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Qualitative Timetabling: An Organizational and Qualitative Approach to Improving University Course Scheduling

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Abstract

Focusing on the current timetabling process at the University of Toronto Mississauga, I apply David Wesson's theoretical framework in order to understand how increasing enrolment interacts with a decentralized timetabling process to limit the flexibility of course schedules, and the resultant impact on educational quality. I then apply Robert Birnbaum's leadership ideas to improve UTM's timetabling process: I propose the provision of strong centralized leadership in the timetabling process instead of the current central service support of a decentralized process.

University course scheduling, or timetabling, is a complex problem involving logistics, politics, funding, and pedagogy. A definition of timetabling typical in the existing literature is "the determination of which courses are taught at what days and times, in which rooms, and taught by whom (Thompson, 2005, p. 198)." To this definition other scholars have added the dimension of who needs to enrol in the courses (i.e., the determination of how each course fulfills requirements for any given program of study). Similarly, the timetabling problem has a common definition among scholars: how to create a feasible timetable given a set of constraints or rules (i.e., any factor that limits when or where any course can be scheduled).

At the University of Toronto Mississauga (UTM), where I have been responsible for timetabling for the past three years, timetabling is a highly decentralized process wherein all course sections, scheduling and instructor allocations are completed at the departmental level; central coordination only occurs at the end of the process when rooms are allocated. While this arrangement has worked in the past, it has recently begun to create problems due to a significant enrolment increase over the past 8 years without a comparable increase in classroom space. Every year more and more courses must be rescheduled on an individual basis because of limited room availability, and it has become increasingly difficult to reschedule courses without disrupting the timetable as a whole. Thus, the quality of the timetable decreases each year as the course-by-course scheduling modifications degrade the overall integrity of the timetable.

The goal of this paper has two parts: to discern the specific nature and cause of the timetabling problems currently facing UTM and their impact on the quality of undergraduate education; and to propose improvements that incorporate adjustments to process, organizational structure, and leadership. I believe that this paper will make a unique contribution to the literature as it will help to fill the gap in non-mathematical and -computational approaches to addressing the university course timetabling problem.

In the first section I will begin by reviewing the existing literature about university timetabling and examine a theoretical framework proposed by David Wesson that will help assess UTM's timetabling problem, followed by a brief description of data collection methodology. In the second section I will look at the nature and impact of the timetabling problem at UTM by analysing UTM's

timetabling and enrolment data and applying Wesson's theories. The third section will describe Robert Birnbaum's leadership ideas and how his framework can be applied to propose a solution for the timetabling problems described in section two. Finally, I will propose areas for further research that could add more to this area of study.

Existing Approaches to the Timetabling Problem

A search through existing literature about tackling the problems presented by course scheduling reveals a great deal of work in the areas of mathematics and computer science. This work has been of great value as it has provided the groundwork for the development of automated course-scheduling software that is typically used by university timetabling officers. What these approaches do not address, however, are the nature and types of constraints that limit the flexibility of a course timetable. In fact, in a search through the ERIC (Educational Resources Information Center) database and a general social sciences search on Scholar's Portal, I found almost no literature dealing with timetabling from an organizational or theoretical perspective.

One notable departure from the computational context of timetabling deals with the concept of scheduling courses based on student preference as a primary constraint. In "Using information on unconstrained student demand to improve university course schedules", Gary M. Thompson measures quality in course scheduling as "the extent to which students are able to take the courses for which they express preferences" (Thompson, 2005, p. 198). This article provides an important perspective because instead of assuming a given array of constraints, Thompson introduces the concept of examining timetabling constraints themselves, and their impact on the timetable. This concept will be applied later on in this paper when I examine the limitations of the current timetabling arrangement at UTM and their impact on educational quality.

David Wesson's Interactive Constraint Model

Another significant departure from the standard treatment of timetabling as a mathematical and computational problem is David Wesson's work on timetabling as a theoretical construct, as described in his 1995 article "The Interactive Effects of Rules on Teaching Timetable Flexibility and Resource Utilization" (Wesson, 1995). Wesson's work is valuable as it provides a method of articulating and assessing timetable inflexibility due to the interaction of scheduling constraints.

Wesson's construct contains four main interacting dimensions: teachers, students, rooms, and time slots. The degree, number, and interaction of constraints related to these dimensions are what govern the feasibility of a timetable. Wesson's model of the interactive effects of timetabling constraints is illustrated by three propositions:

1. Any constraint on a dimension of timetabling reduces flexibility to a greater degree than the constraint considered on its own;
2. Changes to a course's existing timetable will destabilize the rest of the timetable in inverse proportion to the degree of flexibility in the timetable;
3. There is a point at which the ratio of all constraining factors to one another will preclude the production of a feasible timetable (Wesson, 1995, p. 308).

The concept described by these propositions is that no one timetabling constraint exists independently from another, and that any given constraint has a

cascading effect on the rest of the timetable. Wesson theorizes the existence of a “Threshold of Rigidity”: the point at which no additional courses can be scheduled and no existing schedules can be modified without disruption to the rest of the timetable, regardless of whether the institution is operating at 100% capacity (i.e. full room utilization) (Wesson, 1995, p. 307). I will illustrate Wesson’s timetabling theory in the next section by applying his framework to UTM’s timetabling process.

The significance of Wesson’s work is that it highlights the real world effects of timetabling constraints. Program requirements, instructor schedules, and room utilization are no longer computational inputs for an algorithm. Instead, Wesson has created a unique frame of reference that builds an understanding of how each of the key timetabling dimensions work together to form a course timetable, and how constraints to each of these dimensions can interact to degrade the quality of a timetable, and even preclude its feasibility. While his article does not describe the application of his theory to a real-world timetabling problem, it has provided a vocabulary and toolset which can be applied to identify weaknesses in an institution’s timetabling process, as I will demonstrate.

Methodology

The data about UTM course offerings and timetabling were provided by the Office of the Registrar at UTM. The course offering data cover the academic sessions from the fall 2001 session through the spring 2008 session. The data do not include summer session information, as the summer session at UTM is secondary to the Fall/Winter session; typically, comparatively few courses are offered during the summer, and there is little coordination needed as most students take no more than one course at a time. The data are comprised of every unique meeting of every course offering, and include the following information for each of those meetings (example data provided):

Course	FAH288H5
Year of study (i.e. 1st, 2nd, 3rd or 4th year)	2
Session	20051
Discipline	FAH
Class average (GPA)	2.3
Activity type	LEC
Meeting section number	0101
Meeting day	Mon
Start time	10:00
End time	12:00
Duration	2.0
Building	NE
Room number	160
Room capacity	73
Room type	Tiered lecture
Final class enrolment	71

Enrolment cap	73

Data regarding the timetabling process were obtained from the database of departmental scheduling requests in preparation for the 2008-2009 academic year, and compared with the final schedule for that year. All data were analysed using desktop spreadsheet software.

In addition to historical enrolment data, I have relied heavily on my three years of experience as Campus Timetabling Officer (CTO) at UTM and the preceding two years during which I provided back-up assistance and database programming support to the CTO. I have worked closely with academic departments, their chairs, faculty, and administrators, as well as the Registrar and Assistant Academic Dean. These collaborations, combined with my involvement in timetabling during a period of significant increase in enrolment have provided me with valuable and credible authority in discussing the timetabling situation at UTM.

Timetabling at the University of Toronto Mississauga

Two key factors have played a prominent role in the growing inflexibility of UTM's course timetable: a significant increase in enrolment without a corresponding increase in instructional space and the lack of centralization and flexibility in the timetabling process. The problematic nature of the decentralization of UTM's timetabling is highlighted by the three departments who have recently embraced a more centralized method of timetabling.

A Decentralized Process

At UTM, all initial course timetabling happens at the departmental level; all departments build their timetables independently of one another, except in cases where a course is a requirement for an inter-departmental program. The foundation of the timetable every year is the previous year's timetable; decisions about which courses to offer, how many spaces and sections for each course, the allocation of faculty to course sections, and course sections to time slots is done by a designated faculty member with the assistance of a departmental administrative assistant. New courses are slotted in and existing courses are rescheduled as needed while taking into account program requirements and faculty schedules. Room availability is totally ignored in this part of the timetabling process.

Room allocation is conducted centrally in the Office of the Registrar (OR) by the Campus Timetabling Officer (CTO). Because of limited classroom space, the room allocation part of the timetabling process is characterized by a great deal of back and forth communication between the CTO and departmental administrators. This inefficient process results from the fact that the course timetable from each department is developed and set in isolation from the timetable as a whole, before it reaches the CTO.

Effectively, each course activity can only be taught during one preset timeslot – the ultimate form of scheduling rigidity. Any change that is required in order to fit courses into available classroom space requires revisiting this extremely rigid scheduling constraint – a process that requires the involvement of the CTO, the departmental administrator who acts as liaison, and the departmental chair (or designate) who has the authority to make scheduling decisions. This process results in significant disruptions to the timetable each time a course needs to be rescheduled. Because it is impractical to revisit schedules that have already been effectively finalized, the overall integrity and

quality of the timetable is lessened with each subsequent change. The impact of this rigidity will be further examined in the next section.

The exception to the decentralized process has been employed only recently by three out of sixteen departments. The faculty members responsible for the timetable in these departments (one departmental chair and two undergraduate coordinators) work directly with the CTO starting with the scheduling phase (i.e., after course offerings have been decided upon, and section caps have been finalized). This consultative process usually takes the form of one or two face-to-face meetings followed up with email and telephone correspondence. This arrangement is effective because the undergraduate coordinators generally have a better understanding of each instructor's scheduling constraints than the administrative assistants who normally act as liaisons between the CTO and the departmental decision-makers. Furthermore, they have much more influence on the instructors when new scheduling arrangements need to be made, and most importantly, they have authority to make decisions about the scheduling of courses. The degree and nature of cooperation provides the CTO with much more insight and information about the department's scheduling constraints, which is useful throughout the entire process and for the production of future timetables. In the same way, the departmental academic authorities (i.e., the undergraduate coordinator and/or chair) gain much more insight and information about the broader scheduling issues extant on the campus, and tend to be much more flexible with their schedules in accommodating constraints and considerations such as room utilization and student success. The end result is a timetable that is more flexible. It is able to maintain its overall integrity while being adjusted in response to interactions with scheduling constraints from other departments.

The main distinction between the typical decentralized approach and the atypical coordinated approach is that with the latter, the CTO is involved in the timetabling process starting from the scheduling of courses in timeslots. This means that the course schedule for the three departments involved is built in the context of the timetable as a whole, instead of being constructed in isolation from all other course schedules on campus. In effect, the process in this limited instance has been centralized.

Environmental Factors

The limitations inherent in the timetabling process are compounded by recent changes in environmental factors at UTM. Since September 2001, enrolment has increased by 62%, while the number of classroom spaces has increased by only 32% (See Appendix A, Chart 1). As a result, space utilization has increased from 24.4 hours per week in 2001-2002 to 37.1 hours per week in 2007-2008, above the standard of 30-34 hours per week set by the Council of Ontario Universities (COU) (Council of Ontario Universities, 2007, p. 149). Within the overall room inventory, the percentage of rooms operating above COU standards has increased dramatically from about 10% to over 60% (See Appendix A, Chart 2). The significance of this space limitation is that it has presented a scheduling constraint of growing rigidity that interacts with the other constraints to negatively affect the overall flexibility and quality of the schedule.

Overall classroom space available per full-time student has decreased, as defined by COU space standards; we are now well below the COU standard of 1.23 net assignable square metres (NASM) per full-time student (FTE). This figure is calculated using the COU Space Formula (COU, 2007, p. 150):

	Average university classroom	

NASM per FTE Student	station size / Room utilization standard X Station utilization standard	X weekly student contact hours

This standard makes several assumptions: average university classroom station size is assumed to be 1.7 meters per student; the room utilization standard is assumed to be between 30 and 34 hours per week; the station utilization standard is assumed to be 74% to 65% seats occupied when the room is used. Finally, the number of hours each student spends in lectures or tutorials per week is assumed to be about 16. Applying this formula to UTM using UTM's actual room and station utilization values provides insight into the space situation: NASM per FTE student has decreased from 1.67 in 2001-2002 to 1.03 in 2007-2008 (See Appendix A, Chart 3).

The Result of Rigid Constraint Interaction

The impact of the environmental factors is that instructional space is very limited; a constraint which interacts with the constraints that result from the decentralization of the timetabling process. The result is that a significant number of activities cannot be scheduled as originally planned by the department. Because there is an assumption that departmental schedules will be accommodated exactly as requested, instructor schedules tend to be finalized prior to the production of the timetable, creating a very rigid constraint that greatly reduces overall timetable flexibility. Secondly, because all courses for a given department are scheduled to be conflict-free among programs and years of study, any change requested or required during the production of the timetable impacts the other courses that may not have needed to be rescheduled. Without central coordination of the timetable from the very beginning of the scheduling process, departmental timetables inevitably collide and conflict given the scarcity of rooms that must be shared.

In the 2008-2009 course timetable, 43% of lecture sections and 49% of tutorial sections could not be scheduled as requested. The number of these non-optimum schedules is lower among courses where schedules are very rigid due to coordination of lectures, tutorials, and extensive lab times, or due to total rigidity of instructor schedules. The number increases greatly among courses where there is less rigidity. Wesson's first proposition is demonstrated here: the cascade effect of increased constraint among a few courses affects a greater number of courses. It is important to note here that the rigidity of constraints with respect to course coordination and instructor schedules is a presumed or perceived rigidity. I will address this distinction in the next section as it has potential ramifications for the development of a new timetabling process at UTM. Duration and number of meetings per week are additional constraints that illustrate Wesson's first proposition, given that all meetings for individual course sections must be scheduled in the same room. While 56.4% of all activities meet for 1 hour, 1-hour activities represent 62.9% of the courses that were rescheduled. In contrast, 2 hour activities make up 34.7% of all activities, while representing only 29.6% of those rescheduled; three hour courses hold a similar differential at 8.8% of total, and 7.5% of rescheduled activities. Similarly, the variance between courses that meet once, twice or three times per week demonstrates that an inordinate percentage of courses meeting once are displaced: while this group makes up 88.7% of all activities, they represent 93% of rescheduled activities. In contrast, the 3.3% of activities that meet three times per week make up only 0.7% of rescheduled activities; activities meeting twice per week form 8% of the total, and 6% of those rescheduled. Thus, the smaller number of courses with less scheduling flexibility displaces a greater number of courses with more flexibility.

Wesson's second proposition comes to bear after the draft timetable has been published. There are always numerous requests for change in an already very rigid timetable. In the majority of cases, change requests during the draft phase of timetabling are disruptive and destabilize the overall timetable; usually a change requested to one course will impact at least 2 others (often more, especially when rescheduling a mid- to large-sized year-long activity that is greater than 1 hour in length). During the production of the 2008-2009 timetable, there were a total of 249 course sections added to and 55 removed from the schedule after the production of the draft.

Thus, according to Wesson's definition, UTM has crossed the Threshold of Rigidity: no additional courses can be scheduled and no existing schedules can be modified without disruption to the rest of the timetable notwithstanding the fact that UTM is not operating at 100% – 57 hours per week average room utilization (COU, 2007, p. 149).

The Consequences of Crossing the Threshold

The connection of resource limitations (due to increased enrolment) and process problems (due to inefficient organizational structure and decentralization) to course timetabling problems is clear. But what is the impact of the problem – specifically, how does timetabling inflexibility affect the quality of the timetable and of undergraduate education at UTM?

Class Size

The relation of timetabling to quality in higher education has not been extensively researched; the existing literature that relates to this topic tends to focus on the issue of class size. Conventional wisdom holds that large class sizes negatively impact educational quality, yet much of the research conducted in this area does not support that conclusion. However, an examination of class averages at UTM since 2001 suggest that class size has an impact on student success, which in turn suggests an impact on course quality – it follows that a better quality course is likely to produce a higher class average. Among all levels of study – 1st, 2nd, 3rd, and 4th year – class averages degrade as class size increases: small (1-30); medium (31-50); large (51-100); and extra-large (101-500) (See Appendix A, Chart 4).

The apparent link between class average and class size at UTM is compounded by the enrolment increase. As expected, the numbers of all class size groups at UTM have increased. However, between 2001 and 2008, of the total number of offerings, the percentage of small classes decreased by 6.05% and the percentage of extra-large classes increased by 5.57% (See Appendix A, Chart 5). Given the almost 1 point decrease in class average between small and extra large classes, this class size trend suggests a negative impact of the increasing rigidity of the timetable on quality.

The perception that quality degrades with increased class size is shared by some first year instructors at UTM. In my experience as Campus Timetabling Officer, I have encountered a strong negative sentiment from many instructors of first-year courses regarding the increase in their class sizes. They feel that large class sizes have a negative impact on the quality of education as it limits their ability to interact with the class, and limits the ability to teach the material to such a large group.

Class Timing

Although the data indicates little impact of when a class is held on class average, the time of day classes meet could also impact quality from the standpoint of student convenience. While the percentage of lectures offered during the day (before 5pm) has actually increased by 1%, it has been at the expense of tutorial meetings: the number of tutorials meeting at night has increased by 8.4%. Because students' lectures are still largely held during the day (92%), quality could be negatively affected by students' having to continue coursework into the evening, instead of spreading tutorials throughout the day between lectures.

The data also suggest another negative impact on quality: the number of hours each activity meets per week has been negatively affected by the current timetabling process and enrolment growth. Lectures met an average of 2.16 hours per week in 2007-2008, compared with 2.51 in 2001-2002. Assuming each full time student takes an average of 4.5 courses per term, the number of contact hours in lectures and tutorials for each student has declined from 16.8 to 14.9.

Student Preference/Student Demand

Whether or not the course timetable allows students to take the courses they want is integral to student satisfaction and the quality of their educational experience – and it also raises the issue of access, that is, whether the timetable provides access to courses that students want to take. An example of the implementation and effect of student demand timetabling is provided by Gary M. Thompson of Cornell University. In his 2005 article, Thompson measures quality in course scheduling as "the extent to which students are able to take the courses for which they express preferences" (Thompson, 2005, p. 198). By conducting an experiment that tested a timetable based on student demand only versus a timetable that relied on other constraints such as program requirements, he found a 22% increase in the number of students who were able to enrol in at least one additional preferred course (Thompson, 2005). Thus, in this example student demand-based timetabling had a positive effect on the quality of the student experience. While I believe his study was flawed because it did not account for student motivation in course choice, I do agree that student satisfaction is an important factor in educational quality, and that student demand-based timetabling can have a positive impact on quality.

An important part of Thompson's discussion relates to customer service: to wit, relying on information about service provided in the past to make decisions about future service will perpetuate bad service. In UTM's context the current reliance on the previous year's timetable is potentially limiting the service that can be provided by the timetable: access to preferred courses.

While there is currently no data available to ascertain whether or not students are able to enrol in preferred courses at UTM (although I presume they are able to enrol in the necessary courses to graduate), the current timetabling process makes absolutely no provision for student demand. Given the constraints already mentioned, I believe it is likely that students are not able to routinely enrol in preferred courses, and that it is not possible to incorporate student demand into the current timetabling process given its inflexibility and decentralization.

The timetabling process at UTM is characterized by an information disconnect between the departments and the CTO that results in disruption to much of the overall course schedule when the central timetable is being produced. The potential for non-optimum timetables is increased by the

restrictions to the process, which in turn have a negative impact on the quality of the students' education experience.

Toward a Centralized Process

Because UTM's timetabling problem is rooted in communication disconnects and process inefficiencies caused by decentralization, the solution to the problem must move the timetabling process to a more centralized model. As described previously, there has already been some measure of success in implementing a more centralized coordination of timetabling on a small scale. Success in this case is characterized by a more efficient timetabling process; less time was spent on the process, and the number of changes to the timetable after it was produced was minimal. Where there were changes needed in order to accommodate the more rigid schedules of other departments, it was much easier to maintain the integrity of the schedule because the CTO had more constraint information and more discretion to make adjustments. The key components to this success were that the main point of contact at the departmental level was a designated faculty member with the authority to make scheduling decisions, that the departmental designate provided complete scheduling constraint information to the CTO, and that CTO was granted some measure of discretion to make adjustments to the timetable.

The Advantages of Centralization

Centralization of the timetabling process will provide several improvements over the current model. Firstly, it will enable a wider view and assessment of all scheduling constraints prior to the production of the timetable, thereby allowing management of their interactions, which previously had not been possible. A key example of this is the aforementioned problem of instructor scheduling constraints: under the decentralized process, instructor schedules are already set prior to central room allocation. As such, it is assumed that instructors are totally inflexible, as it would prove to be highly onerous to force faculty members to revisit their schedules every time a schedule adjustment is needed. However, if real faculty scheduling constraints are known prior to central scheduling, there is no need to re-consult with each faculty member during the process. Faculty schedules would thus be set after rooms have been allocated. In this way, the rigidity of instructor scheduling constraints is greatly reduced by centralization, as is the correlating negative impact on the flexibility of the overall schedule.

A centralized timetabling process will also allow incorporation of student demand data into the process, thereby identifying potential course combinations heretofore unknown; it will also enable better planning of course offerings based on previous enrolment data and student demand. Additionally, class size may be positively affected: planned station utilization (i.e., calculated from maximum enrolment capacities) has been consistently higher than actual station utilization (i.e. calculated from actual enrolments) during every school year surveyed; more significantly, this differential has also been consistently higher among classrooms seating less than 100 students versus the larger rooms. With better data for planning course offerings and sectioning, we may be able to more accurately predict the number of students enrolling in classes, thereby releasing more space for additional smaller courses.

While room utilization is already comfortably above the COU standard, utilization is slightly higher in rooms that seat 100 or greater. Additionally, in my experience there are a growing number of occurrences where course caps in existing sections need to be raise because there are not enough smaller rooms available for an additional smaller section. Centralization is likely to increase

room utilization, thus allowing more space for additional sections of courses to be offered, assuming the funding exists for instructors.

Consequences to Leadership

Given the institutional culture of research intensive universities such as UTM, wherein faculty members exert significant influence, it is sometimes difficult to effect change, especially that which could be perceived as wresting control and discretion from faculty. However, I believe centralization of timetabling at UTM is possible in spite of this context if changes to leadership and organization in the process are implemented: Robert Birnbaum's work on leadership in higher education can be applied to ascertain and describe these necessary changes.

In his book "How Academic Leadership Works", Birnbaum examines the nature of effective leadership in higher education, based on empirical research. Although the context he uses is that of the college presidency, I believe some of his ideas can be applied to a reorganization of the timetabling process. In particular, he identifies faculty support as a key factor in the success of leadership in higher education, particularly in times of change. He also describes four cognitive frames for considering leadership: structural, collegial, political, and symbolic. With these ideas in mind, I will examine the impact of leadership on timetabling at UTM, and how some structural re-organization could aid the move to a centralized timetabling process.

Structural and Symbolic Frames

At present, course timetabling falls under the sole jurisdiction of the Office of the Registrar. As such, I believe it is viewed as a service provided to students and faculty in much the same way the Office of the Registrar provides other services to students and faculty such as academic advising, maintenance of enrolment data, financial aid, examinations coordination, etc. Essentially, because timetabling happens largely at the departmental level, the central timetabling service provided by the OR is seen simply as the provision of rooms. The continued involvement of the Office of the Registrar is critical: not only does the Office manage the allocation of instructional space; it also plays a significant role in the management of enrolment during course registration periods. However, as demonstrated above, the current timetabling process needs to do more to coordinate the overall schedule – in essence, UTM requires the provision of central leadership in the timetabling process, not simply the central provision of a service.

In order to successfully broaden the mandate of central timetabling to include more leadership, involvement and influence in departmental planning, I believe it is critical to gain the acceptance of the faculty; the timetabling process would therefore benefit from being a shared jurisdiction between the Office of the Registrar and the Office of the Academic Dean. The advantages to this organizational arrangement is that the Academic Dean would provide a formal reporting structure, credibility, and accountability that would have a direct link to the academic side of the campus, and thus to the faculty. The established atypical centralized timetabling style illustrates this advantage. In the examples of the three departments that employ this style, the faculty timetabling designates act as the academic authority. As such, they are able to influence fellow faculty members with respect to scheduling, and by working closely with the CTO, they impart both credibility and authority with respect to centralized timetabling decisions. The additional advantage to this arrangement is symbolic: the formal association of central academic authority with the timetabling process

would ensure faculty that their needs and general academic concerns are considered a priority in the construction of the timetable.

The Office of the Registrar's continued involvement in the process will be enhanced. As discussed, a centralized process would allow more accommodation of student needs into the timetable; the Office of the Registrar will be able to coordinate student success and needs with the construction of the timetable much more effectively than it does now, including the assessment and accommodation of student demand, and more accurate planning with respect to course sectioning.

Political and Collegial Frames

I group the political and collegial frames together because both depend on working with people. The centralized process will require an unprecedented amount of cooperation with faculty and departmental chairs to ensure that all scheduling needs and requirements are met. As such, the central timetabling authorities must maintain strong, collegial working relationships with all departments and faculty. Faculty concerns and needs must be heeded and taken seriously in order to ensure that the final schedule is credible and acceptable.

Politically, it is important that some kind of formal governing body overseeing academic timetabling be established to maintain accountability and credibility in the eyes of the faculty. This will also provide a formal avenue for receiving feedback about the process from faculty, and to resolve timetabling disputes that inevitably arise when space is at a premium, and when there is a variety of different types and qualities of rooms in the inventory, such as it is at UTM.

Conclusion

By applying Wesson's framework to UTM, I have demonstrated that the current decentralized timetabling process has created a set of constraints so rigid that their interactions have pushed us to the Threshold of Rigidity and beyond. The critical factor of increasing enrolment will not subside, and thus change is needed. The proposed centralized process will enable UTM to cope with the current enrolment and instructional space differential by coordinating the timetabling process from the beginning. In short, this means accounting for our physical constraints throughout the process, rather than only at the end. The new process will also open the door for other improvements to timetabling, such as the inclusion of student demand information into the process.

A centralized process will require those responsible for central timetabling to evolve from a service-oriented approach to a leadership approach that has the academic weight to gain acceptance from the faculty. Thus, by reframing the timetabling problem at UTM as a leadership opportunity rather than simply a service problem, current and future challenges can be met.

Further research

Looking at university course timetabling from an organizational, leadership, or theoretical perspective can teach us much about ways to improve our processes and how to cope with limited resources. While I suspect this framework is particularly useful in the context of research-intensive universities, I believe it to be generally useful for many types of post secondary institutions such as community colleges and polytechnic universities. As such, a useful

research topic would be an examination of the impact of institution type and size on the timetabling process.

I have found that the type of instructor has some impact on the constraints in timetabling. Whether a course is taught by a tenured professor, sessional contract instructor, long-term teaching appointment instructor, or graduate student seems to have an impact on the schedule. I suspect that a study of the types of instructors that teach university courses may reveal trends in scheduling restrictions.

While the solution proposed herein focused on managing faculty expectations and requirements, it is equally important, if not more so, to focus on the needs of students with respect to course timetabling, and in the context of process improvements and re-engineering. Of particular interest would be a continuation of the work Gary Thompson started with his study of student-demand timetabling, with a focus on the motivations of students when choosing courses, and also what characteristics of those students may impact course choice and scheduling preferences (i.e. whether the student lives on- or off-campus, is full- or part-time). This may provide valuable insight into the effect of timetabling on educational quality and access.

Finally, a broad study of timetabling at many universities may shed some light on the different styles and processes, different levels of centralization, and the impact of organizational structure and leadership on timetabling processes.

References

Birnbaum, R. (1992). How Academic Leadership Works: Understanding Success and Failure in the College Presidency (1st Ed.). San Francisco: Jossey-Bass.

Council of Ontario Universities. (2007). Council of Ontario Universities' Building Blocks: Users' Guide, Revised for 2007-08 Survey. Toronto, ON.

Thompson, G. M. (2005). Using Information on Unconstrained Student Demand to Improve University Course Schedules. Journal of Operations Management, 23(2), 197-208.

Wesson, D. A. (1995). The Interactive Effects of Rules on Teaching Timetable Flexibility and Resource Utilization. Higher Education, 30(3), 305-312.

Appendix A

Chart 1

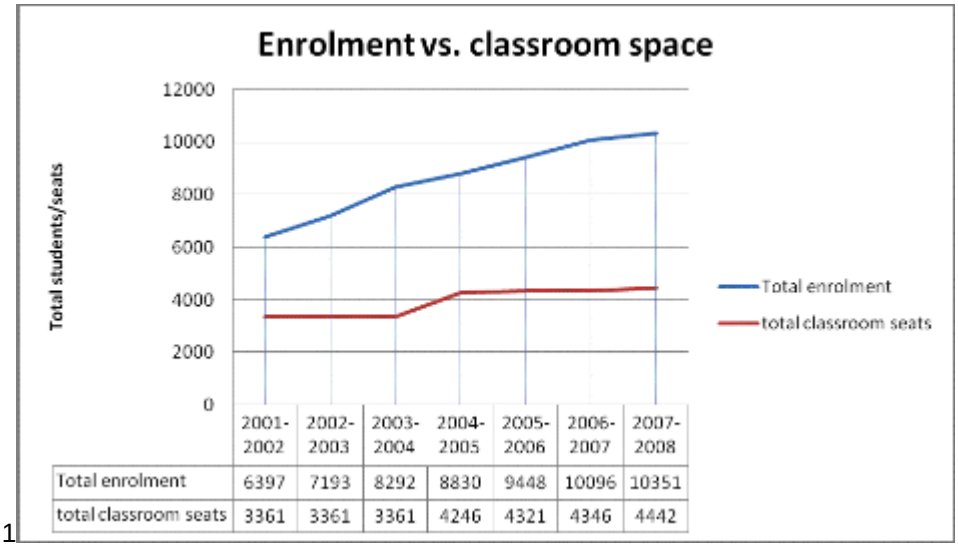

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Chart 2

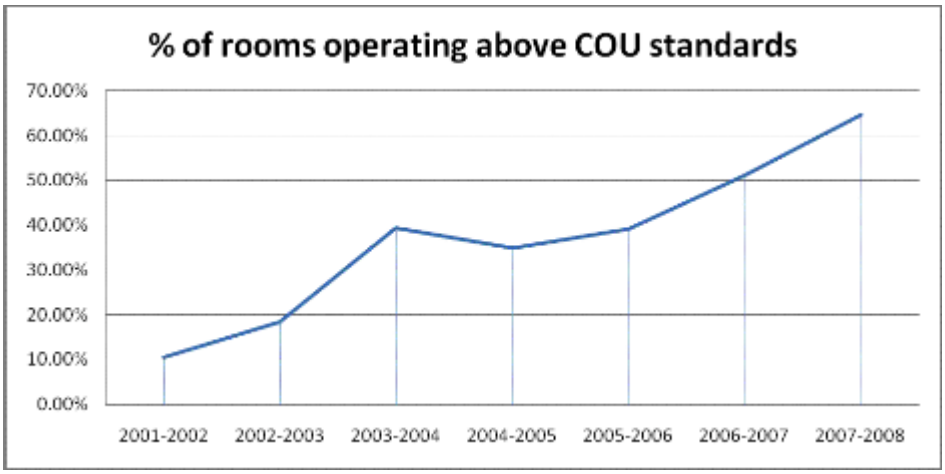


Chart 3

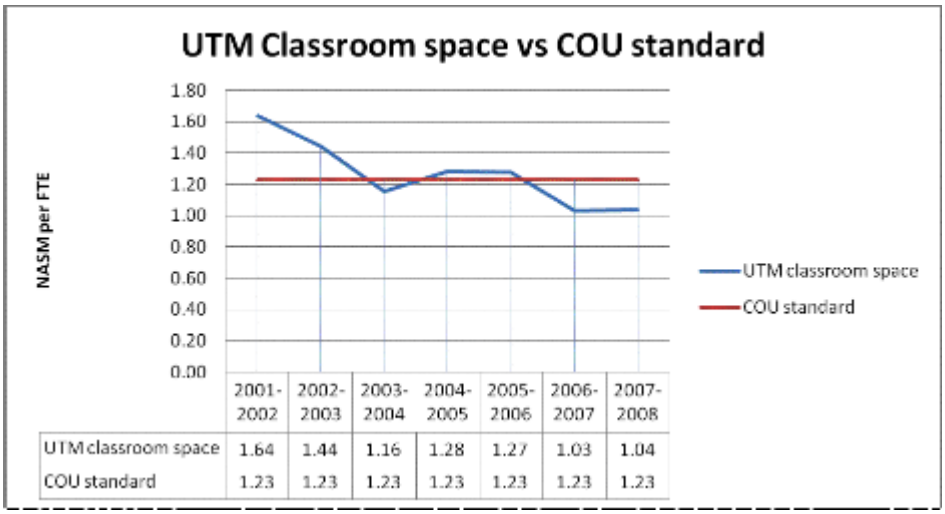
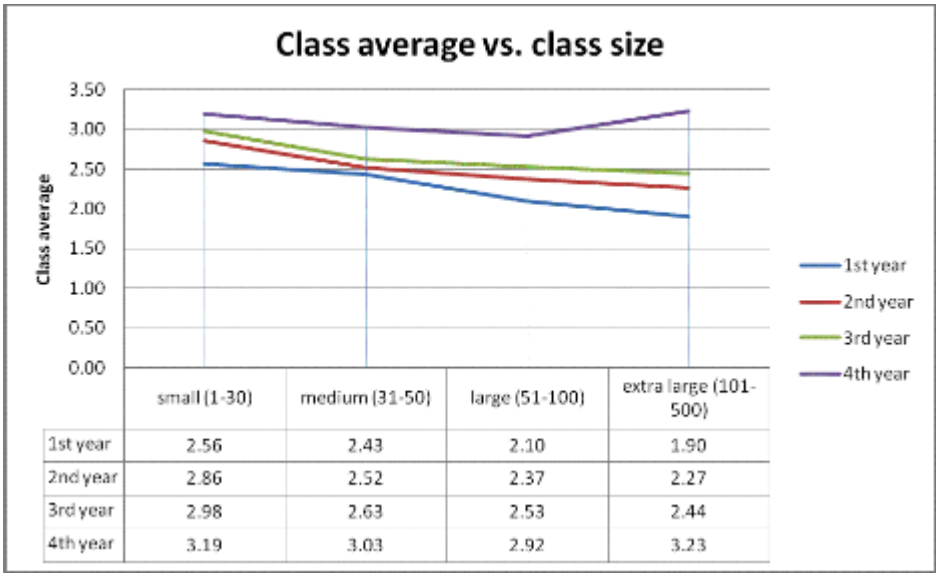
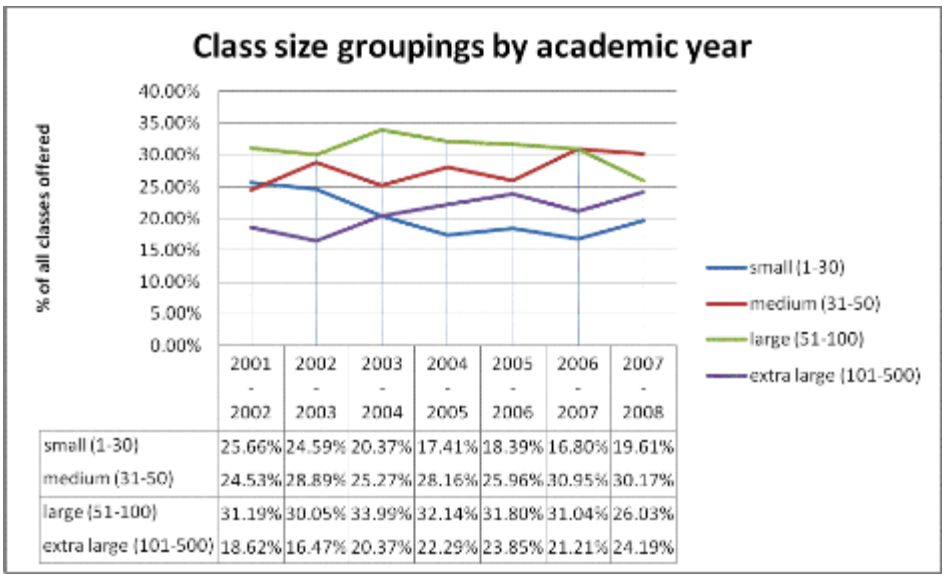


Chart 4



	small (1-30)	medium (31-50)	large (51-100)	extra large (101-500)
1st year	2.56	2.43	2.10	1.90
2nd year	2.86	2.52	2.37	2.27
3rd year	2.98	2.63	2.53	2.44
4th year	3.19	3.03	2.92	3.23

Chart 5



	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008
small (1-30)	25.66%	24.59%	20.37%	17.41%	18.39%	16.80%	19.61%
medium (31-50)	24.53%	28.89%	25.27%	28.16%	25.96%	30.95%	30.17%
large (51-100)	31.19%	30.05%	33.99%	32.14%	31.80%	31.04%	26.03%
extra large (101-500)	18.62%	16.47%	20.37%	22.29%	23.85%	21.21%	24.19%

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