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MANAGEMENT OF ACADEMIC SPACE AT WORCESTER POLYTECHNIC INSTITUTE

Lyubomir Hristov Deliginev
Worcester Polytechnic Institute

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By: Lyubomir Hristov Deliginev

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Professor Roberto Pietroforte (advisor)

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Advisor Signature

Abstract

This study is focused on the topic of assigning college space to academic activities. Currently present papers on classroom allocation, interviews with space administrators, and the available documentation describing the software product Resource 25 will be examined. A set of drawings of existing academic spaces at WPI and a list of recommendations for improving space allocation process at WPI and for best possible utilization of Resource25 at this college will be produced.

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1. Introduction

This study explores the topic of allocation of academic space. Every year, many university space administrators around the world receive information about the courses that will be offered in their academic institutions and try to assign an available appropriate classroom, laboratory, or other type of space to each activity. Allocation principles, imposed restrictions, classification of assigned spaces, and different ways of allocating space on a college-wide level are presented in Chapter 2. In the next chapter, the current structure for space administration at Worcester Polytechnic Institute (WPI) is explored. In Chapter 4, Resource25 (R25), a software management system for assigning activities to academic spaces, is described. It is currently being installed at WPI. The work performed as a part of this study for implementing this tool is described. Finally, recommendations on how to maximize the benefits from using Resource25 and optimize space administration at WPI are provided.

The project started in response to the need of Mr. Charles Kornik, the employee responsible for the implementation of R25 at WPI, and Mr. James Kenary, the Events Program Manager at WPI, to prepare and upload on the system visual data representing room drawings and photos of reservable academic and event (i.e., used for non-academic gatherings) spaces. The study initially included preparation of drawings and a set of appropriate photos. The photos part of this study was canceled later. The project required knowledge about the intended usage and the overall role of the drawings in the room allocation process. Thus, an understanding of the general process of assigning spaces, knowledge about the current policy for allocating classrooms at WPI, and exploration of the software and its intended use were necessary. For this purpose, the study was performed and ended up with the creation of appropriate drawings as well as valuable recommendations on how R25 and some changes in classroom administration can

facilitate space allocation at WPI. These recommendations were based on the results of the performed work, the obvious presence of weaknesses in the current system of space utilization, and the absence of strategies for utilizing R25 in the best possible way.

The methods used in this study for gathering the necessary information can be divided into 2 groups: searches (electronic and library) and interviews. The data was collected primarily through searches, especially electronic ones. In this way, the information about ideas on space allocation was found. 2 interviews were conducted: one with Mr. Charles Kornik and one with Mr. James Kenary. Thus, knowledge about the on-campus academic spaces, the current set of policies for assigning them to activities, and the expected benefits from the implementation of R25 was gained. Finally, information about the software was obtained from the user guide for it and from the website of CollegeNET, the company that produced Resoursce25. These sources were recommended by Mr. Kornik during the interview with him.

No special methods were employed for analyzing most of the collected data. Comparative analysis was used for understanding the general process of assigning rooms. Various papers on space allocation were explored and the ideas expressed in them were compared to check whether and how they are similar. The results were summarized by establishing two broad categories of ideas based on the found similarities: 1) centralized space allocation approach 2) decentralized space allocation approach.

The problem of the lack of optimized and easy-to-perform space allocation at WPI is worth solving for several reasons:

1) Currently, classrooms are assigned by only one person (Mr. Kornik) who uses his work experience and good knowledge of college spaces to allocate a small amount of rooms to a huge number of academic activities. His solutions are based on a set of

principles that proved over time to be effective. In a few years, he will leave WPI and the new space administrator will have to allocate space without having this same experience and good knowledge. This will lead to problems and may even cause a deficiency of classrooms for WPI courses if changes in the allocation policies and procedures are not implemented and faster installation of R25 is not performed.

2) Mr. Kornik doesn't have enough time to allocate all space on campus and generate necessary space utilization data. If taken into consideration, the recommendations in this study will lead to more efficient allocation procedures that don't depend on one person only.
3) The drawing activities performed as a part of this study for implementing R25 will save WPI staff time and money for installing the software.
4) The advice for better utilization of R25 at WPI that are provided in Chapter 4 will save Mr. Kornik time for implementing R25 and will further improve space allocation at the college.
5) The decentralization of the access to classroom information and the reservation process will be expedited and the WPI space administrators will save time previously used for allocating classrooms.
6) Utilization of space will be increased. Due to the small amount of rooms and labs at WPI, any misusage or underemployment of college resources may lead to inability of faculty to offer certain courses or help sessions. Such restrictions on academic activities will happen due to insufficient number of appropriate spaces and will be harmful to the development as well as the prestige of WPI.

7) The problem of deficiency of academic space will be at least relieved. The school will be able to keep a reserve of space to be used in case of emergency, to offer courses requiring special equipment, and still maintain a good ratio of utilization for its spaces.

The people who are most interested in the results of this study obviously are Mr. Charles Kornik and Mr. James Kenary. The prepared drawings will be used as input data for R25. Thus, space users will be able to see room layouts and their need to ask questions about the appearance of spaces will be eliminated. In this way, time for answering those questions will be saved.

The recommendations for improving the current system of space allocation will most probably be used for facilitating the work associated with assigning rooms. If followed, they will change the space assignment process at WPI in a way that will be felt by the whole WPI community.

2. The Problem of Academic Space Allocation

2.1 Introduction

This chapter presents different types of academic spaces. Definition of academic space is presented and explained in detail. Important issues about it are discussed. Finally, the two different approaches of space allocation are described. Their advantages and disadvantages are discussed.

2.2 Definition of academic space

Institutions of higher education encompass many types of spaces: dormitories, dining spaces, computing spaces, administrative spaces, health services spaces, academic spaces, etc. This study investigates the management of academic space, which can be defined as the indoor space used for performing academic activities: holding classes (all types: lectures, labs, seminars, conferences), conducting research (research labs and faculty offices), and discussing course issues or receiving help from TAs (student lounges). To this list Lucchino (1982) adds clerical offices and a new category called "other space" that includes animal quarters, demonstration facilities, field service facilities, general use facilities, greenhouses, and teaching clinics. This study focuses on the types of academic space that are mostly used at WPI and includes the following:

1) Classrooms for lectures, seminars, conferences, and help sessions. It includes any space used for teaching in which lectures and seminars can be held without special

accommodations and no special equipment for conducting research and lab exercises and experiments is present and maintained.

2) Teaching labs are a type of academic space in which equipment for lab exercises is present and maintained and cannot be used for scientific research. The lab and its equipment are meant to serve for educational purposes only. The lab is sized for lab sections of offered courses. This type of space is generally very large. Its use by a single person or a small group leads to inefficiencies.
3) Research labs are a type of academic space in which equipment for scientific research is present and maintained and cannot be used for educational purposes. The lab and its equipment are meant to serve for scientific research only.
4) Faculty office space, any type of space in which faculty members or graduate students conduct research or have office hours. Faculty members are allowed to store their own educational materials as well as materials necessary for their research.
5) Lounge space: any type of space in which no classes or labs are held and students can enter and study without any restrictions (i.e., it is not locked) and help from TAs and possibly lecturers is available
6) Seminar space, any space similar to classroom that is specially equipped for holding seminars

2.3 Space allocation

To explore different ideas on how to allocate academic space, the following documents have been read in this study:

1. “A Methodology of Space Allocation for Implementation at Ohio University” by Carla Lucchino
2. “Instructional Space Allocation in the University System: A Comparative Analysis” by James Prather and Janet Kodras
3. An Efficient Decision Support System for Academic Course Scheduling by John J. Dinkel, John Mote, and M. A. Venkataramanan
4. Class Scheduling Optimization by Janewit Nakasuwan, Piyawadee Srithip and Somrote Komolavanij
5. Solving the University Class Scheduling Problem Using Advanced ILP Techniques by Ahmed Wasfy and Fadi A. Aloul
6. Design and Implementation of a Decision Support System for Academic Scheduling; Authors: Suleiman K. Kassicieh, Donald K. Burleson and Rodrigo J. Lievano
7. METAHEURISTIC AND MULTIOBJECTIVE APPROACHES FOR SPACE ALLOCATION; Author: Jesus Dario Landa Silva.
8. The control and allocation of existing academic space in the management of colleges and universities holding membership in the National Association of State Universities and Land Grant Colleges, by Robert Garrigues

From these sources, it can be concluded that the academic space allocation problem can be defined (in a simple way) as follows: Given an inventory of ***expected academic space*** and a fixed ***list of course and research activities*** that should be performed in this space, the problem consists of assigning each activity to an ***appropriate space*** in the ***best possible way***.

The space allocation problem includes 4 issues that need further explanation.

1) Projected academic space. By its nature, the space allocation problem involves making decisions today for solving future needs. The space to be allocated will be available at a certain time in the future but it may not be available at a current time.
2) List of activities. Space allocation is required to meet the demand for space for a fixed number of activities. Indeed, a space shortage will inevitably lead to a decreased number of activities to be performed and decreased average duration time of activities. Changes in the activities are beyond the control of space allocators. Thus, space should be allocated assuming that the activities number is fixed. Therefore, the space allocation problem takes only space as a function of activities (not vice versa): allocated space and the method of allocation depend on the activities and their characteristics.
3) Appropriate space. As already mentioned, the space allocation depends on the activities to be performed in this space. Due to the diverse characteristics and needs associated with these different types of activities (teaching, research, performing student experiments for educational purposes, etc.), the appropriateness of space varies. Thus, space should be allocated only for performing activities for which it is appropriate. The allocation of space to activities for which it is deemed inappropriate should be avoided or minimized. For example, teaching space should be allocated only to teaching classes. Also, an ordinary classroom without electronic media (like SH 308) should not be allocated to classes relying heavily on the use of overhead projectors (like CE 3021).
4) Best possible way for allocating space. By its nature, space allocation is a subjective process. There is no guide stating explicitly which factors should be taken in mind, how much importance should be given to each of these factors, what exact series of

procedures should be followed, or what the “correct space allocation” is. The appropriateness of a space as discussed in 3) is something relatively objective, but almost all other requirements that must be taken into consideration are subjective. This subjectivity is built into the term “best possible way”. In reality, there is no definition of the best possible way to allocate space given a fixed number of activities and an expected inventory of space. This is due to the subjective requirements for allocating space as well as the relativity of their importance in the overall consideration of space allocation possibilities. Every institution of higher education decides how to allocate space and which factors to consider. Many state regulations determine the maximum number of students depending on the size of the floor area. Also, there are fire codes further limiting this maximum number of students. These regulations cannot form a complete set of rules for space allocation. So, space allocation policies, guidelines, and manuals are prepared in each institution of higher education. They determine the important criteria according to which space allocation should be based. Thus, the “best way” for allocating space is defined at institutional level. Usually, the following factors are used for academic space allocation:

a. Space Utilization

b. Faculty Preferences

3) Room Capacities (for determining appropriateness)

4) Student Schedules

5) Course Characteristics (session duration, number of meetings per week, number of students enrolled in the course)

6) Time Constraints

A brief description of the first five factors is provided below.

Space Utilization. This is the most important factor used in space allocation. It may be defined in different ways. In general, the space utilization of a particular academic space (room, lounge, lab, etc.) is measured as the ratio of its usage in terms of the total number of used hours over its capacity, i.e. the total number of hours of potential use. Lucchino (1982) defines space utilization as the ratio of space assigned versus space requested. Whichever definition is used, space utilization is a major indicator of the cost associated with maintaining and using a facility, of the rate of usage of space resources, and of the efficiency of operations in general. The more a space is used, the higher are the costs but also the higher are the revenues from its use. Thus, a space utilization ratio of 1 is the main target of many academic institutions.

Faculty Preferences. Instructors may have their own preferred location for their lectures, labs, and seminars. Allocators have to take into consideration these preferences. When assigned a new location, a professor may feel uncomfortable for some reasons or have problems figuring out how to use the new space. This can lead to overall waste of time or decreased productivity of the professor. So, desired locations should usually receive priority in allocation.

Room Capacities. As discussed above, academic activities should be assigned to spaces that meet functional and equipment needs. It should also be noted that spaces need to be selected according to the required number of students and seats (or benchmarks for labs). The number of seats is part of the room capacity and cannot be neglected. Fire code mandates that the number of occupants should not be higher than the allowed by the capacity of the room.

Student Schedules. Space allocators should take into consideration the typical course sequences taken by students and the locations of courses. This is especially true for huge campuses where buildings are not always within short distance. They may not be reached in the ten minutes break between consecutive classes. Even in small campuses, space allocation decisions are important since they influence social contacts between academic activities.

Course Characteristics. The number of course meetings per week and number of students directly affect the space utilization ratio. The more the students and the more the meetings per week are, the higher the space utilization is. For example, in some universities, the percentage of occupied seats for a day cannot be less than some fixed efficient value. Thus, a small population will never be housed in a huge classroom. It should also be noted that the duration of a class plays an important role in the space allocation process. For example, longer classes may be assigned to rooms deemed to be more comfortable than other rooms. If a class has a long duration and a huge population, a big room or lecture hall with special equipment such as a microphone may be assigned so that the lecturer do not get tired from talking loudly for the duration of the class. Again, the longer the class is, the higher the level of space utilization is.

Space allocation requires the consideration of 2 important issues.

Firstly, the task of space allocation does not encompass the simultaneous consideration of all available space. In practice, some types of space (classrooms, teaching labs, etc.) are assigned on a routine basis, while others are assigned once over a few years or over long period of time. Thus, the task is actually the sum of many small problems differing by the type of activities to be assigned to spaces and by the time period for which they are assigned. These differences

determine the use of different solution methods, as it will be shown later in this report. All these methods share a common goal: need for a solution that is best for the institution under consideration.

Second, according to Kassicieh et al. (1986), the space allocation problem is actually just a subset of academic scheduling, i.e. a resource allocation problem with 4 components: faculty, courses, space, and time. It involves 3 tasks: 1) Assigning faculty to courses; 2) Assigning courses to spaces (the space allocation problem); 3) Assigning the courses and spaces to time slots. Obviously, these 3 tasks are interrelated: each component influences the others. In practice, space allocation influences and is influenced by three resources: faculty, courses/activities, and time. So, the solutions of space allocation should also meet the needs of the academic resource allocation problem at large. However, this project considers only the solutions of the space allocation problem. Consideration of possible contradictions between these solutions and the solutions of the big academic resource allocation problem is beyond the scope of the project.

2.4 Approaches to space allocation

The ideas about, or solutions of the space allocation problem vary in terms of details of the process of assigning space. Universities follow different rules which are often their own, unique sets of guidelines. As already mentioned, there is no universal solution of this problem. Space allocation is a subjective process with no fixed way to follow. However, the different approaches to space allocation can be grouped in 2 categories: the centralization and decentralization of the allocation process. It should be noted, however, that the process of allocating space is never completely centralized or decentralized. It is always based on some

central committee (or a person in small institutions of higher education) with some controlling functions and a body of faculty with the right to voice their opinion and thus influence the decisions about assigning space to some extent.

2.4.1 Centralized approach

The centralized approach involves one person or a committee making the final decisions about what spaces to be allocated to whom and for how long and, in some cases, under what specific conditions. As by Lucchino (1982), this committee can include the provost, representatives from each department, and possibly the vice president. According to her study, this approach can lead to better utilization of space in a university as a whole. This is one of the reasons why such an institution is included in the decentralized space allocation organization proposed in the study. However, the centralized approach has its disadvantages also. One of the main disadvantages is the possible lack of cooperation among faculty. They are not guaranteed that once they give up unnecessary space, a necessary one that was asked for will be assigned to them. Also, faculty may make the wrong decision due to this inability to allocate space by taking into consideration the preferences and needs of their colleagues. The way the centralized approach works is simple. The space allocating body keeps and updates the inventory of all available space and its characteristics (maximum allowed number of seats, currently available seats, heating, availability of natural light, of overhead projectors, computers, wireless, etc.). Well before the start of the academic year, a list of all courses and events is provided by schools (or departments), administration, or some other university employees responsible for keeping records of offered courses. Also, some of the subjective factors may be provided: faculty

preferences, aimed space utilization ratio, course characteristics, or others. Furthermore, university guidelines for classroom assignment or space policies are available. The allocation process then takes place by assigning courses to spaces and, in some cases, to a time interval and a given day of the week. This allocation is performed in such a way that the university requirements, federal laws, and state laws (particularly, the fire code) are not violated. This activity often encompasses a small amount of the available academic space and not its entirety. The assignment of routine units such as classes is simplified. Usually, this task consists of a modified version of the setups of previous years. These modifications are caused by new changes in the criteria for space allocation. After the allocation of all spaces has been performed, a series of adjustment are required. The allocated space may not satisfy some students or faculty. So, new solutions are tried in a continuous iterative way. It should be noted that the allocators may decide not to take into consideration the preferences of students and faculty and thus stop the process at some point. Whatever is the decision, the iterative process is constrained by time. It must be completed during a certain period after the beginning of the term. Usually, serious attempts to solve the problem before the end of this period are made.

The centralized approach to space allocation cannot be described in detail. It is more an art that is gained from experience. Decision making cannot be formalized into precise set of rules nor can be automated. In recent years, the task of assigning spaces has been tackled by computer programs that build upon the principles of operations research. Almost all relevant literature (5 out of 7) consulted for this study showed space allocation as a task to be performed through the use of dedicated software programs. The advantages of such software are obvious. It can provide the optimum solution without bias in a very short time period (in comparison with a manual

approach). However, the output of a software program cannot be easily modified according to individual needs.

2.4.2 Decentralized approach

The second possible approach to space allocation is the decentralized one. It does not necessarily exclude the presence of centralized administrative bodies that in this case have coordinating and controlling role in the space allocation process. In this situation, spaces are allocated by individual departments or schools. A central committee may be also required to distribute the total available space (at university level) to the academic units that perform space allocation on their own. The advantages and disadvantages of this approach are the opposite of the centralized one. Faculty members prefer it because they have more control over it. However, this method can lead to a suboptimal utilization of space because the process cannot be efficiently controlled by a central body. Decentralized approaches differ according to what elements they include, the rights and the responsibilities within the system of the separate academic units, and other criteria. The decentralized space allocation approach can be simply described as follows. If a central committee exists, it receives requests for the number of rooms, area of assignable space, or number of student seating from academic units. Then, the committee somehow assigns space to each of the departments. As in the case of the centralized approach, the space allocation is not performed by following a fixed algorithm. Differently, it is usually attempted by the whole committee based on codes, requirements, and previous experience. Sometimes computer software is helpful if the assignment task can be modeled. This task is not always easy, especially if square feet rather than a list of necessary room types are used as input

data for finding available appropriate space. Once the departments get their assigned space, they decide how to allocate it among their courses, activities, and events. In many schools where no interdepartmental space assignment is performed, the decentralized system process starts from this point. Once space is allocated to departments, it is their responsibility to use it during a certain period of time (usually, one academic year) and then return it back, so that it can be re-assigned according to the established codes, rules, and policies.

It may seem that the two ideas for solving the space allocation problem are actually one idea applied at different levels (university vs. departmental). Broadly speaking, at managerial level, the two systems are not the same: their characteristics and required input differ. Also, they eventually reduce the original problem to different smaller problems. The centralized approach reduces it to adjusting minor space allocation issues arising from not taking into consideration the preferences of people affected by the decision. In the decentralized system, the problem is reduced to many similar but much smaller ones that can eventually be solved easily without computer aid.

2.5 Conclusion

This chapter has addressed the challenge of allocating spaces for academic operations such as holding classes (all types: lectures, labs, seminars, conferences), conducting research (research labs and faculty offices), and discussing course issues or receiving help from TAs (student lounges). The task requires assigning a space to an academic activity in the best possible way, given a fixed number of activities and spaces. Two approaches to this task exist: the

centralized and the decentralized practices. Both reduce the problem to smaller problems that are easier to solve.

3. Current System of Academic Space Allocation at WPI

3.1 Introduction

This chapter describes the types of academic spaces at WPI and the system of space allocation that is currently used for assigning them. The administrative and academic units involved in classroom assignment are listed and their role in the process is explained. Then, the factors considered in space administration are presented in detail. Finally, the disadvantages of the current space allocation are described. The information presented in this chapter was gathered by personal interviews with Mr. Charles Kornik, Administrator of Academic Programs at WPI, and Mr. James Kenary, Events Program Manager at WPI.

3.2 Types of academic spaces

At WPI, the term "academic space" encompasses the following six types of spaces: classrooms, computer labs, conference rooms, labs, lounges, faculty offices.

1) Classrooms. These spaces are used for lectures, meetings, seminars, conferences, and other types of educational non-laboratory activities. They vary in terms of size, capacity, available equipment, and furniture and can be classified as "classrooms", "conference rooms", and "seminar rooms" based on activities allocated to them. However, classrooms are usually

used for all types of educational non-laboratory activities and meetings. This is due to the fact that most of them do not have installed specialized equipment, so they can be used for different classes and activities. Also, classrooms are considered one category of space in the academic space allocation process despite of their differences. At WPI, there are thirty-five classrooms that are assigned to academic activities by the Administrator of Academic Programs.

2) Computer labs. Those spaces are equipped with computers (and possibly some other hardware such as printers, scanners, etc.) and used for scheduled academic activities (classes, conferences, meetings, etc.). There are nine such spaces at WPI. They are by the Administrator of Academic Programs.

3) Conference rooms. These spaces typically are not controlled by the Administrator of Academic Programs. The departments where these conference rooms are located are responsible for assigning them to activities. When these rooms are used for academic purposes, they are assigned by the Administrator of Academic Programs with the permission of the department heads. Most of them usually are not used for regular academic activities. Currently, the total number of these spaces is unknown. No one tried to count all conference rooms so far.

4) Labs. There are two types of labs. Some are used for both teaching and research while others are used for research purposes only. This is due to the fact that many of these spaces are not used heavily for teaching so they can also be used for research activities. The responsibility for allocating labs to research activities lies with the departments while the Administrator of the Academic programs controls the allocation of labs to teaching activities. However, department heads usually assign these spaces and the administrator just accepts it and makes sure that there are no time conflicts. The total number of these spaces is unknown. So far, no one tried to count all of them.

5) Lounges. These spaces are used for unscheduled gathering of students for performing academic activities as well as for meetings. Most of them are owned and allocated by the departments where the lounges are located. Some of these spaces are allocated by the Events Office. However, they are not used for academic activities and thus are not considered part of the academic space at WPI. The total number of lounges is unknown.

6) Faculty offices. This type of space includes the offices of all the lecturers, researchers, and teaching assistants that can be used for help sessions or educational meetings. These offices are controlled by the departments where they are located. Their total number is unknown.

3.3 WPI units involved in space allocation

The system of academic space allocation that is currently used at WPI for assigning these six types of spaces consists of six units: the Administrator of Academic Programs, departments, Events Office, Provost, Office of Facilities, and Office of the Registrar.

1) Administrator of Academic Programs. One of the responsibilities of the administrator is the allocation of classrooms and computer labs to academic activities. This person also assigns some conference rooms and labs following the permission of the department heads and, usually, their submitted suggestion about which conference room or lab to be allocated to which activity. The administrator is responsible for finding space for each of the planned classes and avoiding scheduling conflicts between activities that take place in the same space.

2) Departments. This administrative unit is responsible for providing the

Administrator of Academic Programs with a list of the courses that are offered during an academic year. Also, the department has to let the administrator know changes from previous years and preferred locations (labs, rooms, and conference rooms) for courses. The department heads usually perform these two activities. Departments are also responsible for allocation of their own labs, lounges, conference rooms, and faculty offices.

3) Events Office. This unit is responsible for all non-academic space. However, it sometimes uses some of the space which is generally assigned to academic activities. The unit may also give some of its own set of rooms to the Administrator of Academic Programs so they can be assigned. So, this office is also a factor in the space allocation process.

4) Provost. One of the responsibilities of the provost is solving any serious conflicts between the administrator of academic programs and faculty members. For example, when the administrator needs to take a class out of a room and allocate another space to it, the faculty member who is teaching the class may not be willing to relocate to other space. In such cases, the provost convinces or induces the faculty member to do so.

5) Office of Facilities. This unit has two main responsibilities. First, it has to keep record of all spaces on campus and off campus. Second, it is responsible for the determination of the fire code requirements for each of the spaces. In this office, there is a fire inspector who periodically checks the places on campus and determines the capacity of each room (i.e. the maximum number of people who can occupy a room at certain time). This capacity is the main requirement that is taken into consideration in the academic space allocation process.

6) Office of the Registrar. This unit is responsible for registering

students for courses. The information about the number of students enrolled in each course is used by the administrator to determine whether the fire code requirement is violated by a faculty member who has allowed more students than permitted by the capacity of the room.

3.4 The administration of academic space

The main unit in the system is the Administrator of Academic Programs, a position held by Mr. Charles Kornik. It is not exaggerated to state that all other units (except departments) have a minor or a supportive function in the allocation process. Almost all of the academic space assignment is controlled by the administrator. Consequently, this study describes in detail the work activities of this employee. Since there are many departments and each of them is free to allocate some of its space, I decided that during my short-term study, it will be impossible for me to explore how each of the them assigns its academic space to activities and to summarize the data into a short report this short-term study could not address this departmental aspect of space allocation. Consequently, only the space allocation performed by the administrator is explored in this study. The views of Mr. Kornik about the current system of allocating space, the problems associated with this task, the issues that arise during his work, as well as the planned future way of space allocation at WPI are also addressed in this report.

In deciding about assigning space to activities Mr. Kornik has to take into consideration the fire code requirements that determine the maximum number of seats in the rooms based on the type of furniture in and the square footage of each of them (in other words, the potential fire hazard of these combustibles). Typically, the permitted seating for each room is determined by the Office of Facilities so Mr. Kornik is not involved in this decision. When allocating space to

groups or courses, Mr. Kornik does not prioritize any activity based on importance, rank of faculty, or personal preference: space is assigned on a first come, first serve basis. The only exception is the priority given to scheduled course activities. Mr. Kornik takes into consideration the needs of student groups and gives them space only after satisfying both stated and expected course space needs. Mr. Kornik always tries to allocate courses to the spaces in the buildings of the departments offering these courses. If this is not possible, department heads are informed of the reasons for unavailability. The most important principle is "best fit". A given student-to-seats ratio should be achieved in each space. Besides these formal and informal rules, Mr. Kornik does not have any other guidelines to use in the space allocation process. Also, his decisions do not need to be approved by anyone else. Mr. Kornik is authorized to make decisions on his own.

In order to perform his task, the administrator needs to obtain specific information about space requests that are made by each department head as well as by the presidents of student organizations. There are three ways of obtaining requests: by phone, by e-mail and by personal conversation. Most of them are received by e-mail or by phone.

According to Mr. Kornik, the available academic space that he is not enough in regard to the current number of WPI students and the courses offered. There are rooms that are used constantly from 8 AM to 10 PM or even later and it takes a lot of time to find spaces for all of the courses. This is the reason why no spare capacity of rooms remains after having allocated all scheduled activities to spaces. This very high level of space utilization also has its disadvantages. In case of a sudden loss of academic space, due to fire or other reason, some of the classes would be cancelled, rescheduled for evening hours or held in buildings of other colleges.

Space allocation is performed as early as possible. As Mr. Kornik explains, "the sooner, the better". Typically, all courses during a given academic year (from A term to D term) are

scheduled and assigned to rooms during a repetitive process that lasts 3 months. For example, the assignment of courses to time slots and spaces for the 2008/2009 academic year was performed from December 2007 to March 2008. This lack of space creates challenges in finding the proper location of events that cannot be scheduled long in advance. These are those exams held in places that are different from where a normal class is held. In this case, faculty is encouraged by Chuck to reserve the space a long time prior to the event. For example, the best time for booking a space for final exams is the week before the term in which the final will take place. In such cases, the only principle followed is allocating space on first come, first serve basis even if this sometimes means assigning a big room to a small group. Mr. Kornik acknowledges that he does not give special consideration to late requests for space used for unscheduled activities even if this means a decrease of the space utilization rate. Meeting very late requests unconditionally, in fact, may penalize those who planned in advance and perpetuate the habit of late requests. The only exception is for student organizations. Mr. Kornik does not give them big spaces during the final week of a term because these spaces are reserved for faculty members and their classes.

In his work, Mr. Kornik, uses the space allocation setup of previous years to facilitate the whole process. If a department wants to offer a course that was also taught in the previous year at the same time and days of the week, then Mr. Kornik automatically allocates this course to the same space that was assigned in the previous year.

The approach to space allocation is relatively simple. As already mentioned, it is based on two main criteria: allocating space on first come, first serve bases and the “best fit” concept (i.e. the principle of trying to maintain a certain student-to-seat ratio).The first criterion can be used at WPI because, according to Mr. Kornik, in most cases the space requests are not simultaneous. In addition, it is crucial to follow the best fit principle. Whenever it is possible, a

course with a high enrollment is assigned to a large room. Differently, a course with a smaller population that was previously assigned to a large room is relocated to another smaller, space. When these criteria conflict, Mr. Kornik usually follows the best fit for maintaining efficiency in the space utilization. A good space utilization, in fact, leads to savings of maintenance and operation expenses. Two software products are used for administering the academic space at WPI: Oracle Developer and Banner. The input they require is the day and time of a course. The output is the spaces available at the requested time. The initial scheduling of courses and related spaces is generally developed in cooperation with the department heads on the basis of the schedules of previous years. Department heads communicate which courses are kept in the same term, time, and days of the week, and also changes in their schedule or the addition of new courses. If there are no changes, a course is assigned the same space of the previous year. If there are changes, the administrator prepares a list of the changed courses and develops a draft of the new schedule to be examined by the department heads. If there are problems, the administrator develops new drafts in order to satisfy departmental needs. Then spaces are assigned to the courses. Department heads usually communicate the location of their departmental courses. Some departments prefer their classes in their buildings while others are more flexible. If some of the preferred spaces have been already assigned, the administrator offers alternatives to department heads. In the absence of preferences, the administrator allocates rooms on the basis of the fire code requirements, the number of permitted students in the class, and the availability of appropriate space at the scheduled meeting hours. During this process, it is crucial to avoid time conflicts. No more than one teaching activity is assigned to the same room at a given time. In this regard, the administrator informs the department heads about the possible time conflicts and let them choose other meeting time or other classrooms for their courses.

Mr. Kornik uses charts and bar graphs to verify the use efficiency of the assigned space. These tools show the time of the day of maximum use of a classroom. This measurement applies to individual spaces and not to the entirety of space on campus. The use efficiency of a given space is expressed as the ratio between students and seats, also called "fill ratio". Efficiency is achieved if this ratio is 67%. Large deviations from this value indicate either overcrowdness or underutilization. If it's considerably more than 67%, there are too many people in the room, and if it's much less, the allocation is inefficient. So, if the number of students in a room is a little bit less than the available seats (and thus the fill ratio is almost the maximum 100% permitted by the fire code), this allocation is still up to code but inefficient. This situation may disrupt lecturing when students are here for class and seek seats in the room. For this reason, Mr. Kornik tries to keep the fill ratio at a value that is lower than 67 %. However, it is difficult to control space utilization because often the faculty members do not have the flexibility to move their courses and also because the number of classrooms at WPI is so small that usually the fill ratio for most courses is close to 100 %. Consequently, Mr. Kornik tries to convince professors to teach classes at hours when there is less demand. For example, at 8 AM and at 4 PM, the number of available rooms is the highest because faculty and students do not want to have course activities scheduled at those times.

In allocating spaces to academic activities, the administrator allows for slight increases in the number of students taking a course if possible. This depends on the population limits for each of the courses, which are set by department heads, and the available classrooms. However, if a course is assigned to a space where the number of seats equals the students registered for the course and the instructor decides to let some more people in, the administrator has to relocate the course to a larger classroom. If such a room is not available due to lack of appropriate free

spaces and unwillingness of other faculty members to exchange rooms, Mr. Kornik asks or, if necessary, forces the faculty member to cut the enrollment of the class, particularly those students that registered at the very last moment. So far, Mr. Kornik always succeeded in finding larger rooms in case of late request. The administrator in addition can control any violation of the fire code seating requirements because every instructor has to sign a paper, called "add form", when students are allowed to increase their standard course load.

Two important factors to be considered during any space allocation process are the length and frequency of classes. At WPI, some classes are 110-minute long and are held twice a week while others that are 50-minute long and are held four times a week. The administrator is responsible for making all the different activities fit into a schedule without conflicts and efficiently, i.e., the fill ratio is achieved for as many spaces as possible. Long classes (110 minutes) can be scheduled without conflicts by using only two ways for assigning courses to time slots over a week: 1) Monday and Thursday, or 2) Tuesday and Friday. Thus, if two courses are scheduled at the same hour and are assigned to the same space, one is held on Monday and Thursday, while the other one is held on Tuesday and Friday. In this way classrooms are used more efficiently.

3.5 Other factors to be considered in the space administration

One other important factor in space allocation is the uniform distribution of activities to rooms. If some spaces are used more than others, their condition deteriorates faster and need more frequent renovations. Mr. Kornik is aware of this problem. However, he considers satisfying the preferences of faculty to be more important than spreading activities evenly over

the available space. So, Mr. Kornik gives faculty members the right to express their preferences and then tries to give them the requested room or, if it has been already reserved, a space that is similar, as much as possible, to the preferred ones. If faculty members have no space preferences, Mr. Kornik tries to assign courses to spaces that are not heavily used and thus achieving some kind of a more uniform distribution.

Another important factor is the maintenance of rooms. After a given teaching session is performed, every space has to be cleaned and prepared for the next class, so some time gap needs to be provided. The Administrator of Academic Programs is not responsible for the cleaning of spaces, nor is required by any policy to provide time gaps between courses for maintenance. The combination of too few of available classrooms and growing number of students causes some spaces to be constantly occupied from 8 AM to 10 PM or even later, leaving almost no time for cleaning. The WPI policy asserts that if a classroom is used for legitimate reasons (i.e. for scheduled academic activities or student activities), the maintenance personnel should wait until it is empty and then starts cleaning. According to Mr. Kornik, the 10-minute breaks before classes are not enough for maintenance purposes. Custodians need at least 1 hour for cleaning. The result is that usually rooms at are cleaned in the evening or early in the morning before classes start. Maintenance activities are also complicated by the fact that some buildings do not have day-time custodian or have one custodian who is responsible for several other buildings, too.

Another important factor is the impossibility of modifying academic space. At WPI, the classroom space is not adjustable and cannot be modified as for WPI policy. The number of seats in each room must be kept constant and equal to or a little bit less than the maximum permitted by the fire code. According to Mr. Kornik, modifying space implies taking the furniture out and

is associated with some amount of manual labor. This means that an adjustment has high price in terms of money spent for it and downtime. Also, customizing rooms to the need of specialized courses makes these spaces appropriate only for those courses. Thus, customization leads to the loss of generic academic space that is available for non specialized courses, the majority at WPI. So, when the need for adjusting a classroom arises, the only modification that can be made is bringing movable equipment (like portable projectors) in. According to Mr. Kornik, proposed courses that require adjustments other than just bringing movable equipment in are not offered.

Space allocation takes also into account the schedule constraints of students and faculty. Mr. Kornik asserts that he does not take into consideration student schedules, but some department heads do. For example, the Department of Physics, Department of Chemistry and Biochemistry, and Department of Mathematical Sciences try to make sure that freshmen enrolled in introductory physics and chemistry courses can also take introductory mathematics courses. As far as faculty preferences are concerned, Mr. Kornik does not work directly with individual faculty members, but with department heads. The latter are responsible for determining the preferred teaching times of the departmental faculty and working out with the administrator course schedules that reflect these preferences and availability of the required space. Faculty members sometimes ask directly Mr. Kornik to put their courses at certain times or to schedule them in such a way that they are not in conflict with other activities. Although Mr. Kornik is not required to satisfy these requests, he does his best in order to avoid time conflicts and friction with the faculty members.

As already mentioned, departments are responsible for making space requests. For each of the courses, the following information is needed: 1) the maximum number of students

permitted to take the course 2) time of use of requested classroom (start-finish) 3) necessary special equipment.

Although not required by any formal rule, departments are responsible for not "wasting" academic space. This happens when spaces are formally assigned, but are not used and kept as a reserve. Mr. Kornik cannot control this possibility and does not have the authority to verify this possibility.

Academic space is also used for non-academic activities by student organizations as well as people who are not part of the WPI community. At WPI, the administrator of academic programs is responsible for allocating academic space to student clubs. In this case, the requests receive lower priority. Only when all teaching needs have been met, space is granted to student activities. As stated before, large rooms are not granted during the final weeks of a term. Demand for this type of space is high if final exams are considered. As far as outside people and organizations are concerned, Mr. Kornik does not work directly with them. This group reserves space through the WPI Events Office.

Once the initial space allocation is performed and classes start, the administrator of academic programs may have to relocate some of the activities to new locations. This change is caused by two circumstances:

1) Faculty members may not be satisfied with the space assigned to their course;

2) The number of enrolled students exceeds the seating limit set by the fire code or it is substantially below it.

In many cases, the first circumstance is the reason for a change. According to Mr. Kornik, in the first week of every term, about 3 or 4 course re-allocation requests are submitted by instructors. In the past, these requests sometimes were communicated and met several weeks

after the beginning of the term. The reasons for these requests vary: inappropriate size of the classroom (too big or too small area), unpleasant carpet, noisy heating, etc. Mr. Kornik does not want and is not required to be a judge whether these requests are justified. He simply tries to find other rooms, also for maintaining a good cooperative relation with the requesting faculty. In case that an alternative space is not found, Mr. Kornik invites the interested faculty to try to exchange his/her space with the space assigned to another faculty. Mr. Kornik may help professors to find those colleagues who do not mind exchanging rooms. However, the exchange of rooms cannot be imposed if the only reason is the dissatisfaction of a faculty with the assigned space. So, if no alternative space is available or no exchange is possible, dissatisfied faculty must use the assigned space until the end of the term.

On some occasions, room change is caused by the very high (above what is permitted by the fire code) or very low (much less than 67%) students-to-permitted-seating ratio. If the number of students is well above what is permitted, the administrator usually moves the course to a larger room. If the number of students is too low for the size of an assigned classroom, the next time the course is offered, it is relocated in a smaller room, following an agreement with the faculty in charge of department head. The reason for this approach to decrease inefficient space allocation is the fact that the administrator does not determine the maximum number of students who are allowed to register in a course. The department heads, in fact, are responsible for determining this number that is forwarded to Kornik when classrooms are requested.

Currently space allocation is finding a balance between centralized and decentralized approaches. According to Mr. Kornik, the system at WPI is as centralized as possible and may actually become a little bit more decentralized. However, the policy of the institute does not

allow departments to allocate academic spaces on their own. These are the three reasons for this policy:

1) A centralized space allocation system "…takes out the political conflicts of each department controlling their own space." (Kornik)

2) Some departments (like the Department of Humanities and Arts) do not have their own buildings. Thus, if a completely decentralized system is used, this department will go through the cumbersome process of asking space to other departments.

3) Other schools with a decentralized allocation system have experienced lower levels of utilization and some space waste. Given the low number of available classrooms at WPI and the high number of students and courses, a decentralized space allocation system can lead to reduction in the number of offered courses due to inability of departments to find spaces for all of their courses. This may lead to a reduction in the number of WPI students.

As far as the access to relevant space allocation information is concerned, Mr. Kornik points out that it should be decentralized. Currently, only he and Mr. Kenary, the Events Program Manager at WPI, have access to the list of unoccupied academic spaces. Once everyone has access to this information, the system will function better because the administrator will save much time currently spent in providing information about availability of academic space.

When asked about the disadvantages of the current system at WPI, Mr. Kornik pointed out the fact that the information about space availability can be accessed only by him and Mr. Kenary and is not shared with other people. The second disadvantage is the small number of available classrooms. This is an obstacle that will prevent WPI from offering more courses because no space can be found for them. The third biggest disadvantage is the lack of full-time assistants to help him. Mr. Kornik in fact needs assistance because he has other duties besides space allocation. The last disadvantage is the lack of

policy regulating the time during which WPI facilities are used. In some other colleges nobody is permitted to use campus facilities during certain hours (e.g., 10 PM-8 AM) called “blackout periods”. Currently the small number of available spaces does not allow any blackout time on campus.

3.6 Conclusion

There are six types of academic spaces at WPI: classrooms, labs, computer labs, conference rooms, lounges, and faculty offices. They are allocated by a system which includes 6 units: Administrator of Academic Programs, Events Office, departments, Provost, Office of the Registrar, and Office of Facilities. The system is based on both centralized and decentralized approaches to space allocation. The main unit in this system is the Administrator of Academic Programs, who is the sole person responsible for allocating classrooms and computer labs, while departments assign the rest of the academic spaces in their buildings. For this task, the administrator uses the software products such as Banner and Oracle Developer. The underlying criteria for space allocation are the “first come, first serve” principle, the goal of student-to-seats ratio of 67 %, the attempt to give individuals and organizations the rooms that they prefer, and the priority of academic over non-academic activities.

4. Resource25 and the Future Allocation of Space at WPI

4.1 Introduction

In this chapter, the features of the resource management system Resource25 (or R25) are presented. The expected benefits from its usage at WPI are discussed. The work performed as part of this project for its implementation at the institute is described. Finally, as a result of the performed analysis of the capabilities of Resource25 and the current system of space administration at WPI, recommendations for better utilization of R25 and for improving the space allocation system at this institute are presented.

4.2 The Resource 25 software

Resource25 (also known as R25) is described as a "…professional level, campus-wide, class/event scheduling and space/resource management system" ("Higher Education Products") by its author CollegeNET, an organization that provides "…web-based on-demand technologies to help colleges, universities, and non-profits save money, improve operational efficiency, and enhance communication." ("About CollegeNET"). The company offers products in seven key areas in the fields of academic and non-profit management, one of which is "…Class and event scheduling, space analysis, and benchmarking."("About CollegeNET") So, R25 was essentially created by an organization that operates in the field of software development for academic space

allocation and over the years has developed structure, command lines, functions, and overall work organization geared toward providing practical solutions to real world problems.

R25 is a part of a big product line for academic management software called Series25 that includes four other products included in this line, each aimed at assisting the scheduling process in academic environment. The software that will be used in WPI in the near future consists of only two programs: R25 and a student information system (SIS)-R25 interface. The latter is an auxiliary software system used along with R25. It facilitates data transfer between R25 and SIS, a college information system for creating and managing student- and class-related data. At WPI, the SIS used is Banner.

CollegeNET states that R25 was developed to enable "…people to securely manage class and event scheduling campus-wide…" ("Series25 Scheduling & Space Analysis: R25: Campus-wide Academic and Event Scheduling"). Also, it is supposed to make scheduling more efficient, easier, and more effective. According to the webpage of the company, the product is also meant to solve the conflict of centralized vs. decentralized space allocation by offering capability of seeing all available classrooms on campus and knowing how and when they are used. Thus, the product is a tool for a creating a more centralized academic space allocation system. Furthermore, it can be used for standardizing all the classroom assignment procedures used by academic units on campus.

4.3 The features of R25

The features of the software are described in the manual, *R25 User Guide* that lists over a hundred features, showing that the software is a complex, adjustable product that can be used by

schedulers with different working preferences and habits and in institutions with various scheduling practices. However, due to the limitations of this study, only the most important ones that relate to the WPI academic environment and scheduling practices are described.

One of the main features of the software is the form *MyR25*, the center place of the whole system where the users can:

1) schedule an event
2) e-mail summaries of events to interested people
3) check the availability of spaces for a group of people with known size at a specific date and time
4) compare the characteristics of several spaces to determine which one is the best fit for an event or a class
5) verify whether the required resources (e.g. movable overhead projectors at WPI) are available for a class
6) check what events are sponsored by an on-campus or an off-campus group over time
7) see the calendar of scheduled events
8) find a list of event-related tasks to do that were assigned to them by their managers
9) create a report for an event or space usage history

From *MyR25*, users can also reach the directories of the system that allow users to create, view, and edit data about a particular topic. The directories are the places where all essential scheduling activities are performed. There are a total of 8 directories.

4.4 The directories of R25

Without doubt, the most important feature is SpeedBook that allows users to look over events, check spaces, and assign spaces to new events. Furthermore, this feature allows the user to print reports about utilization of particular academic spaces, class summaries, and other academic-related topics. In R25, there are links to SpeedBook (called Hotlinks) from anywhere in the system. From this tool, users can create events and add them to the events database. This activity is a 4-step process that requires entering data about the date and the time of the meeting (or, in case of events with multiple occurrences like college classes, entering data about the set of dates and times of the event), assigning space or spaces to the meeting, allocating necessary resources, and providing information about the event: name, title, type, state (there are several possible states in R25), primary sponsor, and "requestor" (the person or organization holding the event). Spaces can be also screened to verify how well they meet customer needs. The SpeedBook can also be used for obtaining information on available resources and e-mailing event summaries to customers (i.e., lecturers, lab instructors, and student organization presidents at WPI).

The Event feature is a place from which any user can view information about, edit, or search for events. There are several ways according to which a user can sort a meeting: by date and time, by reference number (provided automatically by the software), by space, or by sponsoring organization.

The Space feature is a tool that allows the view, editing, and search of classrooms, labs, conference rooms, etc. Users can provide information about space characteristics such as maximum capacity, available installed equipment, accessibility by handicapped people, etc.

Space search can be also accomplished by inputting the name of the space (or at least a part of it), required minimum capacity, and expected head count. Also, users can exclude spaces for which an activity or an event is already assigned at a given date and time and restrict the space search. The search results are sorted according to how close they are to the specified criteria. Users, in addition, can see what events are held in a particular room at certain date and time.

The other five main features of R25, which are less relevant to the needs of WPI, are:

1) Resource tool – used for editing, viewing, searching for resources, as well as viewing the usage of one or several resources.
2) Task list – used for checking personal workflow as well as those of other R25 users and schedulers.
3) Report tool – used for previewing and printing reports. There are many standard forms for reports loaded on the system. Users can also create their own.
4) Organization tool – used for viewing, editing, searching for organizations, as well as viewing events and preferences.
5) Contact tools – used for viewing, editing, searching contacts, as well as for checking events and preferences of selected individuals.

4.5 Other features of R25

One of the important features of R25 is also its security. Set during installation and further refined during data preparation, the security feature determines what information can be viewed, created, or modified by particular users. In addition, R25 offers the opportunity to adjust

the security settings for a particular event in such a way that the requestor (in the case of WPI, a lecturer) may not be able to create or modify an event, but can cancel one.

One other important feature of the security settings is the sharing of event forms. As already mentioned, there are different hierarchical steps for setting events, as defined in R25. The very first step is called *Draft*. The user creating a draft can provide information about the event but cannot schedule it, i.e., cannot create a meeting that will be held at specific date and time at a place on campus. For this purpose, the user has to save the event in one of the steps that are higher in the hierarchy. However, saving the meeting in such a state is typically restricted by security measures. Only the space allocators can do so. Thus, drafts can be used by customers for determining their preferences and then these documents can be sent to schedulers for official allocation.

Another important feature of the system is its practically unlimited ability to accommodate the inclusion of many scheduling units and users, as well as many spaces, resources, and events. Thus, the system can be used campus-wide by the whole college communities.

An integral part of the system is also the *R25 Web Services* software. This tool kit allows users to share their own data over Internet. Also, this software allows integration of R25 with other products that may be used in the space allocation process (e.g. AxisTV, Room Wizard, authentication servers, HVAC systems, etc.).

Last but not least, the *R25 WebViewer* is another important feature of the system. This component facilitates the web access of people who do not use R25 to all or some of the scheduling data generated with the system. For this reason, *R25 WebViewer* is installed on a

customer computer that supports the access of any number of users by creating a website that offers the following capabilities:

1) View and search events
2) See location information
3) Request space and resources for a meeting
4) Track events of interest and their calendar

4.6 Expected benefits

The use of R25 offers two types of probable benefits.

1) WPI likely can benefit from the experience of other academic institutions that have adopted already R25.
2) The people in charge of the space allocation at WPI know best the reasons for R25 implementation, what problems the software is expected to solve and how it will improve the space allocation system further.

4.6.1 Institutions

As pointed out on the CollegeNET website, the company serves over 1200 higher education institutions and non-profit organizations worldwide, and many of them use its software. On the website four case studies of users illustrate the reasons for and the benefits from the adoption of the R25 software. These case studies have commercial and self-servicing

intents. Nevertheless, they were considered in this study because of the informational content of their benefit. These data could be obtained through interviews with R25 users, but this task was precluded by the short duration of this study.

The four institutions described in the case studies are California State University San Marcos; the University of Richmond at Richmond, Virginia; Eastern University at St Davids, Pennsylvania; and the University of North Carolina at Pembroke. The reasons for adopting R25 can be summarized as follows:

- Need for improving, standardizing, and better controlling the overall scheduling process;
- Necessity to increase the availability and consistency of scheduling information across campus;
- Need for improving communication about scheduling between units responsible for event management;
- Relatively low-cost, easy-to-use product;

The benefits from using R25 can be summarized as:

- Savings in time and college resources;
- Improved management of assets;
- Campus-wide availability of detailed information about on-campus events;
- Better attitude of college communities (faculty, students, etc.) towards the space allocation bodies and their work;
- Ability to handle more events;

- Improved coordination of events properties (location availability, availability of required equipment, identification of already planned events that may detract from the event considered, etc.);
- Increased efficiency of the allocation system;
- Better tracking of space utilization through the reports generated by R25;

4.6.2 Space allocators at WPI

The main person responsible for implementing and using R25 for allocating academic space is Mr. Charles Kornik, the Administrator of Academic Programs at WPI. As described earlier, his overall attitude towards the upcoming change in the space allocation system is positive. According to Mr. Kornik, the implementation of R25 will have two major effects. First, information about all academic spaces will be included in the software and available to everyone to check what rooms are free. In this way, Mr. Kornik will no longer provide this information to other members of the WPI community and, at the same time, will know the exact amount and types of spaces allocated by departments. The second big effect will be the automatic assignment of rooms. Space allocation undertaken by departments currently is paper-based. With the new software, the space allocation process by departments and the tracking of space utilization will be enhanced and facilitated.

In the near future, only a small part of R25 capabilities will be used. The software will be employed for meeting current challenges (need for disseminating allocation information across campus, improving department-based space allocation processes, and tracking of available academic spaces) rather than making some radical changes in the system.

4.7 Implementing R25: the work of the author

The implementation of R25 is a very labor intensive process. Eventually, these initial efforts will lead to time savings, once the software is operational. Part of the installation process requires the input of data that describe the academic spaces on campus. In particular, the drawings of these spaces and the type of furniture they house had to be prepared and attached. As a part of this project, the author developed many floor plans of academic spaces. The author, in addition, worked with Mr. James Kenary to create AutoCAD files for spaces that are used for non-academic purposes. The reason for this was that R25 will be used in WPI for allocating all academic and event spaces.

As part of this work, the author first obtained existing floor plans from the Office of facilities at WPI. These documents were successively checked in terms of actual conditions and relative position of walls, door and windows as well as true dimensions. When needed, the size and number of the furniture (chairs, tables, etc.) and the equipment (blackboards, heating bodies, computer stations, overhead projectors, etc.) of each room was recorded. Sometimes floor plans turned to be incorrect or were missing. In this case, the author first measured the dimensions of the walls, the doors, the windows, and the distances between them and then measured equipment and the furniture. All measurements were taken with a standard 12-foot tape, ruler, and angle measuring math tool. The accuracy of drawings was maintained by

1) re-measuring furniture and equipment and
2) making sure that the differences between each two vertical or horizontal walls divided by the measured size for the smaller one was less than 0.5%.

With all these collected data, the author prepared AutoCAD drawings depicting the actual conditions and dimensions of walls, doors, windows, and blackboards as well as the actual number of furniture and equipment arranged in an organized (rather than chaotic) way. Figure 1A shows the typical existing floor plan of a classroom (SL407). Figure 1B, instead, shows the actual conditions of the room, namely modifications of the layout, actual equipment and furniture, including their location and arrangement.

Fig. 1 A) Old floor plan

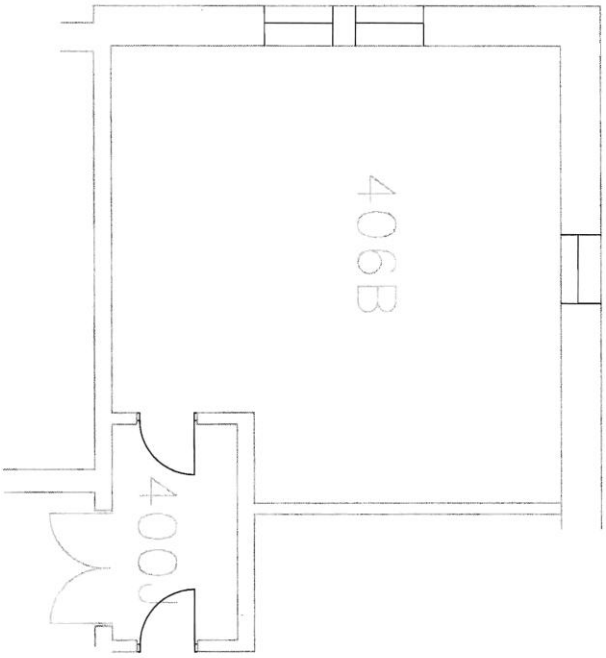
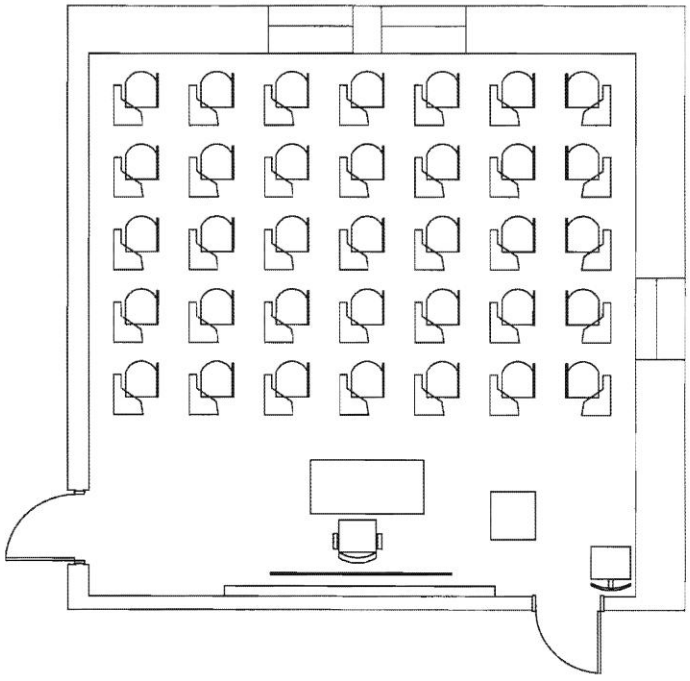


Fig. 1 B) The new floor plan as surveyed by the author



4.8 Recommendations

Two types of recommendations can be made:

1) Recommendations on how to use R25 more efficiently
2) Recommendations on how to improve the space allocation system at WPI as a whole

4.8.1 More Efficient Use of R25

The need for a better way of utilizing R25 stems from two factors: the features of this software including the wide range of its capabilities and the propensity of Mr. Kornik to use only a small percent of the software capabilities. If the features of R25 and the current system of space allocation at WPI are considered, without doubt, the software can improve the space allocation process.

First, faculty and presidents of student organizations should be trained to use the "event drafts" in R25, namely the development of space requests and their transmittal to allocators. In this way, Mr. Kornik will spend less effort in this task, including the reduction of time spent in negotiating space allocation issues with people visiting his office. Furthermore, faculty and students could be allowed to change the data about the events associated with their courses or student activities and transmit these changes to the space allocators for approval.

Second, R25 can be used for creating a network through which professors can contact each other and arrange the swapping of course spaces without using Mr. Kornik as a mediator. Thus, space swapping will be faster and the pressure on the allocators due to relocation issues will be reduced.

Third, a catalogue of courses and preferences for course time, space, and equipment by instructors can be created. Thus, the time spent in space re-allocation due to dissatisfaction of instructors will be reduced. If the development and use of such a catalogue is deemed too complex, then, at least, a list of course types can be made. Each of them can be defined as an event type in R25 in terms of registered students and, for some courses, typical required equipment (e.g. computers for computer science courses). Then, a list of appropriate spaces can be assigned to each of the courses types.

Fourth, R25 allows the sharing of tasks between its users. This feature, combined with the availability of a space allocation team (rather than a single space allocator like Mr. Kornik) can lead to the creation of an efficient central committee responsible for electronic allocation of all WPI academic space. Thus, the problem with the lack of enough time for space allocation activities (as explained by Mr. Kornik in the second part of this study) will be solved and the current expansion of the institute and its academic programs will be facilitated.

Fifth, R25 should be used for space utilization reports and screening. Thus, the challenge with the lack of data about overall campus academic space usage will be met. Allocators would be able to take into consideration issues of campus-wide room utilization when making decisions about space assignment.

There are many other changes that can be made with the help of R25 to facilitate allocation and improve space utilization. Although they are less important and relevant to the current WPI allocation process, they are listed below:

- "Screening" (checking characteristics of) spaces to see how well they meet customer needs;
- Assigning reference numbers to classes so that they can be sorted by time schedule;

- Grouping events by date and time by using R25 “cabinets”;
- Using the option of binding reservations to course meetings held at different times and weekdays and making sure that there are no duplications;
- Exploiting the “Contacts” tool to store e-mails of faculty and other customers;
- Using customer ratings to make evaluations (e.g., punctuality, problems, multiple successive reallocation requests, etc.);
- Creating a list of classes per term before assigning activities to spaces by reserving events without allocating rooms to them;
- Defining blackout dates and thus keeping activities into a certain period of time;
- Attaching information to space assignments or including data in the “Events Properties” to communicate important details to faculty and maintenance employees;
- Using R25 to search for available spaces and their evaluation;
- Attaching categories to events for classification and search purposes;
- Using workflow options to communicate with other R25 users, assign them event-related activities to do, or ask them to approve a request for space;
- Exploiting task views to subdivide work into convenient lists;
- Using event history to detect unauthorized or illegal changes in reservation procedures.

4.8.2 Better Space Allocation System at WPI

As addressed earlier in this report, obvious from the report so far, the current space allocation system has its advantages as well as weaknesses. As a whole, the centralized system

seems appropriate to WPI due to the characteristics of academic space, its small size, the barely sufficient amount of academic space, and the difficulty of differentiating courses according to importance. However, some changes in the system can definitely improve the space utilization, the satisfaction of students and faculty with the assigned spaces and their characteristics, and the ability of WPI to cope with contingent situations due to a sudden unavailability of academic space. The current system, in addition, can be changed in such a way to decrease the effort and time spent in the administration of academic space allocation.

First, the space users of the WPI community (student organizations and faculty) should be able to regularly voice their opinion about space allocation decisions. This is a very important part of a centralized space allocation system like that of WPI. For this purpose, feedback should be encouraged and all space users should be able to make comments and evaluate the performance of space administrators.

Second, space utilization should be improved. There are several ways to achieve this goal:

1) Space allocation can be performed after student registration. This arrangement should be limited to new courses only. This goal can be achieved by organizing a scheduling process first, then student registration, and lastly space allocation could be performed on the basis of actual number of students.

2) If some courses have to be assigned to classrooms with capacity significantly higher than the registered number of students, the lecturer should be instructed to use only a portion of the room not allowing students to sit at other parts. Thus, the cost of using the room utilities (particularly, electricity) and the maintenance costs associated with the course activities will be lower.

3) The space administrator always should try to follow the fill ratio, since this ratio is a compromise between cost minimization, on one hand, and quality and convenience of course activities, on the other hand.

4) 2-hour lectures should be scheduled in such a way that part of them should be between 8 AM and 9 AM or between 4 PM and 5 PM. This way would improve space utilization rate because at those hours there are plenty of free spaces. This arrangement, in addition, would increase the probability that instructors receive the space of their choice.

5) Space requests by departments should be monitored to avoid the possibility that allocated space is not used. This problem can be avoided by allocating space to courses scheduled by lecturers. The current system which includes scheduling courses by space administrator in cooperation with department heads can lead to space waste in some circumstances and should be modified.

6) The allocation of all departmental conference rooms but one should be centralized and controlled by a committee, consisting of the administrator of academic programs, the provost, and possibly one representative of each department. This committee should assign all classrooms, computer labs, and most of the conference space.

7) The scheduler should try to achieve equal space utilization for each room in a building. Thus, the problems associated with different rates of usage and subsequent different rates of deterioration of the premises will be lessened.

Third, more space should be dedicated to academic activities. In this way, the problems with the currently high fill ratios, the absence of reserve free space, and lack of adjustable rooms will be solved.

Fourth, some of the academic rooms should be designated as "adjustable space" and used for courses requiring special equipment. Thus, few of these courses will be canceled. Furthermore, this space should be adjustable in such a way that it can be periodically (say, once a year) modified to allow courses that require different special equipment. To achieve high utilization of these rooms, the allocation committee should assign them not only to courses for which they are suited but also courses with low equipment requirements as well as some student activities that do not require equipment other than tables, chairs, and possibly blackboards.

Fifth, the allocation body at WPI should implement and use an automated course scheduling system for assigning activities to available time slots. In this, way, the significant amount of work associated with manual scheduling will be no longer necessary and space administrators would be able to concentrate on other more important tasks. Also, the possibility of personal preferences affecting scheduling decisions will be lessened.

There are several other changes that could be made to improve the current space allocation system at WPI. These are less important and relevant to the system. Nevertheless, they are listed below:

- The allocation process can be organized in such a way that the most common student schedules with particular majors are taken into consideration.

- The institute can make sure that the student population enrolled in a course does not exceed the maximum capacity of assigned room, as per fire code. This task can be performed by the Office of the Registrar so that the space allocation personnel do not spend much time on this issue. Faculty members should never be allowed to exceed the maximum capacity of an assigned classroom since situations such as letting things go as they are, not accepting students in the course, or looking for a new space have some negative consequences on the image of WPI or may lead to legal actions against the college.
- Space administrators should arrange the courses in such a way that each space is free for maintenance at least one hour per day in the time period 8 AM-5 PM.
- Space administrators should not forget that the displeasure of faculty with the centralized space allocation system is one of its main disadvantages. They should try to meet the needs of professors as much as possible.

4.9 Conclusion

R25 is an effective software product for event management that can be used for the efficient allocation of academic spaces to classes and other on-campus activities. This is reflected in the numerous benefits observed in higher education institutions that implemented the product in the past. R25 is currently being installed at WPI, a task that requires an extensive amount of work. Part of this study supported this installation process by surveying academic spaces and developing visual space data (particularly, layouts of academic and event spaces with the exact location and dimensions of walls, windows, and doors as well as sizes, numbers, and an idealized

organized location of room equipment and furniture). These data had been developed with the help of the software AutoCAD 2009. However, the current plans about R25 are to use only a small part of its capacity, namely the solution of the current allocation-related problems.

No formal strategies for exploiting its full capacity have been developed. For this reason, a set of steps aimed at improving the current WPI system by fully implementing R25 was developed in this study. The most important are: training the members of the WPI community on the use of the software; establishing a network of faculty members that allows them to swap spaces on their own; developing a list of courses with faculty preferences about space; enabling the sharing of tasks among R25 users; using the software to generate both space utilization reports and screening.

As a whole, the current system for allocating space at WPI is appropriate, given the characteristics of the university and the conditions (number and types of rooms) of its academic spaces. However, the system can be improved. This objective can be achieved not only by further implementing R25 at the college, but also by making certain changes. The most important are: creating a system for providing feedback on space allocation decisions; increasing overall academic space utilization; increasing the amount of academic spaces; creating special "adjustable spaces" for courses that require special equipment; and finally implementing an automated scheduling system.

5. Conclusion

In this study, the challenge of allocating academic spaces for operations such as holding classes, conducting research, discussing course issues, and receiving help from TAs was addressed. In facility management and computer science, this challenge is termed "the space allocation problem" and can be defined as the need to assign a space to an academic activity in the best possible way, given a fixed number of activities and spaces. Two approaches to this task exist: the centralized and the decentralized practices. Both of them reduce the problem to smaller ones that are easier to solve.

At WPI, academic spaces can be divided into six categories: classrooms, computer labs, conference rooms, labs, lounges, and faculty offices. They are administered by a system consisting of six units: Administrator of Academic Programs, Events Office, departments, Provost, Office of the Registrar, and Office of Facilities. The allocation practices used at WPI include elements of both the centralized and the decentralized approach to space assignment. The Administrator of Academic Programs is responsible for assigning classrooms, computer labs, and some of the conference rooms to academic activities. The departments at WPI control the use of the rest of academic space in their own buildings. Due to the time constraints of this study, only the work of the Administrator of Academic Programs (currently, Mr. Charles Kornik) was explored and described in detail. As shown in Chapter 3, there are four criteria used by him for allocating space:

1) the "first come, first serve" principle;
2) the goal to achieve a student-to-seats ratio of 67 %;
3) the attempt to give individuals and organizations the rooms that they prefer;

4) the priority of academic over non-academic activities

As a whole, the current system for allocating space at WPI is appropriate with respect to the characteristics of the university and the number and types of its academic spaces.

The existing system for allocating space is undergoing a significant change: the introduction of Resource 25, an event management tool that will be used for more efficient administration of space. It is currently being installed at WPI. Part of this study included facilitation of the implementation process by surveying certain on-campus spaces and developing their electronic layouts. Also, the software was explored and its characteristics are described in Chapter 4 of this report. It is shown that Resource 25 is a tool with big capacity that can be used for facilitation of the space allocation process.

However, the current plans of administrators are to use Resource25 for solving current problems only. No strategies for optimum utilization of the capabilities of the software exist. For this reason, a set of recommendations for improving the current WPI system by fully implementing R25 was developed in this study. It is based on the analysis of the existing space allocation practices, the number and types of available classrooms, and the improvement opportunities offered by the software. The most important recommendations are: training the members of the WPI community to use Resource 25; establishing a network of faculty that allows members to swap spaces on their own; developing a course list with faculty preferences about space; enabling task sharing among R25 users; using the software to generate space utilization reports and screening.

The analysis of space administration at the institute also led to the development of a set of measures that can be taken for further improvement of the utilization of premises used for academic activities. The most significant recommended changes include: creating a system for providing feedback from space users on allocation decisions; improving the overall utilization of

space; increasing the amount of classrooms; creating “adjustable rooms” for courses that require special equipment; implementing an automated system for course scheduling.

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