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Consideration is given to a computer technology approach for studying and developing the best utilization pattern for any complex of academic facilities. The approach basically involves simulating a variety of possible class schedules and then decisively implementing the one schedule that best approximates the existing standard for utilization and that best supports the institution's academic program. Use of computer simulation methodology allows for manipulation of a number of factors with rapidity and ease, therefore, one may maneuver detailed inventory data in order to forecast a variety of heuristic alternative sets of room assignments for achieving optimal utilization of existing facilities. (FS)

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A "WHAT IF" APPROACH TO ACADEMIC FACILITIES UTILIZATION

The first step in effective academic facility planning is knowing with some precision, what is the existing inventory of facilities and, in particular, just how those facilities are being utilized. If these data are valid, the basis for decision making is established. Planning and construction, or reconstruction, of required facilities may commence and progress.

Those who are aware of the current methods and procedures for achieving required academic facilities in the State of Wisconsin agree that the inventory of physical facilities for higher education in this state is one of the finest. There is also agreement that this inventory may be refined further and its validity advanced. Our consensus is that Wisconsin's academic facility inventory has developed enough precision so that we have an excellent start for sound facilities planning. I am not sure we can simply say the same for our techniques of evaluating the utilization of our inventcried academic facilities.

What is problematical is not the methodology of gathering utilization data or even the measures of facility use, such as weekly-student-contact-hours or room-periods. What is questionable appears to be the adequacy of existing utilization criteria. How are the criteria to be refined; what should be their numerical values, how are utilization criteria researched, developed and evaluated? Even now, if we accept the suitability of the current utilization criteria for facilities planning use, we would like to determine better procedures for making sure they are met. Pointedly, we ask what is the best procedure to insure adequate facilities utilization in all of our institutions of higher education. These kinds of questions should be asked and they are answerable.

I would like to speak about one approach we, in the State Universities, must look to in our effort to provide the answers. The approach itself is not so new, but what is new is the way we choose to develop it as a workable procedure for enhancing facilities utilization. The approach we are developing, in fact, asks another question, a "what if" question such as this: *what* will the student station use be *if* a criterion is imposed of 70% station occupancy for classrooms used for 30 class hours of a 44 class-hour week. To answer this type of "what if" question regarding facilities utilization, we will employ simulation methodology and computer technology to maneuver detailed inventory data such as room type and number of available student stations, the university timetable of classes, the faculty with regard to their teaching load and unique course assignments, the students' selection from among the offered courses, and the students' preferential

faculty choices. By means of the computer, all of these factors can be manipulated rapidly and with ease; various constraints can be imposed and a variety of heuristic alternative sets of room assignments for achieving optimal utilization of existing facilities can be forecast. Ideally, the one best alternative, or answer, may be chosen and implemented.

By now, the experienced facilities specialists among you will have concluded that the "what if" approach I speak of is really nothing more than first aid for the old lame duck of automated class scheduling and sectioning of students that almost expired five years ago. Well, yes and no! First, computerized class scheduling is not a lame duck but has suffered in the past, I feel, from an initial lack of sophisticated computing hardware and software, from inappropriate application of the first automated scheduling procedures, and from general inability to meet the needs of college and university administrations. Second, I am convinced that the way to discover the best utilization pattern for any complex of academic facilities is to simulate a variety of possible class schedules and then decisively implement the one schedule that best approximates the existing standard for utilization and that best supports the institution's academic program.

You must appreciate that I am thinking of automated class scheduling not just as a means of expeditiously doing by machine what the scheduling officer of a university traditionally and laboriously does by hand each semester or quarter. The primary objective of the usual scheduling system is to generate a time schedule of classes to be offered by assigning rooms, faculty and students to classes in such a way that the number of conflicts in student programs are at a minimum. This traditional approach to scheduling takes student requests for courses as a starting point and by use of a methodology, as elusive as the Unicorn, constructs a schedule to cover the greatest amount of requests. Forty-five to sixty percent conflicts are not uncommon in class schedules produced in this traditional way. This type of manual process, even if converted identically step-by-step to computer processing for added speed, is tedious, costly, and still time-consuming to the point of becoming ineffective. Most often, the mechanism of assignment employed was so inflexible that so-called time tested class schedules persisted term after term without being really evaluated for the best use of existing facilities.

There is little imagination and creativity in such a class-scheduling process, whether it is done manually or converted with identity to computer operation. Optimal utilization of facilities is not of primary concern and certainly far from being achieved with the traditional methodology. Automated class scheduling should not be considered mechanization or computerization of the traditionally rigid and manual procedure. Automated class scheduling should be looked to as a flexible planning technique which can fit together a complex network of time, physical resources, people and their preferences in order to maximize the use of existing academic facilities and to plan the physical requirements of future academic facilities.

Abundant experience with the traditional class-scheduling methodology has resulted in identifying factors that must be included in the development of newer and more practically applicable scheduling by simulation paradigms or "what if" techniques. For example, while there may be a mathematically optimal solution for the assignment of a fixed number of people to available space, it is not clear that an optimum solution is really required by most universities. In most universities, the administration does not manipulate the faculty at will; it is very difficult to tell a full professor, with twenty-five years seniority and who is heavily involved in research, when and where he will teach. Because many of the faculty have fixed commitments, it is important that instructional assignments remain flexible. Certain facilities *are* for special purposes and *are* practical for use only in a very narrow range of course offerings. Academic departments prefer to do most of their teaching near to their offices. Many classes require unique instructional aids which are difficult to move and set up in different locations in the short space of time between classes. All these factors and conditions must be taken into account in any scheduling system if it is to function in a manner acceptable to the faculty as well as the students.

The automated class-scheduling procedure that we in the State University feel is desirable takes into account the kinds of problem factors just described, in addition to standardized utilization criteria. It enables the university administration to ask and answer the kind of "what if" questions that will optimize facilities utilization. The addition of utilization criteria as important factors in scheduling and the availability of quantity high-speed random access storage in the third generation computers, makes it entirely feasible to develop a computer oriented class-scheduling program useful as a simulator of alternative schedules biased for the best utilization of academic facilities.

The scheduling procedure as we conceive it, then, is a computer program designed to make systematic changes among scheduling parameters as instructed by the university administration and report the results in terms of class schedules and measures of facilities utilization. These changes could include alterations of the timetable for classes, the attachment of differing priorities to faculty and student preferences, information about optimal section size and class balancing factors, and the introduction of the components of standard utilization criteria. Many other systematic changes are also possible.

The scheduling program we have in mind allows for the introduction of successive and incremental changes in any one of, or a combination of, scheduling parameters while keeping still others constant. Or, by way of example, the program could be instructed to hold constant all data except that for room type and the number of available student stations. The same computer scheduling program can be instructed further to successively increase the number and type of rooms and generate output which would display the minimum number and type of rooms required to implement a given academic program. Moreover, by studying the output produced after

each successive and incremental change, the administrators of academic affairs would be able to learn what the contribution of additional space above the required minimum would make to desired and planned improvements in the curriculum.

Note also, that the administrator of academic affairs or the scheduling officer, does not have to examine every successive schedule produced by incremental change in the type of parameters we have just described. We could instruct the program to produce only those alternative schedules which would bracket the current utilization components which contribute to the latest utilization standards for station use. See Table 1.

Table 1

Actual Utilization Criteria

Room Type	Utilization Components: Class-Hrs./Wk.	Proportion of Total Stations Occupied	Station Use
Classrooms	30	.67	20.1*
Laboratories	24	.80	19.2*

Here are displayed current utilization criteria. The computer program will produce a specific class schedule, which will meet the standards for optimizing room use in terms of these standard utilization components. See Table 2.

Table 2

Simulated Utilization Criteria

Room Type	Utilization Criteria: Class-Hrs./Wk.	Proporation of Total Stations Occupied	Station Use
SET 1 Class Rooms	34	.59	20.1*
SET 1 Laboratories	22	.87	19.2*
SET 2 Class Rooms	29	.69	20.1*
SET 2 Laboratories	21	.90	19.2*
SET 3 Class Rooms	38	.53	20.1*
SET 3 Laboratories	30	.64	19.2*

*The utilization standard is expressed as CLASS-HRS./WK. of station use

For each of the three utilization criteria sets displayed, a different class schedule would be produced for the unique interaction of the utilization components in each of the three alternatives in figure 2. Yet, all three alternatives result in the same station use. This type of computer program or simulation technique becomes not only a procedure for the continuing process of scheduling classes each term but, even more, becomes a sophisticated methodology for researching, developing and evaluating existing and proposed utilization criteria.

A well defined class-scheduling simulator, of the type I have previously described, is feasible and can be implemented. The advantages are clear; they include generation of minimum conflict class schedules each term; significant savings of schedule planning time by students, faculty and administrators; provision of accurate figures on facilities utilization; provision of a modern facilities planning aid; and achievement of the capability for matching capital building expenditures with academic needs.

Finally, computer simulation is often the only feasible way to analyse and evaluate a system. Certain very complex systems, such as utilization of academic facilities in higher education, seem to defy analysis by simpler techniques. It would appear that learning to skillfully ask a variety of "what if" questions of a class-scheduling simulator is the best approach for studying and developing optimal utilization of our academic facilities.