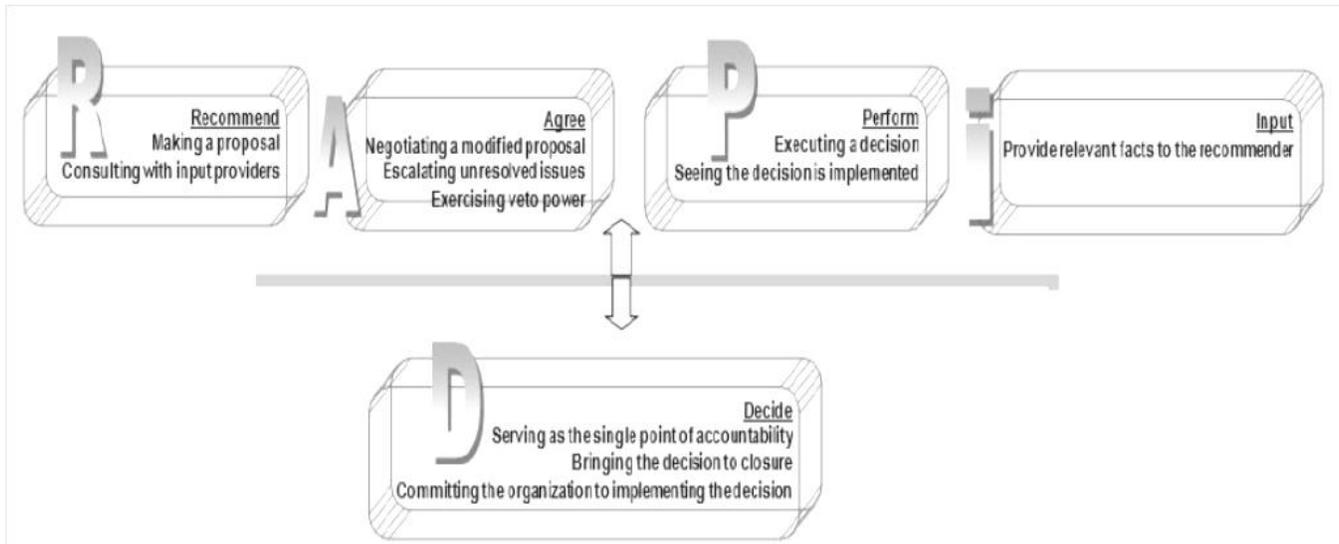
Figure 4: RAPID Decisional Model [Vasile P.B et al]

A rate of the characteristics and favorable circumstances of DSS's can be depicted as takes after [Bendoly, 2008]:

Distinctive aspects:

- Eased Access to unrefined passed on data; routinely updated in close real-time

- Facilitated Analysis of data consistently through use of modernized understanding.

- Rich Communication of results and novel considerations in an essential and utilitarian structure, as often as possible extended by complex graphical outlines.

Widespread Targeted Benefits:

- Worker Empowerment

- Abridged outlay

- Better Partner contentment for both clients and dealers

- Superior Strategic gain

- Reduced Lead-Time to carry out work

- Improved Originality

- Privileged Maintenance

- Superior Stability

- Smarter Response to changes/ dissatisfactions

An additional capability ought to be drawn among periods of improvement of the support headways for decision making. A couple of experts [Kryssanov et al] verified that any idea concerning the headways, to be feasibly put into organization, should have an adequate embodiment on each of these three levels of issue attentiveness: prescribed and recognized Specification, design and Implementation & maintenance.
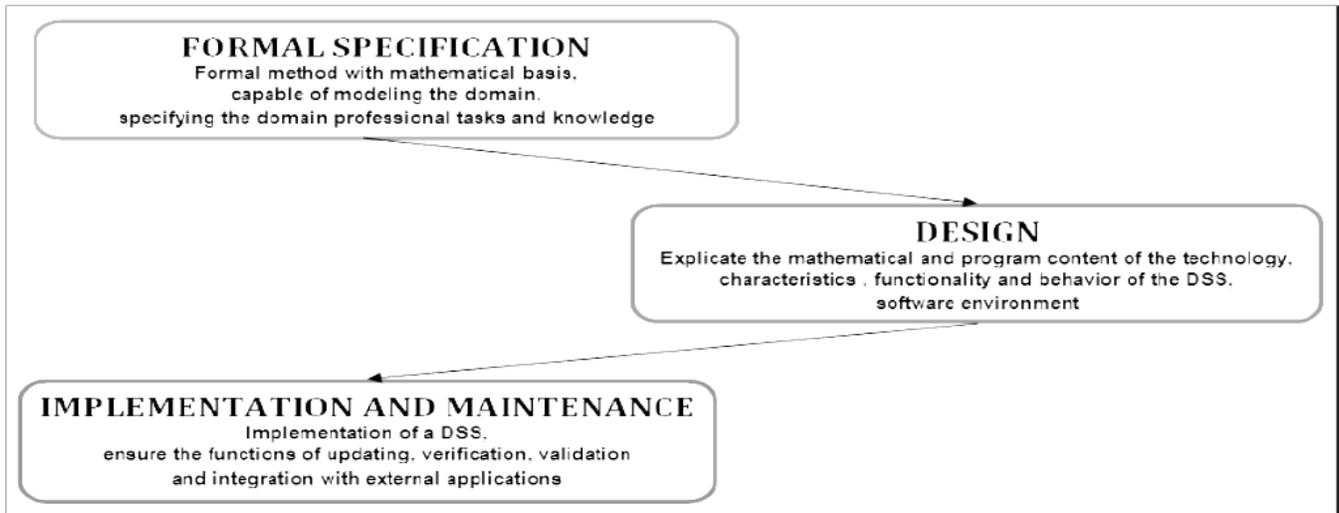
Figure 5: Attentiveness concerns, levels and technologies in DSS conception [Kryssanov et al, Vasile P.B et al]

DSS can go from a system to answer direct inquiries that allow a resulting decision to be made, to a structure that gives separated addressing over a scope of related datasets, and further to obfuscated structures which particularly "answer" addresses, particularly strange state 'envision a situation where' circumstance showing [Rippen, 2005]. The examination of interest and upgrade advances bolsters the progression of DSS in an expansive number of usages across over industry, business, science and government [Burke et al, 2005], with a discriminating level of contrasts among change and computational request applications. Relationship, for instance, higher education institutes, can continually deal with the issue of how to make use of a far reaching mixture of information resources and how to make this information open to the gathering [Van Leeuwen et al, 2005]. Decision reinforce locale has gotten discriminating thought from made specialists transversely over an extensive variety of academic requests, including transport booking, bioinformatics, personnel roistering, restorative/medical decision support and timetabling [Burke et al, 2005]. Front line research [Van Leeuwen et al, 2005] in DS and DSS for money related zones, take in:

- E-management models that join strong participatory decision making practices and quality organization/management pointers in the insightful world (Education) [Hashim et al, 2009],

- Implementation of mechanized/digital media to allow all around taught synergistic decision making - logical examinations of gathering enthusiasm for range usage orchestrating [Pettit et al, 2005],

- Platforms that support joining and interoperability of various data sources concerning social, economic, and physical parts of the urban milieu [Parolin et al, 2005],

- Development of on-line planning support systems in the association of open venture [Shen et al, 2005],

- Systems that endeavor parts of cellular automata and describe models for organized cell agents [Vizzari G

et al, 2005],

- Decision support in raised thought drug [Gago et al, Santos et al 2009] et cetera.

4. SUMMARY
In the present day we can say with extreme confidence that the expansion and incorporation of a DSS with the higher education or university ICT systems will accomplish an abridged outlay or cost and time required to determine imperative concerns of outlining and taking on the most fitting decisions, for the distinctive complications or impediments of higher educational systems. The arranged Decision Support System would be appropriate and apt fitting for the school's enlightening mission, innovative investigation, and latest gathering of data, academic organizations offered to society and gathering, which is a key mission for national, European and Gulf (GCC) propelled instruction establishment (Higher Education). Its structural design is under further headway and progression and would be extended to diverse scopes of a front line higher education institute fiscal, open and all inclusive relations, association, new capacities required by the work market et cetera. The headway and integration of a DSS with the higher education institute Information and Communication Technology structures may possibly settle on a compact outlay and time anticipated that would focus key issues of drafting and grasping the most fitting decisions, for the higher educational systems delegate involvedness.

5. REFERENCES
[1] "A.S. Sodiya (2009)", Information Systems, A Course Guide for National Open University of Nigeria

[2] "Arnott, D et al", "A critical analysis of Decision Support Systems research" Journal of Information Technology, 20, 2, June, 2005, pp67-87.

[3] "Vizzari G et al, Crowd Modeling and Simulation, in Recent Advances in Design and Decision Support Systems in Architecture and Urban Planning, Springer Science and Business Media, 2005, p.161-176

[4]   "Parolin et al"., A Spatial Decision Support System for the Management of Public Housing, in Recent Advances in Design and Decision Support Systems in Architecture and Urban Planning, Springer Science and Business Media, 2005, p. 69-84

[5]   "Bendoly.", Excel Basics to Blackbelt. An Accelerated Guide to Decision Support Designs, Cambridge University Press 2008

[6]   "Bresfelean et al"., DSS Module for Teaching Staff Activities, Recent Advances in E-Activities, Information Security and Privacy, WSEAS Press 2009, p. 292-296

[7]   "Ghisoiu N et al"., Sitar-Taut D.-A., Towards the Development of Decision Support in Academic Environments, Proceedings of ITI 2009, Cavtat, Croatia, 2009, p. 343-348

[8]   "Bresfelean et al"., Decisions and the Implications of Information Technologies in Academic Environments, Proceedings of EDULEARN09, Barcelona, 2009

[9]   "Ghisoiue et al.", Designing a DSS for Higher Education Management, Proceedings of CSEDU2009, Lisbon, Portugal, 2009, p. 335-340

[10] "Bresfelean., ImplicaŃii" ale tehnologiilor informatice asupra managementului institutiilor universitare, Ed. Risoprint, Cluj-Napoca, 2008

[11] "Burke et al"., Search Methodologies. Introductory Tutorials in Optimization and Decision Support Techniques, Springer Science and Business Media, 2005

[12] 'Filip"., Sisteme suport pentru decizii, Editura Tehnica, Bucuresti, 2005

[13] "Forgionne G.A"., "An Architecture for the Integration of Decision Making Support Functionalities, Decision Making Support Systems: Achievements, Trends and Challenges for the New Decade, Idea Group Inc., 2003

[14] "Gago P et al", Closed Loop Knowledge Discovery for Decision Support in Intensive Care Medicine, Recent Advances in Computers, 13th WSEAS International Conference on Computers, WSEAS Press, p. 447-452

[15] "Grünig et al"., Successful Decision-making. A Systematic Approach to Complex Problems, Springer-Verlag Berlin Heidelberg, 2005

[16] "Gupta J et al"., Intelligent Decision-making Support Systems. Foundations, Applications and Challenges, Springer-Verlag; 2006

[17] "Hashim et al"., Ensuring participatory based decision-making practice in Higher Education through E-management: A faculty initiative, Recent Advances in E-Activities, Information, Security and Privacy, WSEAS Press 2009, p.280-285

[18] "Kacprzyk J et al''., Towards Human-Consistent Data-Driven Decision Support Systems via Fuzzy Linguistic Data Summaries, in Perception-based Data Mining and Decision Making in Economics and Finance, Springer-Verlag; 2007.

[19] "Kopackova et al"., Sedlak P., Decision making with textual and spatial information, WSEAS Transactions on Information Science and Applications, Volume 5, Issue 3, March 2008, p. 258-266

[20] "Kryssanov et al", A Decision-Making Support System Based on Know-How, arXiv e-print service, Cornell University, arxiv.org/pdf/cs.CE/0606010

[21] "Marga, A"., Schimbare, codificare, competitivitate (proiect managerial), UBB Cluj-Napoca, Dec. 2007

[22] "Michael Rippen (2005)". Tessella Support Services Plc, Issue V2.R.M0.

[23] "Panian Z"., Just-In-Time Business Intelligence and Real-Time Decisioning, in Recent Advances in Applied Informatics and Communications, Proceedings of AIC '09, WSEAS Press, 2009, p.106-111

[24] "Pettit et al"., Cartwright W., Using On-Line Geographical Visualisation Tools to Improve Land Use Decision-Making with a Bottom-Up Community Participatory Approach, in Recent Advances in Design and Decision Support Systems in Architecture and Urban Planning, Springer Science and Business Media, 2005, p.53-68

[25] "Rippen", Decision Support Systems, Tesella Scientific Software Solutions, Issue V2.R1.M0, October 2005

[26] "Rogers P et al"., Who has the D? How Clear Decision Roles Enhance Organizational Performance, Harvard Business Review, January 2006

[27] "Santos et al"., Nursing Information Architecture for Situated Decision Support in Intensive Care Units, in Recent Advances in Applied Informatics and Communications, Proceedings of AIC '09, WSEAS Press, 2009, p.491-496

[28] "Shen Z.J et al"., Visualization of Usable Building Space According to Planning Permission Ordinances for Public Participation in District Plan in Japan, Introduction in Recent Advances in Design and Decision Support Systems in Architecture and Urban Planning, Springer Science and Business Media, 2005, p.85-98

[29] "Shimizu et al"., Strategic Alignment Process and Decision Support Systems: Theory and Case Studies, Idea Group Inc., 2006

[30] "Van Leeuwen et al". , Introduction in Recent Advances in Design and Decision Support Systems in Architecture and Urban Planning, 2005 Springer Science + Business Media, Inc.

[31] Facultatea de Stiinte Economice si Gestiunea Afacerilor, Propuneri pentru Proceduri interne, Tiron A. (coord.), Crisan E., Bresfelean V.P et al., www.econ.ubbcluj.ro

[32] "Ghid privind finanŃarea sistemului de invatamant din Romania, www.competition.ro/documente/en/publicatii_Nota 20invatamant2060606.pdf

[33] "Vasile P.B et al", "Higher education decision making and decision support systems", November 2010