

Timetable Benchmarks for Tertiary Institutions

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Measuring Timetable Quality: An Introduction

This paper addresses an issue of concern to those responsible for creating and managing the teaching timetables / class schedules of post-secondary educational institutions. It is a 'first pass' at addressing these issues, which may prompt further reflection and debate: the author welcomes comments. It may also contribute to the set of tools used to assess the quality of the teaching and learning experience.

When a university-wide¹ timetable is initially created, most often in advance of the student enrolment process occurring, several questions come to mind:

- How good is this timetable?
- Is this timetable better or worse than last year's, or last semester's?
- Can we improve on this timetable further, and in what ways?

Such questions can generally be answered easily at the 'micro' level, when the question asked is of the individual – "how well does this timetable work for me?" An individual member of the academic staff / faculty simply compares one timetable with the last and judges whether their own working-life and/or personal convenience will be better or worse. The assessment by an individual student may be more complex, since it will be informed by their ability to enrol in a combination of classes that fits with their own personal situation – their study habits and preferences, their choice of course/subject and their non-student life (work, family, etc). Their ability to select a preferred combination of classes may be limited by the availability of places in popular classes, or be influenced by a preference for a particular teacher.

The space manager already has a set of measures to determine whether or not the classroom space is used in an efficient manner. Other resource managers will have the ability to determine whether the resources they provide are used in an efficient and effective manner. But it is not always easy to undertake a comparison between two or more whole-year timetables at an institution-wide or faculty/division/school/department-wide level, taking into account the range of factors such an analysis requires. Timetable managers frequently find it difficult to answer questions such as those above in the absence of any readily definable measures of timetable quality.

Accordingly, this paper defines a set of possible benchmarks to be used to 'measure' the nature of the teaching timetables / schedules of universities and other post-secondary educational institutions. Such benchmarks alone are not a sufficient measure of 'quality' – this will depend in part on the plans and priorities of the individual university. The goals of many institutions include such things as efficient space utilisation, student service and convenience, wide student course choice, staff convenience, etc. However the priority order of such goals is almost certain to vary from place to place.

The origin of this consideration was in discussions that took place at a meeting of the Australasian Syllabus Plus Reference Group (ASPRG), led by Tim Bambrick from the Australian National University together with Tom Sankey and the author, both of Mosaic Software Development. I am grateful to them, and a number of other people who reviewed the first draft of this paper.

Revisiting the set of measures after four years confirms the view that, in essence, they provide a good framework for timetable assessment. This is not to suppose that more detailed, more sophisticated or alternative analytical approaches may be added or adopted in the future.

The goal of this approach to Timetable Benchmarking (or Schedule Benchmarking) is to develop a methodology that will permit those who develop institutional timetables to assess the nature and quality of the timetable. It is envisaged that ultimately users will be able to:

- simply analyse an institutional timetable using these benchmarks;
- assess a timetable against a range of policy-determined criteria;
- assess a timetable in comparison with timetables from previous years, or previous semesters, or previous iterations of the current year/semester; and/or
- assess a timetable in comparison with timetables from other comparable institutions.

Existing Measures of Performance

For the sake of efficiency, and to enable any timetable benchmarks to be integrated or used in conjunction with other efficiency and/or quality measures already applied to institutions, we should seek to identify and use existing measures where such exist. This is by no means a comprehensive discussion of this topic: a very large number of statistical and qualitative exercises are undertaken in higher education throughout the world.

Institutional Performance

Throughout the world, and particularly in developed economies, the last few decades have seen increasing interest in the measurement of the quality of tertiary institutions. This has been fuelled primarily by the drive for accountability in the use of public funds. There is also an increasing awareness that tertiary education is to some extent a competitive environment, where institutions compete for students by offering a 'quality' educational experience.

In higher education, this has resulted in a range of Quality Assessment approaches aimed at developing and improving the research activity of universities. In many countries there has been a gradual drift away from the traditional position of the university as a largely-autonomous self-managing institution to one where institutions are required to satisfy a range of social and economic goals. This has often resulted in much greater data reporting responsibilities for institutions. However in many areas there remains a clear expectation that universities themselves will set the criteria for the success of their activities, and assess and improve their own performance against such measures. Such an approach to assessment is perfectly reflected in one Australian approach to university benchmarking, the McKinnon Benchmarks.²

Two other sets of data on the operation and performance of tertiary institutions are virtually universal: institutional financial performance, and student numbers. Because almost all tertiary educational institutions are either business corporations or are in receipt of public funds, reports on their financial operations are generally publicly accessible. Similarly, because a large amount of public funding is determined by or determines the number of students an institution teaches, those numbers are publicly reported and frequently published in a collected form using common classifications and terminology by funding authorities.³

Timetable Performance: Classroom Space Utilisation

After staffing, the second largest cost faced by most institutions is that of constructing and maintaining its buildings and rooms. Since teaching rooms are one of the most flexibly allocated space types on campus, they are an obvious place to look when wanting to increase space efficiencies.

Under some governments, the annual reporting of classroom space utilisation is a requirement of the state funding body. This is the situation in the UK, and in a number of US states. Classroom utilisation statistics are used in some institutions as part of a space chargeback regime. In many other institutions, classroom utilisation audits and/or analyses are used for a range of space management and planning purposes.

Between educational systems and institutions there are some variations to the methods of measuring classroom utilisation, but the basic measures and calculation methods⁴ are essentially the same everywhere: one measure to assess the *frequency* with which a space is used; another to assess the efficiency of such use (*occupancy*) and finally a *utilisation* measure calculated as a product of the two other measures. Further, the language of such measures may also vary, so it is important to clarify the terms in any benchmarking exercise.

There is some debate over what 'counts' when measuring utilisation levels:

- Should all activities in rooms be counted, or only 'official' institution activities, or - even more restricted - only timetabled classes?

- Which is better: a room audit (physically counting the number of people in each room on an hourly basis) or analysing timetable or enrolment system data to calculate utilisation levels?
- Should utilisation analysis extend to other types of space, such as research labs, or shared facilities such as multi-occupant offices, common rooms, etc?

A case can be made for each of these approaches in certain circumstances. For an institution, regular use of a consistent methodology enables trend analysis. For the space planner, use of all approaches provides a rich data set on which to base decision making.⁵

Several features of these benchmarks are core to what a set of timetable benchmarks should aim for.

1. The measures define, as clearly as possible, the particular factors to be measured;
2. The measures include the ability to report both absolute and relative measures;
3. The measures are designed to be compared against targets that can be determined by the institution but for which 'guideline' targets can be established;
4. The measures are 'granular', and can be applied institution-wide, or campus-wide, department- or building-wide down to individual teaching room;
5. The measures may be taken by means of a physical audit, or may be extracted from timetabling / room allocation software;
6. The measures facilitate year-to-year and institution-to-institution comparison.

Proposed Timetabling Measures

The existence of modern computer software timetabling products (*Syllabus Plus*, *Facility CMIS*, *CELCAT*, *Infosilem* and *Ad Astra*) in some ways makes the definition of timetable measures and benchmarks more challenging, because of the wealth of information they provide. At the same time, one must always remember that they are in essence planning tools, which do not necessarily match exactly with the reality of institutional life, and actual patterns of student enrolment.

Accordingly, what I am trying to enunciate are measures and benchmarks that can be applied in a more universal way: if a measure is to be truly capable of being applied to a benchmarking exercise between institutions, then it should be free of the specifics of a particular software solution.

Below I list a number of proposed measures. These address several criteria by which timetables may be assessed.

- The institution is interested in having a timetable that is efficient and effective, and that makes good use of resources (space, equipment, teaching and ancillary staff).
- Staff are interested in a timetable that provides them with the capacity to undertake good teaching (eg. not ten hours straight leading tutorial classes) while also offering a convenient class pattern that enables them to achieve other work goals (research, scholarship, administration, community service, consulting, etc) as well as enjoy a work/life balance.
- For students, a convenient timetable that balances good learning opportunities (eg no class overloads on any one day) with sufficient teaching-free time to undertake individual study, participate in work to support them while studying (of increasing importance to many students), and also enjoy a study/life balance.

The importance of and relative priority placed on these sometimes conflicting criteria will vary from institution to institution, however all should have an interest in the adoption of measures to assess each criterion.

Classroom Utilisation

As explained above, there already exists a set of defined measures for the assessment of classroom utilisation. The application of these to a timetable provides an assessment of the extent to which the timetable uses space efficiently and effectively. I don't propose any further direct discussion of these measures in this paper.

Utilisation of other Physical Resources

Most institutions utilise physical resources that are situated in particular teaching spaces, and considered to be “utilised” whenever the room is in use. However there may be circumstances where an institution deploys portable pooled equipment items (typically specialist or high-cost items) to teaching spaces on an ‘on-demand’ basis. Examples of such items in use at individual institutions include:

- portable audio-visual consoles containing specialised items,
- trolleys from which a large number of wireless-enabled notebook computers can be deployed, and
- mannequins for use in health sciences teaching.

Utilisation of such resources can be measured using the same formulas as are used with classrooms: *frequency* of use is applicable in all cases; *occupancy* may not be appropriate in some circumstances, in which case *utilisation* would be best expressed as equal to *frequency*.

Targeted Timetable Week Attainment (TTWA)

The first new element of the Timetable Benchmarks is a deliberately broad measure: *Targeted Timetable Week Attainment*.

This element measures the extent to which the timetable aligns with the institution's own definition of a *Target Timetable Envelope*.

The Target Timetable Envelope is comprised of two parts: the *Primary Target Timetable Envelope* and the *Secondary Target Timetable Envelope*. Each of these is a set of periods across the week within which the institution seeks to distribute the majority of its teaching activities. The envelope is almost certainly not contiguous hours, and is not necessarily comprised of the same periods for each day of the week. For example, it may or may not include periods on Friday afternoon or evening. Similarly, there may be periods during the middle of the day (or week – eg Wednesday) when the institution might prefer that teaching not take place so that, for example, student activities may occur, or staff and students have a 'forced' lunch break.

The division of the Target Timetable Envelope into Primary and Secondary segments acknowledges that some institutions deliver courses to two distinct cohorts of students: a group of (largely) full-time students taught during the day, and a separate group of (largely) part-time adults students taught after hours. However this division into segments more generally permits institutions to distinguish between different levels of preference for different sections of the teaching week. Of course, an institution can elect to nominate only a Primary Target Timetable Envelope.

Note that I have not attempted to describe this timetable envelope as a “Standard Teaching Week”. Partly this is to emphasise that the nature of this ‘common’ set of periods during which the majority of teaching takes place differs from university to university, and from region to region, often influenced by such external factors as the work practices of surrounding business districts, the availability of public transport services to the campus, etc. Furthermore, there is resistance in some institutions to the idea of defining a “norm” or “standard” for several reasons:

- Industrial: definition of ‘normal’ implies definition of ‘non-normal’, which suggests over-time rates should apply to teaching outside standard hours;
- Discipline variations: some programs have ‘normal’ hours that differ from the rest of the university - eg specific postgraduate courses offered only in evenings, or on weekends; and
- Cultural: desire that academic staff maintain individual independence, the ideal of the independent agent - researcher, teacher - deriving from the ideal of ‘academic freedom’.

The *Target Timetable Envelope* therefore has six measures:

- the number of hours in the Primary Target Timetable Envelope,
- the number of hours in the Secondary Target Timetable Envelope,

- the target proportion of teaching activity hours timetabled in the Primary Target Timetable Envelope,
- the target proportion of teaching activity hours timetabled in the Secondary Target Timetable Envelope,
- the target proportion of student contact hours timetabled in the Primary Target Timetable Envelope, and
- the target proportion of student contact hours timetabled in the Secondary Target Timetable Envelope.

The Targeted Timetable Week Attainment has two measures, each expressed in both absolute and relative terms.

The first measure is the **Teaching Hours (Actual and Target)**: the total number of teaching activity hours that fall within the Targeted Timetable Week, expressed first as total hours then as a percentage of the grand total of teaching hours.

Activities that run over the boundaries between the Primary, Secondary and non-Targeted Timetable Week are divided into separate sections, with each section counted in the total for the appropriate segment of the Target Hours.

[The argument can be made that since the class includes hours outside the Target Timetable Envelope, and thereby forces the student to attend classes in non-preferred periods, the entire class should be counted as being outside the envelope. This approach would give an undue balance or emphasis to such classes, and an unjustifiable loading to the effect such classes have on the overall 'picture' of the timetable that we are seeking to create through the use of these benchmarks.]

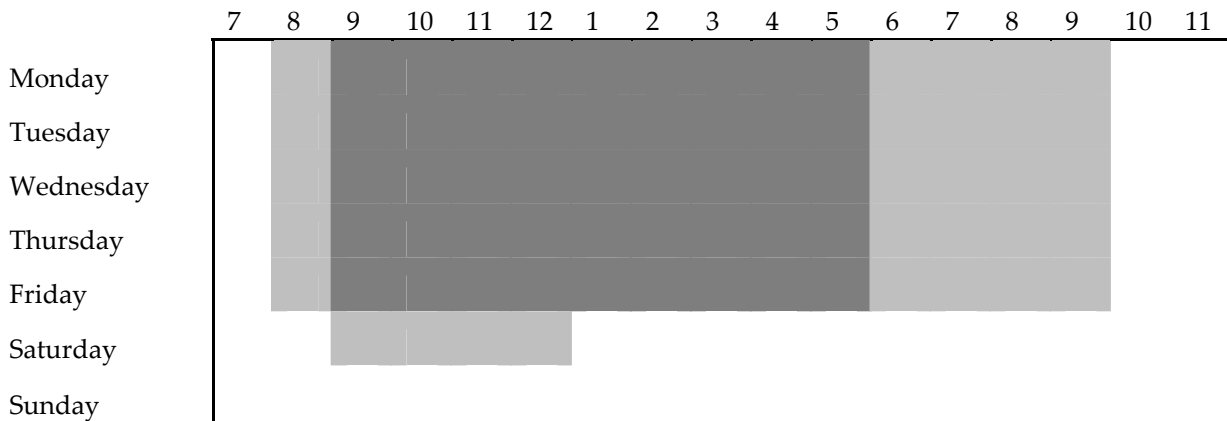
The second measure is the **Student Hours (Actual and Target)**: a measure of the total number of student contact hours that fall within the Targeted Timetable Week, expressed first as total hours then as a percentage of the grand total of student contact hours. Student contact hours for each teaching activity are calculated by multiplying the planned or actual size of the class by the total number of hours of the class. This measure delivers a better sense of the overall impact of the timetable on the student body. If larger classes are scheduled at undesirable hours, the measure declines more than the simple measure of Targeted Teaching Hours. By contrast, the scheduling of a small class outside the Target Timetable Envelope will not have too significant effect on our measure.

Each of these two measures can be assessed for:

- a) The institution as a whole;
- b) Courses taught by an individual academic Department (or set of Departments);
- c) Staff members, either individually or grouped by Department (or some other grouping - level, gender, etc); and
- d) Students, either individually or in groups.

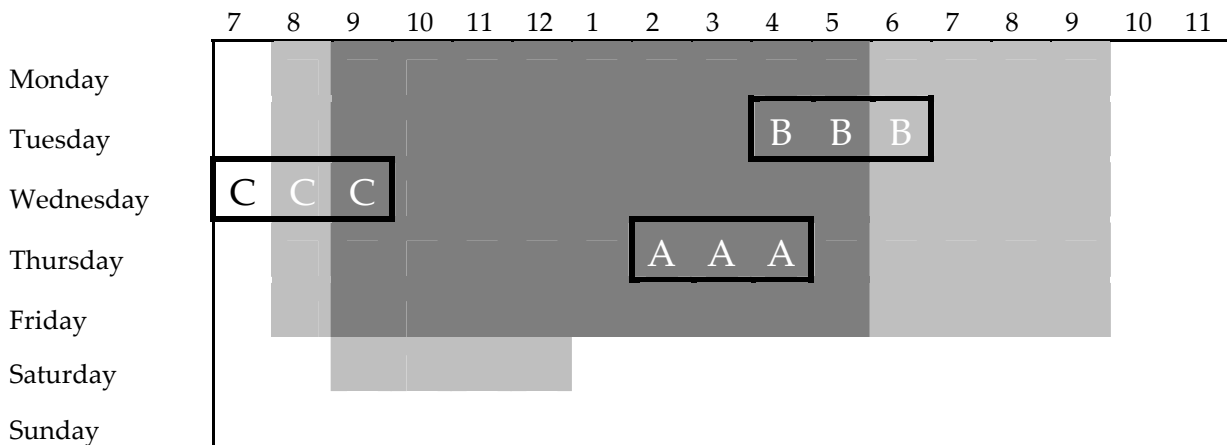
Obviously, the aggregated results of such an analysis are likely to be more significant than results for an individual. However the comparison between the disaggregated results and those of the total, expressed as a percentage variance, may give rise to further investigation and possibly identify problem areas of the timetable that deserve rescheduling.

Example: Institution-defined Targeted Timetable Week



The dark-grey periods represent the Primary Target Timetable Envelope: 45 hours
 The light-grey periods represent the Secondary Target Timetable Envelope: 29 hours
 The institution has set the following targets -
 Primary Teaching Hours Target: 85.0%
 Secondary Teaching Hours Target: 15.0%
 Primary Student Hours Target: 90.0%
 Secondary Student Hours Target: 10.0%

Three teaching activities (A, B and C) are scheduled in the week.



Activity A (150 students) is 'counted' entirely in the Primary section.
 Activity B (70 students) is 'counted' for two hours in the Primary and 1 hour in the Secondary section.
 Activity C (30 students) is 'counted' for 1 hour in the Primary and 1 hour in the Secondary section, and 1 hour contributes to the overall total of teaching in the week.
 Calculations run as follows:

Total Teaching
 = Hours (A + B + C) = 3 + 3 + 3 = 9

Teaching Hours within Primary Targeted Timetable Week
 = Hours in Dark Grey periods (A + B + C) = 3 + 2 + 1 = 6

Teaching Hours within Secondary Targeted Timetable Week
 = Hours in Light Grey periods (A + B + C) = 0 + 1 + 1 = 2

Teaching Hours inside Targeted Timetable Week

$$= \text{Teaching Hours within Primary Targeted Timetable Week} \\ + \text{Teaching Hours within Secondary Targeted Timetable Week} = 6 + 2 = 8$$

Total Student Hours

$$= \{\text{Hours (A)} \times \text{Class Size (A)}\} + \{\text{Hours (B)} \times \text{Class Size (B)}\} + \{\text{Hours (C)} \times \text{Class Size (C)}\} \\ = (3 \times 150) + (3 \times 70) + (3 \times 40) = 450 + 210 + 120 = 780$$

Student Hours within Primary Targeted Timetable Week

$$= \{\text{Hours in Dark Grey periods (A)} \times \text{Class Size (A)}\} \\ + \{\text{Hours in Dark Grey periods (B)} \times \text{Class Size (B)}\} \\ + \{\text{Hours in Dark Grey periods (C)} \times \text{Class Size (C)}\} \\ = (3 \times 150) + (2 \times 70) + (1 \times 40) = 450 + 140 + 40 = 630$$

Student Hours within Secondary Targeted Timetable Week

$$= \{\text{Hours in Light Grey periods (A)} \times \text{Class Size (A)}\} \\ + \{\text{Hours in Light Grey periods (B)} \times \text{Class Size (B)}\} \\ + \{\text{Hours in Light Grey periods (C)} \times \text{Class Size (C)}\} \\ = (0 \times 150) + (1 \times 70) + (1 \times 40) = 0 + 70 + 40 = 110$$

Student Hours inside Targeted Timetable Week

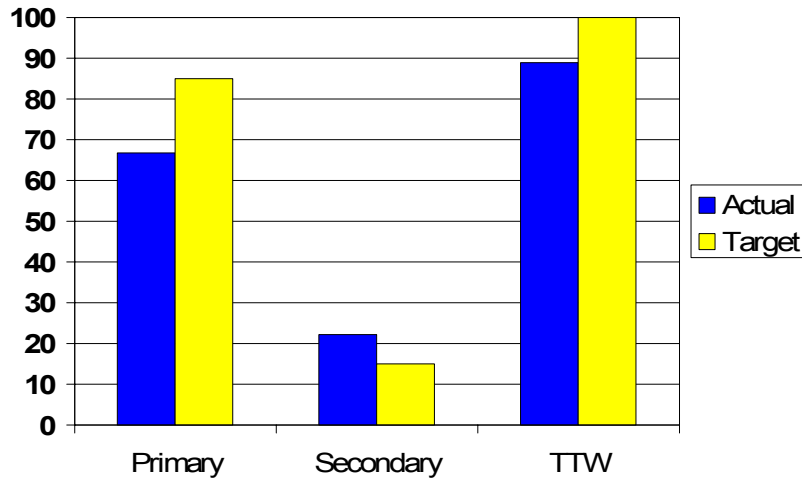
$$= \text{Student Hours within Primary Targeted Timetable Week} \\ + \text{Student Hours within Secondary Targeted Timetable Week} \\ = 630 + 110 = 740$$

In summary, the figures are:

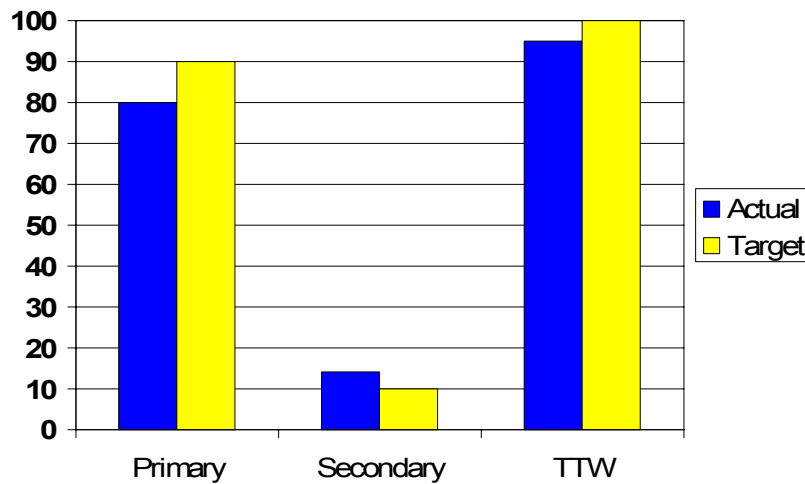
Targeted Timetable Week Attainment	Teaching Hours			Student Hours		
	Hours	%	Target %	Hours	%	Target %
Within Primary Targeted Timetable Week	6	66.7	85.0	630	80.8	90.0
Within Secondary Targeted Timetable Week	2	22.2	15.0	110	14.1	10.0
Within Targeted Timetable Week	8	88.9	100.0	740	94.9	100.0
Outside Targeted Timetable Week	1			40		
Total Teaching	9	100		780	100	

These are represented on the Targeted Timetable Week Attainment charts below.

Teaching Hours:



Student Hours:



Staff Measures

When we approach the task of assessing the quality of the timetable in relation to staff, the measurement of *utilisation* in the same manner as that applied to classrooms or other physical resources makes little or no contribution to the value of our assessment. Academic staff, in contrast with rooms, are not normally assigned dynamically to individual classes⁶. Instead, staff members are more often assigned to individual classes as the result of a process of workload negotiation between the individual and the head of department. Hence to use measures of ‘staff timetable utilisation’ would turn the exercise into an assessment of this work assignment process and, perhaps, of the level of resources available to the department in relation to the number of students it teaches, rather than a measure of the efficiency and effectiveness of the timetabling process. Were such measures to be used, a method is discussed in Appendix 2: Staff Timetable Utilisation. Instead, the measure of *Staff Timetable Convenience* is proposed.

Staff Timetable Convenience (STC)

We require measure(s) of how well the *timetable* works. From the perspective of the individual academic staff member, this may mean different things. For the casual/contract staff members, who comprise a growing proportion of the academic teaching workforce, there are particular advantages in having teaching clumped on particular days, or even within part of particular days, to reduce their on-campus time. The same *may* be true of the full-time staff member who wants to have uninterrupted periods to devote to other (non-timetabled) academic pursuits: research, reading, writing, meetings, one-to-one student support and counselling, community contributions, etc. For other staff members, however, there may be appeal in having

timetabled activities distributed across the teaching week: this decreases the extent of 'load' on the individual imposed by the intensive concentration that a class can demand, and permits the scheduling of one-on-one student meetings before and after classes. Overall, however, I have a sense that most members of the academic staff whether full- or part-time, would feel that the timetable offered the greatest level of professional and personal convenience if their teaching is 'clumped'. Accordingly, I propose that this following measure be applied – the extent to which it matches staff members' assessment of their personal convenience could become the subject of one or more staff surveys that universities undertake periodically.

To measure such 'clumping outcome', I am proposing a measure of workload spread that can apply equally well to teaching scheduled on single days or multiple days. And, as with the staff utilisation measures above, these measures can be applied and analysed at institution, department or individual level.

In essence, the measures are based on the time a staff member spends teaching classes, expressed as a proportion of time the staff member is required to be 'at work' (on campus). To accommodate the fact that an individual's classes may all be scheduled on one day, or spread over several days, I propose that the measures take into account all travel to and from campus for the second and subsequent days. To do that, it is necessary to identify an informed (but arbitrary) period that is equivalent to the average travel time from home to campus of the average staff member. For ease of calculation, this should be expressed in the same period units from which the Target Teaching Week is comprised.

Example:

If the smallest periods from which the TTW is comprised are one-hour blocks, then the Average Home - Campus Travel Time (AHCTT) should be multiples of one-hour. If the smallest period is 5-minute blocks, the AHCTT is expressed as a multiple of 5 minutes.

Having first defined this AHCTT, *Staff Timetable Convenience* can be defined as the ratio between the number of periods of timetabled teaching, and the number of periods from the beginning of the staff member's first class to the end of their last class. This is expressed as a percentage.

The number of periods from the beginning of the staff member's first class to the end of their last class includes, for each day other than the first, an additional time of twice the AHCTT. In other words, if a staff member is required by the timetable to go home one day and come back another day, we factor in the travel time to and from home for that staff member. The AHCTT is only used for the days when the staff member is required to attend campus for classes, and not on intervening days.

Example:

Staff member A teaches on Wednesday only. They have a one hour class at 9.00 am, a two hour class at 11.00 am, and a one hour class at 3.00 pm. Total teaching hours is 4; total teaching spread is 7; Staff Timetable Convenience (STC) = $4 / 7$, or 57.1%

Example:

Staff member B teaches at the same university, with the same number and length of classes. Their first two classes are at the same time and on the same day as those of staff member A. Their final class is on Friday morning at 9. The AHCTT for the university is 1 hour. Therefore the STC for this staff member is $4 / (5 + 1 + 2) = 50\%$

This method of calculation ignores the total amount of time the staff member spends on campus - the self-determined period(s) before the first and after the last class of each day, since these periods are not *imposed* by the nature of the timetable. At the same time, it acknowledges the additional load of having to travel to and from the campus imposed by the timetable.

Having now defined a method of measuring the effect of the timetable on the work practices of the individual academic staff member, there remains the question: how do we establish a benchmark for this figure?

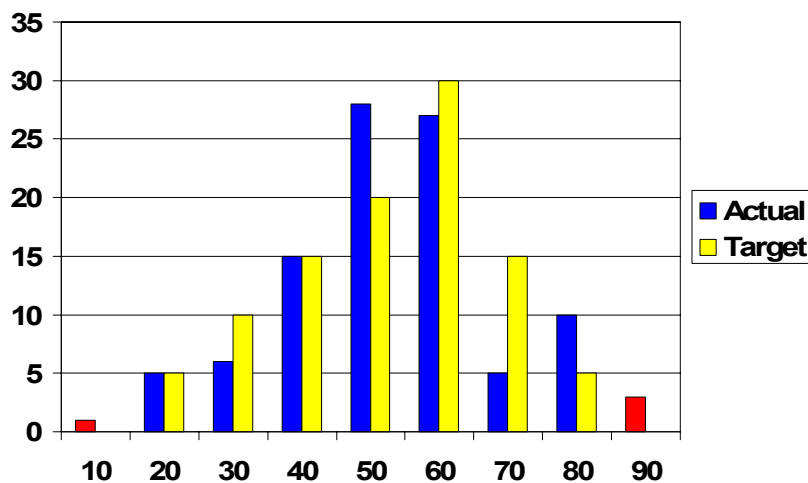
I propose two measures. One is the mean STC. As it increases from one timetable to the next, this indicates that there has been a decreased amount of clumping. The reverse is equally true.

Added to this is another measure: the proportion of academic staff members with an STC within the range of "acceptable" STCs that the university establishes as a target.

Example:

A university may identify an 'acceptable' STC range as being from 35% - 90%. Anything less means the staff member is being 'forced' (rather than electing) to spend time on campus doing other tasks; anything more means the staff member has too great a proportion of time on campus devoted only to timetabled teaching. The university may, from past experience, establish a target for the proportion of staff within this 'acceptable' range: typically this group outside this range would comprise part-time staff with a teaching-only role in the professional disciplines whose presence on campus is restricted intentionally to the delivery of timetabled teaching. Any variance, then, from the accepted target would be worth investigating, with a view to re-scheduling some of the affected staff outside the range if appropriate.

The chart below represents how such data might be displayed, with the lower and upper margins of actual results being flagged as requiring further investigation of possible poor staff conditions.



Student Measures

Assessing a timetable from the student perspective is somewhat different to the methods discussed above, since students do not comprise a university 'resource' in the same way as space/classrooms, equipment and staff and the institution has no need or expectation to consider the timetable from a 'resource utilisation' perspective. However analogous measures may be used to monitor the performance of the timetable with respect to two aspects of interest to students and the institution: *student convenience* and student course choice.

Student Convenience (SCON)

Principles of convenience increasingly drive institutional approaches to student services, as students are increasingly recognised as 'clients' who, in a competitive environment, have the capacity to take their business to another supplier of educational services. In recent years, this focus on the manner in which

students have contact of various sorts with the university is summarised as the 'student experience', with universities seeking to improve and enhance the experience.⁷

For an individual student, the *convenience* of the timetable will vary according to the student's individual circumstances:

- students with external work or family commitments may prefer that teaching be 'clumped' within certain periods of the day/evening,
- students living a long way from campus may prefer that all classes they are required to take be clumped on one day, or clumped in the middle of the day,
- students studying full-time with a demanding class-load and a large volume of additional reading may prefer that classes be spread over the week.

On the whole, I sense that Australian students are increasingly likely to be inclined to clumped teaching activities. This is supported by several studies of Australian first-year students undertaken by the University of Melbourne's Centre for the Study of Higher Education. These report a growing pattern of students engaged in part-time employment in addition to study, as well as a decreasing interest in engagement in traditional campus life⁸. Whether such changes should be encouraged, and whether or not there is a link between such changes and a preference for clumped teaching activities, requires further consideration and testing, possibly through independent student surveys. Again, the extent to which the student population is changing varies from institution to institution, campus to campus and discipline to discipline. My appreciation of the student campus experience in other countries is less certain, but the proposed measure – of clumping or, conversely, spreading – is still a reasonable method for assessing the performance of the timetable in relation to an overall pattern of perceived student preference.

Proceeding on the assumption that the measurement of 'clumping' is an appropriate method of assessing the student convenience of the timetable, a similar method to that used to calculate staff convenience is proposed as the method to calculate student convenience.

For a particular set of courses, a range of class offerings may exist, providing several alternative values for this measure. Not all class options will be available to all students. To handle this possible range of results, several approaches are possible:

- Use the class combination that produces the lowest, most clumped result;
- Use the class combination that produces the highest, least clumped result;
- Use the class combination that produces the result at the middle of the range; or
- Calculate the mean of all results, or
- Calculate the mean of the lowest and highest.

The 'risk' of using the lowest or highest results is that some of these class combinations may have been deliberately constructed to accommodate the needs of particular types of students, in particular part-time students who are only available for on-campus study in intensive blocks or after hours. On balance, the mean of all results is probably the best indicator of the overall student convenience measure.

Using this approach, the method of calculating *Student Convenience* (SCON) would be the same as that used above to calculate Staff Timetable Convenience. The benchmark measure would similarly be a mean SCON, and the proportion of students outside the institution's accepted SCON range.

Student Choice (SETC)

The capacity of a university timetable to provide a wide and appropriate choice of course offerings for students remains an important and significant goal for university timetablers. A method for measuring this capacity to timetable is difficult to determine, because in undertaking such a measurement not all options are realistic or acceptable student choices and many need to be exempted from consideration in such a measurement process.

Factors to be taken into account in including or excluding course offering combinations include the following:

- Degree program completion rules which permit some course offering combinations and specifically forbid others;
- Pre-requisite and co-requisite rules that prevent or enforce certain course enrolment combinations;
- Assumed knowledge and discipline progression patterns that militate against a combination of early-year and later-year courses, or undergraduate and postgraduate courses; and
- Course offering combinations on different campuses, which require consideration of inter-campus travel times.

Measurement of this element of the timetable remains one where I am not confident that I have identified the best method that can be applied and calculated efficiently and effectively, and is also realistic.

The idea that *every* possible course combination is necessarily a required option for students to select is clearly not acceptable. At most institutions, such a set of combinations is impossible for the reasons outlined above. Consequently a calculation that comprehensively looks for the capacity for a student to undertake every possible course combination is of little benefit.

It is therefore a question of identifying the realistic and acceptable course combination options for which a measure should be developed. This is discussed below under the heading “student and course samples”.

Once such a set of target course combination options is defined, a simple measure could be the proportion of those combinations that are possible, because there is a clash-free set of classes in those courses within the proposed timetable.

Using this measure, the *Student Enrolment Timetable Choice* (SETC) measure can be defined as the number of course combinations for which a clash-free set of classes is available in the timetable, expressed as a proportion of the total number of course combinations considered.

Example:

A university identifies a set of 400 target course combination options.

For each combination, we search the timetable to identify whether a set of clash-free classes for those courses is available.

That process identifies that class clashes would prevent a student undertaking 50 course combinations. In other words, 350 course combinations are available for enrolment.

$$\text{SETC} = \{\text{available course combinations}\} / \{\text{all considered course combinations}\} \\ = 350 / 400 = 87.5\%.$$

Student and Course Samples

In order to calculate the measures for Student Convenience and Student Enrolment Timetable Choice, it is first necessary to determine a set or sets of student course combinations. At most institutions, at the stage of the timetable development process when we are most interested in examining these timetable measures, no student enrolment has taken place, so no ‘actual’ patterns are available. With regard to student choice this is probably of little importance, since it is unlikely that students will choose to enrol in a set of courses where the classes are unavailable (although this does occur in certain circumstances) ⁹.

Student Sets

Accordingly, to undertake these measurements we need to select some set of student enrolment patterns. To use an example familiar to users of *Syllabus Plus*, an option that is initially appealing is the use of Student Sets, which exist within the software to enable clash-free scheduling for student course combinations. However the use of these for measurement purposes is self-defeating since by definition they will have both enforced student course choice and the actual time at which classes are scheduled will have been directly influenced by the Scheduling Preferences applied to the sets: some more objective measure is required.

Furthermore, the measure can only be used with Syllabus Plus rather than the range of other timetable software solutions, or using timetable audit data.

Model Sets

Another possible set of student enrolment patterns would be a 'model' set of desirable or popular course enrolment choices, based on input from staff of the institution experienced in the management of student academic programs.

Sample of Prior Actual Enrolment

Yet another option, and my preferred solution, is a random sample of actual student enrolment details that, initially at least, would have to be extracted from a previous year's enrolment records. This set of student / course combinations would be extracted from the student enrolment system.

The key drawbacks of this sampling solution are:

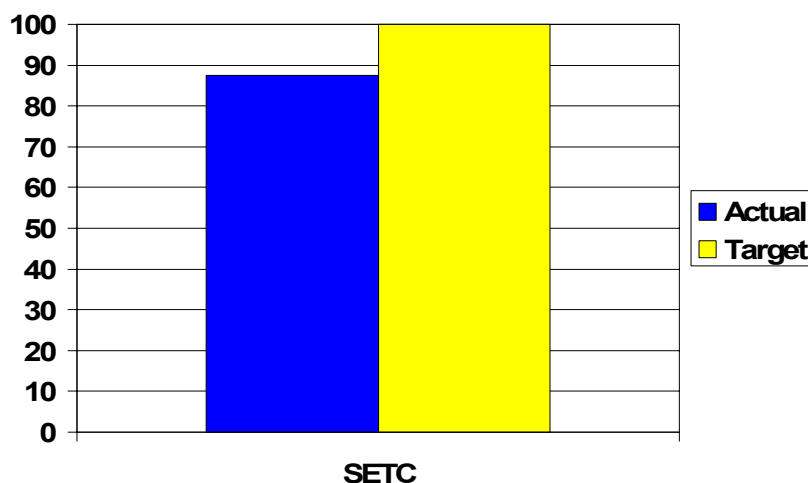
- the enrolment choices made by the students have been influenced by the previous year's timetable, which may have limited the course choices made by students, and prevented what would otherwise have been popular course combinations; and
- the set of courses may include courses that are no longer offered, or not offered in the current year's timetable.

Each of these flaws has a possible solution:

- augment the set of selected student / course combinations with additional sets based on the 'model' sets approach described above; and
- either select additional samples so that those student / course combinations containing courses no longer offered can be ignored, or identify the closest equivalent courses to those not offered

Sample Size

Because of the number of calculations involved, and the probable need for intervention to modify individual student / course combinations to accommodate courses no longer offered, a small sample size is preferred. Against this, there is the requirement that the randomly-selected sample be sufficiently large to reduce sampling error and the probability of error (difference between results for the sample set and the student population as a whole). Given the current size of student populations in Australasia, a sample size of 400 students should be adequate (allowing for the possibility of 5% error in larger institutions, lower in smaller institutions).



Timetabling Degree of Difficulty (TDOD)

Some of the methods outlined above are a first step towards enabling the measurement and comparison of timetables. On their own, they permit the comparison of different timetables for the same institution within the same year.

However experience tells us that the task of generating a timetable changes in difficulty from year to year, and from institution to institution, for a range of factors. Accordingly, we need to identify a simple measure to help us evaluate whether or not changes in the results we get for the measures outlined above are the result of a better or worse timetable, or are caused by other factors that make it easier or harder to generate a good timetable.

Such a measure will then facilitate a wider comparison of timetables, and the benchmarking of timetable measures. This will provide a method of comparing performance between different universities, or between departments of significantly different size and complexity, or even between years at the same institution where the number and complexity of other factors (resources, student numbers, course offerings, etc) change to the extent that they prevent a reasonable timetable comparison from one year to the next.

Accordingly, the measure proposed reflects the constraints that force a particular university to timetable in a particular manner. This *Timetabling Degree of Difficulty* is – like the TTWA – not necessarily a measure that captures *every* nuance of what it seeks to measure. Instead, it is intended to be a measure that is relatively easy to determine at a variety of institutions.

Factors affecting the ability to create a good timetable

The ability to construct an institution-wide timetable is determined and influenced by five major factors:

- access to sufficient resources,
- complexity of the teaching delivery model,
- efficiency of the teaching delivery model (or ‘ability to access to *appropriate* resources’),
- number of students, and
- spread of the teaching week.

Access to sufficient resources

The relative availability of resources at an institution, or within an organisational unit, may act to limit the capacity to deliver an efficient or convenient timetable. The most significant resources, from a timetabling point of view, are teaching staff and classrooms.

If resources are limited, their use must be rationed in time. To take the example of ten classes requiring a room of a particular type: if there is only one such room, the classes must necessarily be spread across ten hours of the teaching week; if there are two rooms, it may be possible to spread the classes over five hours of the week; the example extends to having ten rooms available, when the institution has the freedom to schedule all ten classes at the same time if desired. The same argument applies to staff able to teach in a particular subject area.

As a simple rule-of-thumb:

The more rooms and the more teaching staff, the **easier** it is to construct a timetable (other factors being equal). Fewer rooms and/or fewer staff make the task more difficult.

Complexity of the teaching delivery model

A second factor causing problems for the institutional timetabler is the number of classes that need to be scheduled clash-free, in order to accommodate the degree requirements of the institution and the number of course options made available to students.

A course offered within one degree program will need to be offered clash-free with a set of complementary courses. The more such courses within that program, the greater the expectation that there will be a larger number of clash-free class combinations.

When the same course is included within a second program, a second set of complementary courses is identified resulting in an expanded number of clash-free classes to be scheduled.

As a simple rule-of-thumb:

The more programs and the more courses, the **harder** it is to construct a timetable (other factors being equal). Fewer programs and/or fewer courses make the task more straightforward.

Efficiency of the teaching delivery model

Not all universities are designed to best accommodate the requirements of the current forms and styles of teaching. On some campuses, or within some programs or disciplines, a lecture / tutorial paradigm has been replaced by a seminar model. In other cases, problem-based learning has demanded the provision of break-out spaces for small group consultations. The economics of university funding have resulted in staff-student ratios that demand larger class sizes than some rooms can accommodate.

As a result, the timetabler may face a range of space resources that are ill-matched with the set of classes that need to be scheduled into them. While it is always possible to schedule a small class into a larger room, the reverse is not the case (or is at least unacceptable from a safety perspective). The more large classes there are, or the fewer large rooms, the harder it will be to construct a class schedule. To recognise this aspect of the timetabling task, a simple measure relates room size to class size – a ‘classroom size factor’.

As a simple rule-of-thumb:

The higher the average class size in relation to room size, the **harder** it is to construct a timetable (other factors being equal). As the average ratio is lowered, the greater the likelihood that a room of sufficient capacity will be available to accommodate the requirements of a particular class.

Students

The number of students at an institution does not cause as direct an impact on the timetable as some of the factors described above. Expanded student enrolments are generally accommodated through larger classes, and duplicated classes. The financial resources that generally accompany an expansion in student numbers facilitate an increase in staff resources to permit such class expansion, or result in larger classes taught by the same number of staff (in which case the previous measures will capture the change of scheduling difficulty).

That said, experience tells us that number of student contact hours for which timetabling is required makes the task of timetabling more difficult because the institution faces pressure to accommodate a greater number and range of course combinations. These include the course options normally exercised within individual programs as well as the effect of student failures: increased multi-year enrolments, with added ‘non-standard’ course combinations being expected by both staff and students in order to facilitate student progression through difficult programs and/or courses.

As a simple rule-of-thumb:

The more students, the **harder** it is to construct a timetable (other factors being equal). Fewer students make the task more straightforward. This factor is not as significant as the issues of resources or program complexity.

Spread of the teaching week

The capacity to build a timetable that takes account of the preferences of staff and students, the constraints of available resources and the complexity of program structures and teaching delivery patterns is improved if there is a degree of flexibility to rearrange the timetable components across the different days and hours of the week. For a given set of classes, such flexibility increases as the number of hours available for use within

the teaching week increases. For a given set of teaching hours, such flexibility decreases the more classes we have to schedule within those hours.

Put simply, this is a simple case of a ‘container’ (the hours of the teaching week) and the objects (classes) with which we are filling it – the task gets easier as the number of objects gets smaller or the container gets bigger, the task gets harder as the number of objects gets larger or the container gets smaller.

As a simple rule-of-thumb:

The more hours there are in the teaching week, regardless of where they are distributed within the week, the **easier** it is to construct a timetable (other factors being equal). Fewer hours make the task more difficult.

Constructing the TDOD

Given these factors, it remains to determine a formula for the Timetabling Degree of Difficulty.

The first version of this paper proposed a method of calculation that was entirely related to the set of measures contained in the timetables being assessed. The paper indicated a degree of uncertainty over whether this was the best approach: after reflection on application of the calculation, it seems that a more ‘universal’ reference point would be useful. This would reduce the need to recalculate the TDOD every time the ‘sample’ of timetables is increased or decreased.

What remains is the general approach that, for ease of comparison and calculation, each of the factors identified above be reduced to a ranking before being introduced to the equation. The proposed formula is:

Timetabling Degree of Difficulty

$$= (\text{Program Factor} \times \text{Course Factor} \times \text{Student Factor} \times \text{Classroom Size Factor}) / (\text{Room Factor} \times \text{Staff Factor} \times \text{Hours Factor})$$

Example:

Three universities have the raw numbers as detailed in the first table below. By identification of a common denominator, each of these numbers is converted to a ranking factor as detailed in the second table. From these factors, the timetabling degree of difficulty is calculated for each set of data.

	Reference Institution	University A	University B	University C
Programs	400	650	480	980
Courses	2,000	2,467	1,850	4,300
Students	10,000	23,100	16,400	18,500
Average Class Size	20	19.7	14.2	21.4
Rooms	400	627	413	559
Average Room Size	20	25.3	15.2	28.0
Teaching Staff	500	1,123	876	986
Hours	50	56	64	58
Class / Room ratio	100%	77.9%	93.4%	76.4%

To calculate the individual rankings, the number for the data in the reference institution for each factor is used as the ‘base’ value, with numbers expressed as a multiple of the reference number (calculated to 2 decimal places).

	University A	University B	University C
Program Factor	1.63	1.20	2.45
Course Factor	1.23	0.93	2.15
Student Factor	2.31	1.64	1.85
Classroom Size Factor	0.78	0.93	0.76
Room Factor	1.57	1.03	1.40
Staff Factor	2.25	1.75	1.97
Hours Factor	1.12	1.28	1.16

From the formula above, the timetabling degree of difficulty for University A
 = (Program Factor x Course Factor x Student Factor x Classroom Size Factor) / (Room Factor
 x Staff Factor x Hours Factor)
 = (1.63 x 1.23 x 2.31 x 0.78) / (1.57 x 2.25 x 1.12)
 = 0.91

The results for universities B and C are 0.73 and 2.31 respectively.

The same method of comparison of two data sets can also apply to the same university in different years.

It is important to emphasise that this measure is a **relative** measure, not an absolute measure of timetabling difficulty. TDOD enables us to compare a set of timetables, to say "A is harder to schedule than B, but easier than C".

Conclusion

As noted in the introduction, this is a 'first pass' at defining a set of measures for something that has not, to my knowledge, previously been measured in a relatively simplistic way.¹⁰ The proposals reflect the authors experience in Australasian universities: the applicability of the approach in other tertiary institutions remains to be tested.

In addition to the existing measures of classroom utilisation analysis (RFF, SOF and UTIL), I have proposed a set of measures that I hope will contribute to a better understanding and benchmarking of university timetables. These measures are:

- Targeted Timetable Week Attainment (TTWA) – a "big picture" measure to identify how well the timetable accords with university timetable plans;
- Staff Timetable Convenience (STC) – a measure of how 'clumped' a staff member's classes are, with a focus on staff convenience;
- Student Convenience (SCON) - a measure of how 'clumped' classes are, from the perspective of students undertaking a range of courses, and with a focus on student convenience;
- Student Choice (SETC) – the extent to which the timetable facilitates student course choice; and
- Timetabling Degree of Difficulty (TDOD) – a measure to account for changes or variations in the level of resources available to the timetabler, and the complexity of the scheduling task.

Whether this is the best set of measures remains unclear. I look forward to the continuing consideration and discussion by others of the proposals, with a view to refining the measures further or identifying alternative measures that will better fulfil the purpose.

John Pryzibilla
 February, 2010

Appendix 1: Staff Timetable Utilisation

In a very early version of this paper, I developed the model below for a measure of ‘teaching staff utilisation’ that attempted to calculate the ‘efficiency and effectiveness’ of their teaching in relation to the number of classes and students they taught. This was an exercise in applying to staff the same model that is used for rooms. However the two ‘resources’ of physical space and human teachers are not easily or appropriately equated, and the measures are flawed for this reason. I have included them in this appendix purely for information.

Staff Timetable Utilisation

The application of measures akin to those used for measurement of room utilisation is, on the surface, appealing. However the form and manner in which staff teach in universities is distinct from the manner in which classroom resources are applied. A number of ‘natural’ inefficiencies exist, and we would need to develop a method of making allowance for these. We would also need to be sensitive to the personal and personnel issues involved in making such an assessment. Staff teaching courses using a major online or distance component could appear, using timetabled class information only, to be “less efficient” than their colleagues. Similarly, “effectiveness” of teaching is not just a measure of face-to-face class contact hours – we need to clearly acknowledge the other contributions academic staff make to their students’ learning.

To make a comparison with classroom utilisation: the TEFMA benchmarks make allowance for the fact that some types of rooms designed for special purpose use may be used less frequently, or when in use with greater or less seat occupancy, than other rooms. Accordingly, Room Frequency Factor (RFF) and Seat Occupancy Factor (SOF) targets for a lecture theatre will vary from those for a computer lab, or a design studio, or a music practice room, and so forth.

We are not in the habit of so clearly delineating the category of academic staff in so clear a fashion. In most Australian universities, we make distinctions between the levels of staff (Lecturer A to Lecturer E)¹¹ but these are still not necessarily the best divisions to use to apply different targets for “efficiency and effectiveness”.

Perhaps we need to group staff into “Major Lecture Teaching Staff”, “Tutorial Teaching Staff”, “Laboratory Teaching Staff”, and so forth. Because of the nature of the preparation required to undertake each of these different teaching tasks we could expect each of these groups to have a different target for the number of hours of class contact, and the number of students with whom they would interact in such classes. However it remains the case that many academic staff in Australian universities fulfil all these diverse roles within a typical teaching week: they will deliver three or four lectures, lead one or two tutorials or seminars and perhaps supervise one or two laboratory or studio sessions.

That said, it still remains that a university could elect to define, based on past experience and an assessment of either ‘best practice’ or ‘common standards’, a set of targets for (a) the average number of hours they would expect their staff to be undertaking timetabled teaching in a typical week, and (b) the average number of students they would expect to be attending those timetabled classes. These measures could be determined for either all academic staff, or different levels or categorisations of staff. And, as with classroom utilisation figures, anomalous results could be analysed and explored if no obvious reason can be identified for a variance from the target. The measures outlined, and the analysis of variance from target, can be applied to staff at institution, department or individual level.

Thus, using the same approach as is used with room utilisation, we can define two measures for staff, which multiplied together become a single measure of staff utilisation – a ‘frequency’ factor and an ‘intensity of use’ factor:

Teaching Frequency Factor

This is the proportion of the number of hours in the week for which the staff member is scheduled to teach. This doesn't include non-timetabled teaching for the purposes of this exercise, although such teaching could be included if the staff member's hours were audited (as distinct from extracting data from the teaching timetable).

Should this calculation include or exclude hours taught outside the Target Timetable Week? To be consistent with the approach taken with space utilisation calculations, such teaching should be excluded. The question is – is the extent of after-hours teaching by staff significantly different, in either its nature or order-of-magnitude, from after hours use of classrooms?

Example:

Staff member A teaches 3 x one-hour lectures, 4 x one-hour tutorials and 1 x two-hour seminar. The Target Teaching Week is 55 hours. The staff member's TFF = $(3 + 4 + 2) / 55 = 16.4\%$

Student Contact Factor

This 'intensity of use' factor is a measure of the average number of student contact hours for all classes taught by the staff member.

Example:

Staff member A teaches:

3 x one-hour lectures, with attendances of 185, 120 and 85 respectively;

4 x one-hour tutorials, with attendances of 25, 15, 20 and 10 respectively; and

1 x two-hour seminar, with an attendance of 65.

The staff member's SCF = $[(1 \times 185) + (1 \times 120) + (1 \times 85) + (1 \times 25) + (1 \times 15) + (1 \times 20) + (1 \times 10) + (2 \times 65)] / 9 = 65.5\%$

Staff Timetable Utilisation

This would be determined by multiplying the Teaching Frequency Factor by the Student Contact Factor.

Example:

Staff member A Staff Timetable Utilisation = $16.4 \times 65.5 = 10.7\%$

Notes

¹ In a number of places throughout this paper, I refer to the “university” although I am conscious that many of the issues discussed apply equally to colleges, polytechnics, TAFE institutes, private providers and a wide range of other post-secondary educational institutions.

Similarly, despite the original Australian focus of the paper, there is again a broader application of the principles discussed to education institutions and practices around the world. For “academic staff” in Australia, read “faculty member” in the US; for “timetable” read “class schedule”, etc.

It is simply not possible to write a paper such as this using language common to all post-secondary institutions: universities, FE colleges, polytechnics, private providers. For the sake of clarity I am using the following terminology in the following ways:

- A Program is a combination of Courses that, possibly undertaken over several years, permits the student to gain a qualification from the institution (e.g. Bachelor of Arts, Certificate in Automotive Maintenance);
- A Course is a combination of Classes and other learning activity, normally offered in one specific discipline within one defined teaching period of a term or semester (e.g. English 101, Automotive Electronics);
- A Class is a teaching activity for a Course, normally repeated regularly over a series of weeks throughout the teaching period;
- A Timetable is a schedule of Classes, for an entire year or for one teaching period.

² The McKinnon Benchmarks are one commonly applied set of university benchmarks, developed in 1999 for the Department of Education, Training and Youth Affairs (DETYA) by Professor Ken McKinnon, Suzanne Walker and Dorothy Davis. The benchmarks are consciously broad and institution-wide, and do not address timetable issues to any degree of specificity. Their paper does propose that universities, in assessing the effectiveness of administrative services for students, take into account the timetabling of both classes and examinations, and assess such factors as the timeliness of provision of information about the timetable for the subsequent teaching period.

The paper proposes that “further work is necessary to set the levels more explicitly, perhaps for sub-sets of similar universities”² for a range of administrative functions. On the matter of timetables, the paper provides the sample measure of: “lecture timetables available in Week 11 of the preceding semester”, a measure that is oriented towards the provision of adequate information to students in advance of enrolment.

I am not aware of any subsequent discussions that have resulted in agreement on such a measure, although this may have occurred in the context of one of the networks of Australian universities (Go8, ATN, etc). ASPRG may want to address this issue, with the aim of establishing a measure or measures for its members.

³ An extensive data collection exercise is undertaken in Australia each year. For universities this is done by the Higher Education Group of the Department of Education, Employment and Workplace Relations (DEEWR), after liaison with the Australian Bureau of Statistics. Such data is published in several places, and is used for a wide variety of research purposes. It also contributes to the analysis of university performance against a range of key performance indicators. There is a comprehensive collection of statistics on all Australian universities that is referred to as the *Higher Education Statistics Collection*. It includes data on:

- courses conducted by higher education institutions
- numbers and characteristics of students undertaking courses
- student load
- completion of units of study and courses
- numbers and characteristics of staff in higher education institutions

(Note: In DEEWR terminology, an award program is a “course”, an individual course or subject is a “unit of study”.)

Comparable, but not equivalent measures, are collected for New Zealand tertiary institutions by the Ministry of Education. In the UK, the Higher Education Statistics Agency (HESA) collects and disseminates statistics about publicly funded UK higher education, although other specialised collections (eg Estates Management Statistics) are also maintained. A parallel statistical data collection operates for Further Education statistics.

For Australian TAFE institutions, the National Centre for Vocational Education Research (NCVER) collects and provides statistics on vocational education and training. There is a nationally consistent standard for the collection, reporting and analysis of publicly-funded vocational education and training information: this is part of the *Australian Vocational Education and Training Management Information Statistical Standard* (AVETMISS). Again, these are comparable, but not equivalent, to the measures applied to Australian universities.

These statistical collections are reported in greater detail on the web sites of the relevant bodies:

- DEST - www.dest.gov.au/sectors/higher_education/publications_resources/profiles/
- NZ Ministry of Education - www.minedu.govt.nz/index.cfm?layout=index&indexid=1047
- NCVER - www.ncver.edu.au/
- UK Dept for Employment & Learning - www.delni.gov.uk/index/statsandresearch/statistics.htm
- HESA UK - www.hesa.ac.uk

⁴ Benchmarks to measure classroom space utilisation in higher education are well-established, and are documented. In the UK, publications from HEFCE's Space Management Group advocate regular measurement of utilisation. The authors of the National Audit Office's *Space Management: A Good Practice Guide* offer the cautionary note:

"it has to be recognised that a space utilisation survey is simply a measure of one aspect of space use or space management. It records the number of people using a space across a given time period - it does not assess the 'quality' of this use of space, and generally only focuses on a relatively small part of the estate, namely teaching space."

Guidance for Further Education Colleges on the Management of Floor Space can be found at:

http://readingroom.lsc.gov.uk/lsc/National/Floorspace_Guidance_-_02_05_07_doc_v2_2_.pdf

Space Management: A Good Practice Guide can be found at:

<http://www.smg.ac.uk/documents/swanspace.pdf>

AAPPA Space Planning Guidelines (Edition 2, 2002) can be found at:

<http://www.tefma.com/PDFs/Publications/SpaceGuidelines.pdf>

(A more recent version of the publication is available to members only.)

One issue associated with benchmarking between institutions is that of comparability of measures: how to enable a set of 'standard' or 'typical' classroom types to be defined and compared, to improve the intelligibility of data comparisons between institutions . . . currently, what one institution calls a "lecture room" may be called a "lecture theatre" or a "general teaching space" at another. In the US, since 1973, a standard classification of educational space-types has been defined through the Postsecondary Education Facilities Inventory and Classification Manual (FICM). The document is detailed and extensive, although the classification of classroom space is much simpler than the number of classroom types most space managers and planners in the UK, Australia and New Zealand would be familiar with.

⁵ For users of timetabling software solutions such as *Syllabus Plus* and *CELCAT*, and for the analysis of manually collected room audit data, *RUIS (Room Utilisation Information System)* is an existing software package that can analyse and report such statistics making use of data already recorded in the timetabling system (see <http://www.mosaicsd.com/productruis.html>). RUIS is a product of the author's company Mosaic Software Development: mention here does not imply endorsement of the product by any organisation making use of this paper.

⁶ There are some institutions where staff are ‘dynamically assigned’ to classes in a manner comparable to that used for class-room assignment. At the University of Western Sydney, to cite one example, the first stage of the timetabling process may dynamically assign one person from a small group of staff to one particular class from a number of classes that are specifically assigned to be taught by members of that group. However, in contrast to allocation of classrooms, the staff member can arrange for their reassignment to another class at another day and/or time.

⁷ In an increasingly competitive student marketplace, there is a growing consensus that certain factors exert the primary influence on a student’s choice of institution. First amongst these is the perceived ‘quality’ of the institution, as expressed through the university ‘brand’. A second major factor is the availability at the institution of the program or discipline of particular interest to the student. If these factors are equal, however, students will make their choice of institution on the basis of the student experience offered by the university (and campus where applicable).

⁸ Three major student surveys (1994, 1999 and 2004) have resulted in a range of articles and papers, the most recent of which is:

Krause, K, Hartley, R, James, R and McInnis, C. (2005). *The First Year Experience in Australian Universities: Findings from a Decade of National Studies*. Department of Education, Science and Training. Available online from <http://www.dest.gov.au> or <http://www.unimelb.edu.au>. Accessed June, 2005.

Of particular relevance is Chapter 4 “Engaging with Learners and Learning at University”, principally pp 31 – 36. I am not aware of comparable studies of later-year students.

⁹ Students deliberately enrol in courses with a clashing timetable in several situations:

- (a) when they are repeating a course from a previous year, and may only need to attend one class element in order to achieve a passing grade; or
- (b) when they are required by a tightly-structured degree program to undertake a certain course combination but the institution has failed to timetable it in a clash-free manner: in these circumstances, students will make alternative arrangements to access the content of the missed classes (getting copies of lecture notes from fellow students, accessing online recordings of lectures, etc)

¹⁰ There are, of course, a range of algorithms developed for the purpose of generating a timetable. These complex mathematical approaches are less transparent to the average university timetabler or manager.

¹¹ Lecturer A equates to the traditional position of Tutor, lecturer B to Lecturer, Lecturer C to Senior Lecturer, Lecturer D to Reader or Associate Professor and Lecturer E to Professor.