DSS For Academic Resource And Capacity Management

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Abstract

Growing complexity of the data and processes to be managed, as well as the transition from strict governmental regulation towards autonomy makes academic institutions a significant consumer of advanced software solutions. Strategic management requires a comprehensive analysis of large data volumes from heterogeneous sources, often imprecise and incomplete. With the many new technology application areas evolving from the domain of electrical engineering, computer engineering, and computer science, deans and department chairs must ensure that new specializations and programs are adequately supported. Academic workload management is concerned with distributing teaching resources to support the university's educational framework adequately (faculties, degrees, courses, admission policies, teaching workload, etc).

The main objective of this paper is to present a methodology for Academic resource Capacity Management and planning its distribution and utilization. The system extracts data from multiple systems and integrates into single repository to provide a data basis for querying and computations. Graphical visualization of output produces by dependencies in the data.

From the existing information systems and from the hottest educational issues that we were generally facing every day, I have first attempted to implement simulation models for handling the educational resource management by the use of advanced Information Technology on formulating the general principles and approaches of the model-based DSS for academic environments. This work based on Methodology proposed by Svetlana Mansmann and Marc H.Scholl in 2007.

The contribution of the project is threefold:

- ***To propose the methodology for assessing the educational capacity,***
- ***Utilize the resources inside the college at maximum level.***
- ***Calculate Faculties Individual contribution.***

1. INTRODUCTION

Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities. DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make

decisions. Decision-making in academic planning involves utilization of large data volumes originating from various sources.

Academic resource planning is a highly complex administrative procedure based on extensive analysis of large volumes of data related to the educational framework, such as teaching resources, offered degrees, course structure and curricula, enrolment and retention, etc. Faculties are confronted with the necessity to reengineer the curricula of the offered study programs periodically or even design new curricula to keep pace with rapidly changing educational requirements.

The goal of my project is to propose a more comprehensive framework for assessing the university's resources in form of a DSS for academic policy makers.

Major tasks of the systems are defined as follows.

- Input data is extracted from multiple systems. Integrated into single repository to provide a data basis for querying and computations.
- Every student and faculties have separate account for accessing centralized server to get information's whatever they need.
- Administrator has all rights to control the department. His work includes assign subjects to faculties, edit information related to students or faculties.
- Decision-making process is supported primarily by means of intelligent presentation of the retrieved or computed data and by providing options for its explorative analysis.
- Utilize the resources in the college at maximum level. Workload management is represented in graphical format. It is easy way to view and re-arrange resource workload.

2. RELATED WORK

In the 1980s, the academic decision theory focused mainly on formulating the general principles and approaches of the model-based DSS for academic environments [2]. Various academic DSSs were proposed for handling problems, such as resource allocation [3],[4], performance assessment [5], workload management [6], course scheduling [7], admission policy [8], student profile evolution [9], and strategic planning [10].

In the 90-ies, there was a renewed enthusiasm in developing software solutions for academic domain. Decision support and expert systems were offered in the fields of course/exam/instructor scheduling, program assessment, resource allocation, admission policies, managing university funds, academic advising, and strategic planning.

3. METHODOLOGY

3.1 Curricular Value

The academic capacity utilization is all about providing and consuming curricular activities. The overall educational capacity is the total of the capacities of all offered courses. Each course is characterized by the volume measured in TPW (Number of Academic periods per week of Teacher) and the support relation (N) limiting the number of course participants. The TPW of each course type T are translated into the TPW of the teaching load by weighing the former with an adjustment coefficient adj_T, ranging between 0 and 1, which expresses the course's preparation-

intensiveness on behalf of the teaching staff. Therefore, the teacher-hours-per-student cost of some course C of type T with support relation N, called the course's curricular value (CV), can be estimated by calculating equation 1.

$$CV_C = \frac{TPW_C \; X \; weight_T}{N_C} \qquad (1)$$

3.2 Total Contribution

Curricular value of some particular degree is thus the total of the CVs of all the courses specified in the respective curriculum, representing the necessary number of teacher periods per-student necessary for completing that degree. Table I. Shows an example of estimating the CV from the degree's curriculum. Such per-faculty portions in the total degree's CV are called faculty's total contributions (TC) within a degree.

3.3 Faculty Demand

Intuitively, a convenient overview of all faculty/degree interactions is achieved by arranging the TC into a matrix with faculties as columns and degrees as rows. Each cell [d, F] thus describes faculty's TC in degree.

For a single semester, the per-student demand value in any matrix cell [d, F], divided by the length of degree d in semesters, and multiplied with number of enrolments in that semester, describes d's demand with respect to faculty F. Faculty demand is calculated by equation 2.

$$demant_d^F = \frac{TC_d^F}{\#semesters_d} X \#enrollments_d \qquad (2)$$

3.4 Workload Utilization

The ratio between F's total demand and the available teaching resources measured in TPW describes the faculty's teaching capacity utilization. Capacity utilization is calculated by using equation 3.

$$CapUtilization^F = \frac{\sum_{all} d^{demand^F} d}{Teaching\ Load^F} \qquad (3)$$

3.5 Faculties Individual Contribution

Administrator can analyze the Faculty's Individual Contribution in their respective department as well as in other departments. From this analysis, administrator can come to know whether the faculty is occupied in his principal department or working for other department.

In this work three columns has been taken, Disciplinary relationship, exports and Inter-disciplinary relationship.

- Disciplinary relationship: It is the relationship when a faculty is working for his principal department in which he is deputed .i.e: faculty's curricular contribution in his own department.
- Exports relationship: It is the relationship when a faculty is working for other than his principal department and is not sharing the particular teaching load with any other faculty.ie: faculty's contribution in different departments.
- Interdisciplinary relationship: It is the relationship when a faculty is working for other than his principal department and is sharing the particular teaching load with any other faculty.ie: faculty's contribution in different departments partly.

Faculty total contribution can be calculated by summing up disciplinary, exports and inter disciplinary relationship contribution values shown in equation 3 and administrator gets Faculty's total contribution.

Faculty Contribution = Disciplinary + Exports +Interdisciplinary (4)

4. ANALYSIS AND DISCUSSION

Table I
Curricular Value of Study Program

Semester	Course title	TPW	Support relation	Offered by Faculty	CV
1st	Engineering Maths	2.0	12	Commerce	0.16
	Advanced Analog & Digital Circuits	1.0	2	Electronics	0.5
	Semiconductor Devices	1.0	2	Electronics	0.5
	…	….	….	….	….
2nd	Mat Lab	2.0	2	Electronics	1.0
	Electrical systems	1.0	2	Electronics	0.5
	….	….	….	….	….
3rd	Life Sciences	1.0	11	Commerece	0.09
	VLSI Design	1.0	16	Electronic	0.06
	….	….	….	….	….
….	….	….	….	….	….
6th	Computer Application	1.0	2	Comp Sc.	0.2
	Computer Network	2.0	11	Electronics	0.08
Total Curricular Value (M.Sc. Electronics)					3.001

I have calculated the Curricular value of study program e.g. (MSc Electronics), shown in Table I, where We get the curricular value for each subject by using equation(1).

Table II. Shows the Exports/Imports relationship within University, where administrator can analyze the interaction of faculties with respect to degree. Calculated values are Total Contribution (TC) value of each faculty.

Table II

Exports/Imports Relationships within a University

Degree Faculty		Electronics	Comp. Sc.	Commerce	Economy		Total
Electronics	CS1,Dipl.	1.50	0.20		0.02		2.55
	CS1,T.E.D	2.05	0.07				2.12
	Cs1, T.E.D	0.55					1.82
Comp. Sc.	Inf.Eng. B.Sc.	0.04	2.33		0.03	…	2.60
	Inf.Eng. M.Sc.		1.41				1.85
	Comp.Sc., T.Ed.	0.04	1.80				2.25
Commerce	Commerce, Dipl.	0.30		5.11			6.44
	Commerce, B.Sc.	0.17	0.02	2.97		…	4.02
	Commerce, M.Sc.			1.85			2.25
Economy	Economics, Dipl.	0.92	0.02		2.43		3.40
	Economics, T.Ed.	0.74	0.01		2.11		2.74
	Economics, B.Sc.	0.80	0.04		2.56		3.05
	Economics, M.Sc.	0.06			1.40		1.74
Interdisciplinary	Inf.Management, B.Sc.		1.72		2.12	…	2.84
	Inf.Management, M.Sc.		0.90		1.65		1.50
	Life Sciences, B.Sc.	0.02	0.02	2.78			4.55

Table III. Shows Faculty Individual Contribution where Administrator can analyze whether faculty is occupied in his respective department or taking load of other department.

Table III
Faculty Individual Contribution

Sr. No.	Subject-Id	Subject Name	CV value	Department
1	1069	Business Information	0.10	Commerce
2	1148	Info Technology	1	Computer Sc.
3	1149	Marketing Management	1	Commerce
4	1073	IT Management	0.100	Computer Sc.
5	1137	Marketing	0.25	Commerce
6	1151	Marketing Research	0.166	Commerce

Administrator can also see in which department the faculty is occupied. As per load shared, he can rate the faculty. I have calculated curricular values of

faculty in disciplinary, exports and interdisciplinary study program by using equation (4).

Experimental Results shows that administrator can analyze the demand of each faculty from the calculated value by using equation (2). If value is high then Administrator can conclude, that faculty is of high demand in university. Calculation of Faculty Capacity Utilization, administrator can analyze the faculty is overloaded or under loaded.

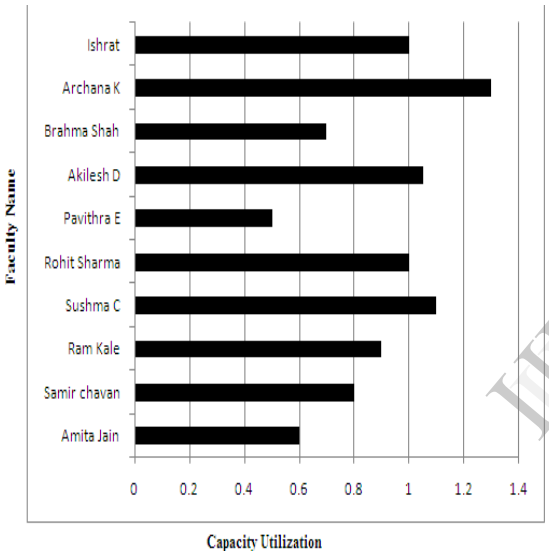

Fig.1: Analyzing the resulting capacity utilization ratios of the faculties in a user-defined scenario.

Fig 1. Is the screen shot of bar chart of capacity utilization ratios of the faculties in a user-defined scenario. Three ratios defined in the figure 0.8(min), 1.0 & 1.1(max). Result shows that some faculty have a ratio less than min where administrator can conclude that particular faculty has less work load. Max value determines that faculty is overloaded. Ratio 1 indicates balanced load of faculty.

5. CONCLUSION AND FUTURE WORK

The work focuses on problem to offer reliable decision support to the process in order to balance educational demand and supply in the universities. Result of Faculty Individual Contribution helps Administrator to analyze backup, to find out faculty of key importance in the university and rate them on the basis of importance.

Analyzing the resulting capacity utilization ratios of the faculties, administrator can judge which faculty is overloaded or under loaded, administrator can decide and balance the load of Faculty.

The future work will be directed towards re-fining the methodology and powerful interactive visual analysis and exploration of the accumulated data.

6. REFERENCES

1. Svetlana Mansmann and Marc.H.Scholl," Decision Support System for Managing Educational Capacity Utilization",IEEE Transaction on Education,vol50,No.2, May 2007.
2. S. K. Kassicieh and J. W. Nowak, "Decision support systems in academic planning Important considerations and issues," Inf. Process.Manage., vol. 22, no. 5, pp. 395–403,1986.
3. C.A. Casper and M. S. Henry, "Developing performance-oriented models for university resource allocation," Res. Higher Educ., vol. 42, no. 3, pp. 353–376, Jun. 2001.
4. S. Vinnik and M. H. Scholl, "UNICAP: Efficient decision support for academic resource and capacity management," in

Proc. Int. Conf. E-Government:Towards Electronic Democracy (TCGOV), Bozen-Bolzano, Italy, 2005, pp. 235–246.

5. D. Z. Deniz and I. Ersan, "Using an academic dss for student, course and program assessment," in Proc. Int. Conf. Engineering Education (ICEE), Oslo, Norway, 2001, pp. 6B8-12–6B8-17.
6. D.Z.Deniz, M. Uyguroglu, and H. Yavuz, "Departmental workload administration using group forecasting in universities," in Proc. Int. Conf. Engineering Education (ICEE), Manchester, U.K., 2002 [Online].
7. S. B. Deris, S. Omatu, H. Ohta, and P. A. B. D. Samat, "University timetabling by constraint-based reasoning: A case study," J. Oper. Res. Soc., vol. 48, no. 12, pp. 1178– 1190, Dec. 1997.
8. A. A. Elimam, "A decision support system for university admission policies," Eur. J. Oper. Res., vol. 50, no. 2, pp. 140–156, Jan. 1991.
9. V. M. Borden, J. F. Dalphin, and L. Carson, "Simulating the effect of student profile changes on retention and graduation rates: A markov chain analysis," presented at the 38th Annu. Forum Association for Institutional Research,Minneapolis, MN, May 1998.
10. Y. Barlas and V. G. Diker, "A dynamic simulation game (UNIGAME) for strategic university managements," Simulation & Gaming, vol. 31, no. 3, pp. 331–358, Sep. 2000.