Queen Mary
University of London

Senate

Paper Title	Forecasting the effects of planned growth in student numbers on the teaching timetable.
Outcome requested	Senate is asked to **note** the report on the effects of planned growth to 2019-20 on the teaching timetable.
Points for Senate members to note and further information	In August 2014 the Vice-Principal (Student Experience, Teaching and Learning) established the Student Expansion Contingency Task and Finish Group to investigate the practical implications of planned growth in student numbers and make recommendations on infrastructure requirements, student services and approaches to timetabling that would accommodate growth while enhancing the student experience and institutional efficiency. This initiative recognises that spare capacity in the learning infrastructure has been consumed and that we therefore need to refine our understanding of the implications of different patterns of growth.

The Task and Finish Group commissioned ARCS, Estates and Facilities and Strategic Planning to develop a tool for forecasting the effects of planned growth in student numbers on the teaching timetable. The tool does not address the issues of specialist teaching space, individual study space or staff office space, but it provides nonetheless useful information on which to base a discussion on future curriculum development and delivery.

The following report considers the effects of planned growth to 2019-20 with existing space and space that is already in the pipeline. As a starting point it assumes that growth will be distributed evenly across the existing curriculum, using existing modules and increasing the size of existing teaching activities without causing additional groups to be created. It is the intention to develop the tool further in order to model scenarios that are more realistic and imaginative, and that are grounded in what schools and institutes are doing academically.

David Boyle, Assistant Academic Registrar (Timetable), will be meeting with schools and institutes over the coming months to discuss their needs, with a view to developing further modelling scenarios to assist with planning teaching space for the future. David will also discuss plans for the use of the Graduate Centre for postgraduate taught provision. Please contact David Boyle (david.boyle@qmul.ac.uk) if you would like any additional |

	information.
Questions for Senate to consider	• What are the optimum patterns and room configurations to enable high quality teaching and learning? • What are the best ways to engage staff and students with this work in order to achieve the best solutions for planning teaching space?
Regulatory/statutory reference points	n/a
Strategy and risk	This report is aligned with three Strategic Objectives. [3.1] Encourage all students to achieve their potential by ensuring that teaching, learning and assessment, and student support are optimised, with the provision of Appropriate levels of resource. [4.4] Increase the number of students (including associate students) from outside the UK whose education is presented, in whole or in part, on our London campuses, while adhering to the highest quality standards. [6.3] Increase income from educational activities though an Enhanced portfolio of courses, and more effective use of resources. The report also touches on four broad risk areas in the Strategic Risk Register. [1] Student recruitment. [2] Student experience. [7] Design and delivery of a high quality portfolio of Programmes. [14] Failure to develop and implement strategic development projects in support of the College's overall Strategic Plan.
Reporting/ consideration route for the paper	An earlier version of the paper was considered by the Task and Finish Group on 18 March, QMSE on 31 March, DTPG on 23 April 2015 and the Education Quality Board on 13 May 2015.
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Student Growth Forecasts and the Implications for Timetabling

Aims

This document outlines the results of a number of modelling exercises designed to measure the impact of an increased student population on the teaching timetable.

Data

In order to ensure that the initial timetabling data is accurate and truly reflective of the teaching activity at QMUL, a process of data validation and cleansing was undertaken. This has led to the following data improvements:

- Removal of all bookings that were superfluous, unneeded or made in error.
- The correction of teaching patterns to reflect the accurate space requirements.
- Validation process to ensure all teaching in departmental space is recorded.

In addition to this, all ad-hoc bookings were deleted. This left only timetabled activities in the data set.

Method

The next stage in the process was to track the QMUL's current space utilisation and space demands. This would provide a baseline onto which growth rates could be applied. Non-timetabled activities were removed from the data set in order for the teaching space demands to be interrogated in isolation.

This then enabled us to run modelling exercises for the following scenarios:

1) Re-scheduling the 2014-15 timetable using the projected student numbers for 2019-20. This timetable was generated keeping the suggested timeslots (that had been requested by schools/institutes) as the primary constraint.
2) Re-scheduling the current timetable using the projected student numbers for 2019-20, but using 'best-fit' for room versus class size as the primary constraint.
3) Repeating scenario 2 with the inclusion of anticipated changes to teaching space stock.

Note on projected student numbers

By 2019-20 Student numbers are projected to rise by 14% for UG and 18% for PG from the current figures (see table below). There is variation in growth rates across programmes of study but for the purposes of this modelling exercise, uniform growth rates of 14% and 18% have been applied to all UG and PG programmes taught at Mile End campus.

	2014_15	2015_16	2016_17	2017_18	2018_19	2019_20	Grand Total
PGT	3017	3005	3311	3549	3560	3562	20005
PGT- Assoc	156	150	150	150	150	150	906
UG	11364	11972	12431	12784	12928	12975	74454
UG- Assoc	870	859	859	859	859	859	5163
Grand Total	**15407**	**15986**	**16750**	**17342**	**17497**	**17546**	**100528**

Current versus Future Demand

Current demand for teaching space can be represented in terms of Room Frequency, Occupancy and Utilisation Rates[1] as detailed below.

Room Usage Statistics for Teaching Purposes (Only) 2014-15*

Room Size	Frequency Rate	Occupancy Rate	Utilisation Rate
01 to 25	49.97%	78.85%	39.40%
26 to 50	64.66%	61.37%	39.68%
51 to 75	54.84%	57.94%	31.77%
76 to 100	67.08%	67.91%	45.56%
101 to 150	68.68%	72.55%	49.83%
151 to 336	70.56%	75.15%	53.02%

*From sample weeks 9 (Sem1) and 24 (Sem2)

HEFCE define room utilisation figures of 35% and above as 'good', and the data would suggest that QMUL exceeds this benchmark for most room sizes. It is however important to note that occupancy rates are based on anticipated attendance and are likely to be higher than *actual* attendance.

Space demand is not only defined by limitations of the estate, but also by the institution's approach to timetabling. QMUL's de-centralised approach affords a degree of choice in terms of space and timeslots to schools and institutes as they construct their teaching timetables. This has the effect of skewing the data as it focuses demand on particular spaces and times.

This may not necessarily provide us with a true representation of QMUL's actual space demands at the institutional level. The table below shows the statistics for the 2014-15 timetable remodelled using 'best-fit' for rooms versus class sizes as the primary factor.

Indicative *'Best-Fit'* Room Usage Statistics for Teaching Purposes (Only) 2014-15 *

Room Size	Frequency Rate	Occupancy Rate	Utilisation Rate	Net Freq. Change
01 to 25	66.67%	82.28%	54.86%	16.70
26 to 50	59.14%	68.74%	40.65%	-5.52
51 to 75	47.47%	67.73%	32.15%	-7.38
76 to 100	56.54%	84.59%	47.83%	-10.54
101 to 150	43.80%	81.45%	35.67%	-24.88
151 to 336	71.46%	76.24%	54.48%	0.90

*From sample weeks 9 (Sem1) and 24 (Sem2)

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[1] Frequency rate is the average percentage of available teaching hours that a room is in during the teaching week. Available teaching hours at QMUL are 09:00-18:00 Mon to Fri with the caveat that only PG teaching takes place from 13:00-18:00 on Wednesdays.
Occupancy rate is the average percentage of seats in a room in use at any one time. This is calculated by dividing the average number of students in the room by the maximum room capacity.
Utilisation rate is calculated by multiplying frequency rate by occupancy rate.

The data suggests that there is a bias towards larger spaces which shifts demand away from the smaller teaching rooms. This will in part be due to cautious over-booking of space as class sizes are uncertain at the initial stages of the timetabling process.

For the purposes of this paper, both sets of data have been used for future modelling. In each instance staff and student clashes have been avoided in order to generate meaningful results.

Scenario 1 – Current timetabling practice with 2019-20 numbers

This Scenario assumes that timetabling practices remain unchanged in 2019-20. The primary factor in the generation of this simulation were the 'set times' that had been requested through S+ by schools and institutes for each teaching activity. Student numbers have been increased by 14% on all UG teaching activity and 18% for all PG activity.

Frequency			
Room Size	Set Times 2014-15	Set Times 2019-20	Change
01 to 25	49.97%	51.34%	1.37%
26 to 50	64.66%	60.94%	-3.72%
51 to 75	54.84%	53.47%	-1.37%
76 to 100	67.08%	58.13%	-8.96%
101 to 150	68.68%	73.12%	4.45%
151 to 336	70.56%	75.25%	4.69%
Occupancy			
Room Size	Set Times 2014-15	Set Times 2019-20	Change
01 to 25	78.85%	85.49%	6.65%
26 to 50	61.37%	69.34%	7.97%
51 to 75	57.94%	69.74%	11.81%
76 to 100	67.91%	79.63%	11.72%
101 to 150	72.55%	88.77%	16.22%
151 to 336	75.15%	80.11%	4.95%
Utilisation Rate			
Room Size	Set Times 2014-15	Set Times 2019-20	Change
01 to 25	39.40%	43.89%	4.49%
26 to 50	39.68%	42.25%	2.57%
51 to 75	31.77%	37.29%	5.52%
76 to 100	45.56%	46.28%	0.73%
101 to 150	49.83%	64.91%	15.08%
151 to 336	53.02%	60.28%	7.26%

Observations: Frequency rates

The data suggests that teaching spaces of 101 and above will be in greater demand than they are currently. As cohort sizes become too large for rooms smaller than this, the demand for those spaces decreases. Demand for large lecture theatres is particularly high and will likely leave very little flexibility for timetable changes or rescheduled lectures.

There is a small rise in frequency rates for rooms of capacity 01-25. This may be a result of smaller space becoming available in the timeslots requested by the schools as the timetable is regenerated.

Observations: Occupancy rates

Occupancy rates have increased in all room sizes as a reflection of the larger cohort sizes. Increased occupancy rates suggest that the increase in student numbers has generally been absorbed by the spare capacity in teaching rooms.

Observations: Utilisation Rates

The scenario has generated higher utilisation rates for rooms of all sizes. The increased efficiency in room utilisation is a consequence of higher occupancy rates. There is a large increase in the utilisation rate of rooms sized 101-150 as these rooms become needed more frequently and are filled closer to capacity.

Observations: Problems

- In some instances the Great Hall is filled almost to capacity.
- In some instances Lab spaces are filled to capacity.
- Although suggested times have been used as the primary factor, the system was not able to match all requests. Some teaching activities were automatically allocated to alternative slots.
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Scenario 2 – 'Best-fit' as Primary factor with 2019-20 numbers

In this exercise, teaching activities have been assigned to the available locations that match the class sizes the closest.

Frequency			
Room Size	Best Fit 2014-15	Best fit 2019-20	Change
01 to 25	66.67%	62.71%	-3.96%
26 to 50	59.14%	53.63%	-5.50%
51 to 75	47.47%	44.36%	-3.10%
76 to 100	56.54%	53.36%	-3.18%
101 to 150	43.80%	53.55%	9.75%
151 to 336	71.46%	78.63%	7.17%
Occupancy			
Room Size	Best Fit 2014-15	Best fit 2019-20	Change
01 to 25	82.28%	88.32%	6.04%
26 to 50	68.74%	76.90%	8.16%
51 to 75	67.73%	71.09%	3.36%
76 to 100	84.59%	81.59%	-3.00%
101 to 150	81.45%	87.66%	6.21%
151 to 336	76.24%	84.97%	8.73%
Utilisation Rate			
Room Size	Best Fit 2014-15	Best fit 2019-20	Change
01 to 25	54.86%	55.39%	0.53%
26 to 50	40.65%	41.24%	0.60%
51 to 75	32.15%	31.54%	-0.61%
76 to 100	47.83%	43.54%	-4.29%
101 to 150	35.67%	46.94%	11.27%
151 to 336	54.48%	66.81%	12.33%

Observations: Frequency Rates

Some variation in frequency rates should be expected as the timetable is completely regenerated with size requirements as the primary factor, though there is a there is a clear shift in demand from smaller to larger teaching spaces.

Observations: Occupancy Rates

Occupancy rates are generally higher with the exception of rooms ranging 76-100 in capacity. This suggests that whist space is being used more effectively overall, the cohort sizes in these rooms do not quite match the room capacities as well as in the simulation with 2014-15 data. This suggests that some classes may have been pushed just over the capacity of smaller rooms.

Observations: Utilisation Rates

Utilisation rates are high. A small drop in the rate for rooms of 76-100 is attributable to the occupancy rate fall in these rooms as described above.

Observations: Problems

- In some instances the Great Hall is filled almost to capacity.
- In some instances Lab spaces are filled to capacity.

**Consideration of Ad-hoc / non-teaching Activities**

These modelling exercises have viewed teaching activities in isolation, but we must also consider the impact of increased student numbers on the non-teaching activity and ad-hoc bookings.

The table below shows the average room frequencies for non-timetabled activities in teaching spaces for the 2014-15 academic year.

Room Size	Additional (non-timetabled) Usage
01 to 25	15.08%
26 to 50	5.69%
51 to 75	11.64%
76 to 100	8.12%
101 to 150	4.97%
151 to 336	6.74%

There appears to be significant variation in demand for space depending on its size. It is difficult to ascertain if this is due to the desirability of the space or if this is simply a reflection of its availability at the time of booking.

However, we can use these figures to provide us with an overall projection of space usage in 2019/20, as illustrated below:

Total Room Freqency Rates
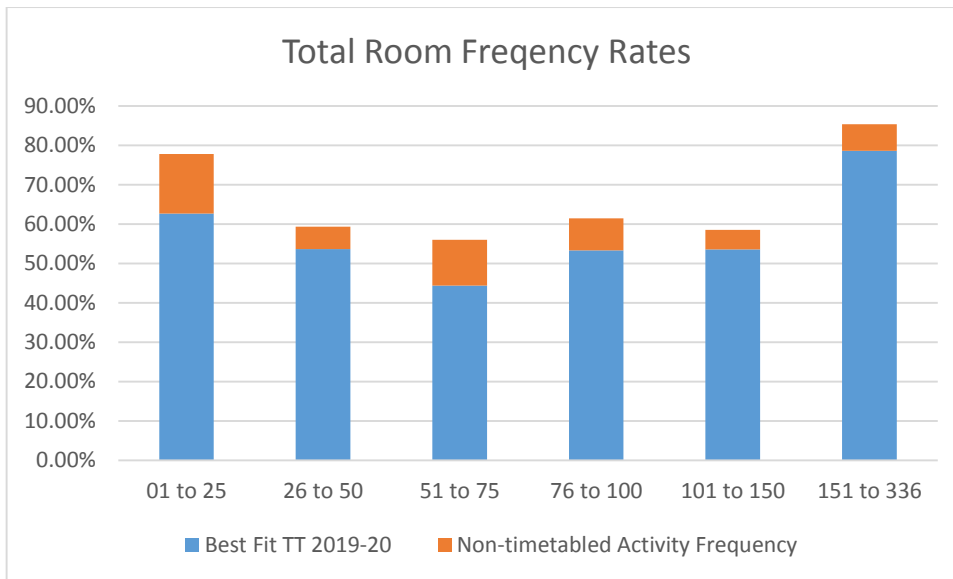
The data suggests that there will be strong demand for space, in particular at either end of the size scale. Once non-teaching activity is factored into the room usage figures the opportunities for timetable amendments become extremely limited. It would be unlikely that a lecture in one of the larger spaces could be re-scheduled following AV failures, staff illness or other unforeseen circumstances.

Further Scenario (3) - Factoring in future changes to estate

The exercises above are based on the assumption that the QMUL estate remains static. There are, however, planned changes to the stock of teaching space.

By 2015-16 we are anticipating the loss of 4x 20-36 capacity seminar rooms in the Scape Building. Meanwhile, current building plans are expected to deliver the following:

Graduate Centre	202 Capacity Lecture Theatre* 66 Capacity Lecture Theatre* 2x 60 Capacity Lecture Theatre*
Maths Building	140 Capacity Lecture Theatre 3x 60 Capacity Lecture Theatre
Engineering Building	2x 110 Capacity Lecture Theatre 4x 25 Capacity Seminar Room

*Designated for PG teaching only

When this data is inputted into the timetable model we note the following implications on utilisation figures:

Frequency			
Room Size	Best Fit 2019-20	With Projected Space	Change
01 to 25	62.71%	62.90%	0.19%
26 to 50	53.63%	63.30%	9.67%
51 to 75	44.36%	46.70%	2.34%
76 to 100	53.36%	56.70%	3.34%
101 to 150	53.55%	36.30%	-17.25%
151 to 336	78.63%	68.30%	-10.33%
Occupancy			
Room Size	Best Fit 2019-20	With Projected Space	Change
01 to 25	88.32%	85.29%	-3.03%
26 to 50	76.90%	73.00%	-3.90%
51 to 75	71.09%	62.20%	-8.89%
76 to 100	81.59%	78.00%	-3.59%
101 to 150	87.66%	91.70%	4.04%
151 to 336	84.97%	71.50%	-13.47%
Utilisation			
Room Size	Best Fit 2019-20	With Projected Space	Change
01 to 25	55.39%	53.65%	-1.74%
26 to 50	41.24%	46.20%	4.96%
51 to 75	31.54%	29.00%	-2.54%
76 to 100	43.54%	44.20%	0.66%
101 to 150	46.94%	33.30%	-13.64%
151 to 336	66.81%	48.80%	-18.01%

Observations: Frequency Rates

The addition of 3 rooms for groups sized 101-150 reduces overall demand for rooms of this size as the teaching activities are distributed more widely among them. This also happens to a lesser, but still significant extent for the largest room category.

The frequency rate for the smallest category of room remains almost static, which is perhaps unsurprising given that there is very little change in the estate regarding rooms of this size.

Increased frequency of use of rooms 26-100 are harder to explain but may be the result of altered availability that is always generated by auto-scheduling.

Observations: Occupancy rates

The general trend is downwards in terms of efficiency as measured by occupancy. This is likely caused by the designation of teaching space in the Graduate Centre as being reserved for PG teaching only. PG teaching has shifted to the Graduate Centre when it is available and a consequence the principle of 'Best Fit' has been diminished. Because of the way space has been designated, this timetable model can really only be described as 'partial best-fit'.

Observations: Utilisation Rates

Poor occupancy rates pull down the overall utilisation rates in most cases.
Utilisation rates are still generally 'good' by HEFCE standards (35+ %), however.

Limitations of Data

- Due to incomplete/unreliable data for teaching sites outside of Mile End, these exercises have focussed entirely on the largest campus. It is possible that student growth forecasts will have a greater or lesser impact at other sites.
- Some natural variation in all figures can be expected when using auto-scheduling functions.
- Not all course structure information is available on the timetabling system. It is possible that adopting the 'best fit' approach may have created some timetables that would not be practical and that different space demands may arise for these to be fixed.
- There has been no consideration of staff constraints in the modelling exercises.
- The modelling assumes that all teaching patterns will be identical to now in 2019-20.
- There is variation in growth by each programme (and year of programme) which these exercises do not take into account. These modelling exercises can only give a generalised view of future usage.
- 'Real' student numbers are not available for all teaching activities. In these instances 'planned' numbers have been used.
- The modelling exercises do not allow for any overbooking due to uncertainty of final student numbers. It is common practice for schools to allow for a margin of error in the initial stages of timetabling to ensure that the classes will fit into their allocated spaces. Were this practice to continue it could put additional demand on the larger teaching spaces. This has not been accounted for in this exercise.

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