# classroom utilization
## MASSACHUSETTS COLLEGE OF ART AND DESIGN

**classroom metric** .442

- MCAD classroom use is close to the DCAMM guideline
- Significant additional use would need to focus on Fridays

■ Capacity  ■ Scheduled Use

Seat Fill

Time Fill

**utilization by room size**

Weekly Room Hours

Station Count

**histograms**

Monday

Tuesday

Wednesday

Thursday

Friday

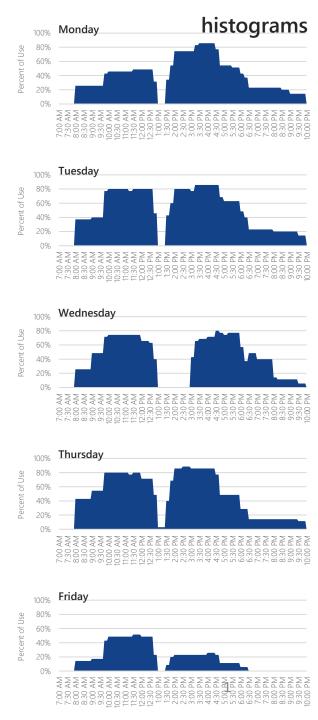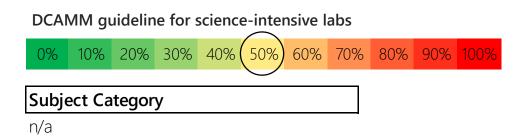Percent of Use

Notes: 1. Analysis excludes 10 classrooms not scheduled in Fall 2015.

2. A score of .450 is roughly equivalent to 67% utilization with 67% seat fill.
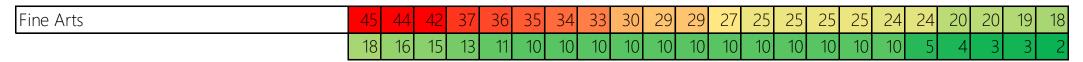
# teaching lab utilization
## MASSACHUSETTS COLLEGE OF ART AND DESIGN

- Each box represents a teaching lab assigned to that discipline.
- The number inside the box is scheduled weekly room hours.
- The color of the box indicates the intensity of use.
- For science-intensive labs the guideline is 50% of the available scheduling window.
- Calculations do not include setup time.

**DCAMM guideline for science-intensive labs**

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|

**Subject Category**

n/a

| 0% | | | | 67% | | | 100% |
|----|--|--|--|-----|--|--|------|

- For other labs (like computer labs), we assume a usage pattern like that of classrooms. The color scheme has been adjusted for consistency.

| Fine Arts | | 45 | 44 | 42 | 37 | 36 | 35 | 34 | 33 | 30 | 29 | 29 | 27 | 25 | 25 | 25 | 25 | 24 | 24 | 20 | 20 | 19 | 18 |
|-----------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 18 | 16 | 15 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 4 | 3 | 3 | 2 |

- **MCAD has a unique program and uses its lab spaces for both scheduled and unscheduled activity. They are not well suited to this kind of high-level analysis**

Note: Instructional spaces at MCAD are also used as open labs / student studios.

# SPACE UTILIZATION ANALYSIS

## METHODOLOGY

We undertook a high-level space utilization study, targeted at understanding data quality and establishing basic metrics across all 29 institutions.

## DATA QUALITY

Multiple data sources contributed to the space analysis:

- Sightlines building inventory
- Sightlines data on capital renewal
- Space inventories from each institution
- Course schedule from each institution
- Faculty and student counts from the institutions and the Department of Higher Education

The Sightlines building inventory, last updated in 2015, provides the foundation for building condition analysis. (Massachusetts Maritime Academy and Framingham State University were last updated in 2014. Salem State was last updated in 2012 - they have additional information from VFA which was not incorporated in our analysis. UMass Worcester did not have data for 2008.) Because of reporting inconsistencies across institutions, we used the Sightlines building lists as the baseline across all institutions. The dataset also includes building gross square footage (GSF), date constructed, date of last major renovation, leased versus owned status, and a differentiation between E&G and Auxiliary space.

The Sightlines capital renewal information included institution-level data for 2008-2015 (with the exceptions noted above) on replacement value, deferred maintenance expenditures, net asset value, new space spending, asset reinvestment expenditures (from both one-time and recurring sources), and target-spend levels. For those institutions with incomplete data sets, we created values using a methodology consistent with that of the capital renewal needs projection described below.

Each institution sent a space inventory, which we standardized into one file. This file provides information at the room level, including room ID, building name, assigned square footage (ASF), and FICM code (the standard taxonomy for describing room use like classroom, lab, office etc.).

The course schedules provide information on scheduled instruction. They include course location (building and room), start and end times, start and end dates, course ID, course title, enrollments, days of the week on which the course meets, and department.

### Building Match

Our first step manually matched buildings among the three primary data sets (Sightlines building list, institutional space inventories, institutional schedules) and to document mismatches, many of which were expected (e.g.: some buildings are not used for scheduled instruction so they did not appear in the course schedule). We documented a city location for each building in order to better understand the distribution of campus facilities, and subdivided all buildings into three categories:

- **Main**: Main Campus facilities are on the main campus or are within walking distance of the main campus. This category may include leased spaces, especially where institutions utilize foundation acquisition with a long-term buyback arrangement. The three north shore community colleges all have multiple "main campuses".

- **Satellite**: Satellite facilities are usually leased, but are facilities where the institution has primary control over the space. They frequently serve a different audience than the main campus. Even if they are located in the same city as the main campus, they are not in walking distance. Available data on satellite campuses is uneven, and they are excluded from the primary analysis (although instructional delivery is recorded).

- **Off-Campus / Partnership**: Off-Campus / Partnership facilities are usually places where the institution delivers instructional content, but does not have primary control of the space. Examples include high schools where dual enrollment or adult education occurs. Available data on off-campus locations is uneven, and they are excluded from the primary analysis (although instructional delivery is recorded).

*We sent preliminary match lists to institutions, but not all information has been confirmed at this point in time. We are sending draft space analysis and on-campus location maps to institutions for additional confirmation.*

*For a building match list, see the Appendices.*

### FICM Codes

Postsecondary Education Facilities Inventory and Classification Manual (FICM) codes are used to capture room use, with lower-level FICM codes rolled up into larger categories. For example, the office/conference category includes office support spaces like copy and break rooms; laboratory space includes instructional, open, and research labs; general use includes assembly, exhibition, dining, lounge, and merchandizing spaces; and special use includes athletics and demonstration spaces.

All institutions generally follow FICM categories but include specialized categories not consistently classified system wide. If space metrics are used in future decision making, it will be important to standardize room classifications in those reports.

We document potential FICM errors but did not go through an extensive clean-up process in this analysis. Potential FICM errors include rooms that have a room description that does not match the FICM code, such as an art studio (210 or 220) labeled as a classroom (FICM 110).

*The National Center for Education Statistics (NCES) website is the source for FICM definitions: https://nces.ed.gov/pubs2006/ficm/content.asp?ContentType=Section&chapter=4&section=3&subsection=1*

## DATA CLEANING

### Space Inventory

Our data-cleaning process removed errors and established rules for evaluating space across all institutions. The following exclusions improve data consistency and focus the analysis on usable space:

- **Non-Residential Assignable FICM**: Our analysis focuses on non-residential ASF, FICM codes 100-700. It eliminates clincial space associated with hospitals (FICM 800), residential space (900), and unassignable space (FICM 000) such as hallways.

- **Not on main campus**: As noted in Building Match above, we eliminated satellite campuses from analysis. Middlesex Community College, North Shore Community College, and Northern Essex Community College have two main campuses, and the resulting metrics combine both geographies.

Analysis excludes entries missing key data in the following fields:

- FICM
- Room Number
- ASF

## Course Schedules

Each entry in an institution's course schedule was evaluated for inclusion in our analysis. For each entry we calculated the number of weekly student contact hours (WSCH), which is the number of hours in a week the room is used for scheduled instruction (WRH) multiplied by the number of students enrolled. Entries were not included in our analysis if they failed any of the following tests:

- **Not on main campus:** These rows exclude courses taught online, at satellite or off-campus facilities. The "Other" category includes field work, internships, and independent studies.

- **Buildings not in space inventory**: Courses taught in buildings for which we don't have room-level information were excluded.

- **Not in busiest week**: We eliminate courses not included in the busiest week so that short-term courses don't skew utilization. These often include one-day seminars.

- **No day assigned / no time assigned / no room assigned**: These three data points are required to determine space use.

- **Room not in space inventory** The course schedule must match to the space database to incorporate FICM codes and ASF.

- **Not instructional space**: Some courses are taught in spaces not coded for instruction. (See details in the Instructional Space section below.) These can include physical education courses taught in an athletic center (FICM 520) or seminar courses taught in conference rooms (FICM 350). It is not appropriate to apply instructional metrics to these space types, but the institutions may want to consider coding changes if these rooms are primarily used for instructional purposes.

## INSTRUCTIONAL SPACE METRICS

Our analysis considers classrooms (FICM 110: general purpose rooms usable by any academic discipline) separately from labs (FICM 210: specialized instructional spaces that are departmentally specific; e.g. include chemistry labs and dance studios). Computer rooms are sometimes classrooms, sometimes labs. We did not attempt to make this consistent in this analysis, but relied on existing institutional designations.

We included multiple FICM codes in order to incorporate specialized coding used by some institutions. We excluded all support spaces (FICM codes ending in 5). We eliminated Open Labs (FICM220) and Research labs (FICM250) from the analysis but included others not explicitly described in the NCES.

### Classroom Metric

The two most important data points for understanding classroom use are the number of hours in the week a room is scheduled (a room-level metric) and the correlation between the station counts of rooms in the classroom pool versus the range of section sizes in the course schedule (an inventory-level consideration). The classroom metric chart captures these essential relationships in a single diagram. The blue area shows classroom supply: each classroom generates a rectangle with height determined by the number of seats and width determined by a desired number of hours of scheduled use in a week. For this analysis, we set a target of 40 hours of use for scheduled instruction. This number is higher than some state standards (which can be around 30 hours), but consistent with targets for states that are reconsidering historical norms in the light of resource constraints. Rooms are arranged along the X-axis from largest to smallest. The red area shows all registrar-scheduled

classroom courses. Each course in the schedule generates a rectangle. Course duration is represented on the x-axis and enrollment on the y-axis. Courses are not necessarily placed in their actual classrooms, but are instead distributed evenly across the x-axis, arranged from largest enrollment to smallest.

The picture shows potential for two kinds of opportunity. Vertical opportunity is any blue area that lies above a red block, and horizontal opportunity is any blue area between red blocks. Vertical opportunity represents empty seats in a room while classes are in session and captures notions traditionally resolved through an average seat occupancy factor; i.e. the capacity for larger section sizes or for renovations to create smaller rooms with lower station counts. (Of course, such changes must align with pedagogical goals.) Horizontal opportunity represents the capacity to schedule more sections; i.e. times when rooms are vacant and available for use.

The classroom metric is the ratio of the red area (WSCH) to the blue area (40 x number of seats in classroom inventory). Theoretically, the numeric metric has a value between 0 and 1.000. But like baseball batting averages or SAT scores, the extreme values are likely not achievable in practice. No one bats 1.000; SAT scores range from 200 to 800. Even if every classroom is scheduled for 40 hours per week, no institution can perfectly match classroom sizes with section sizes. No institution can (or should) fill every seat in every classroom every time a class is scheduled. Scores are typically observed in the .200 to .800 range—with .800 likely representing operating at, or very close to, capacity. A score of .500 equates to the desired level of target use in many traditional state standards. We advocate the range between .500 and .700 be considered as an appropriate target for modern purposes.

## Classroom Scatterplots

We created scatterplots to help understand how individual rooms perform. Each dot on the graph represents an individual classroom: the y-axis shows weekly room hours (WRH), and the x-axis shows the capacity of the room. These scatterplots allow you to check how many rooms are scheduled at least 30 hours per week (the historical standard) and 40 hours per week (an evolving standard), and to see how these utilization patterns correlate with room size.

## Teaching Labs

Unlike classrooms, which can be used interchangeably across departments, teaching labs are designed for department-specific use. Generally, science-intensive teaching labs have lower utilization targets than classrooms to allow for setup time and project work outside of scheduled instruction. The suggested minimum target for these labs is 18 to 22 weekly room hours; other labs should have the same target as classrooms.

We have grouped departments in order to understand them at a high level across all institutions. We apply a 20-WRH target to science labs in the following categories:

- Biology
- Chemistry
- Engineering
- Health Professions
- Physical Science

Other categories have a 30-WRH target.

- Business
- Computer Science and Math

- Culinary Arts / Hospitality

- Fine Arts

- Humanities, Social Sciences, Education

- Performing Arts

A full list of departments within each department category can be found in the Appendices.

The lab portfolio at each institution is displayed as a series of boxes, with the boxes divided among the categories specified above. Each box represents one lab. The number inside the box is the lab's WRH. The color of the box comes from a heat ramp signifying intensity of utilization, with red being highly utilized and green being lightly utilized.

## OFFICE METRICS

True utilization metrics for office space (e.g: how many hours an office is occupied) are non-existent in higher education. Instead, metrics tend to focus on ratios like the number of office stations per employee who requires an office, average square feet per office station, and average square feet per employee requiring an office.

The Commonwealth is relatively data-poor with respect to offices. There is no consistent record of number of stations within an office (i.e.: no way to tell if two people are sharing an office, or if a single "office" is in fact a bullpen used by 20 employees). There is also no easy way to determine which university employees should be designated as "requiring an office" (this last issue is a problem endemic throughout higher education).

We therefore compute our metrics at the highest possible level based on the available data:

- The ratio of rooms coded as offices to FTE employees (faculty and staff). Given the very high-level nature of this metric, we are reluctant to suggest definitive targets. In our experience, institutions with ratios in the range of 0.5 to 0.75 tend to be operating in a healthy zone. Institutions with ratios above 0.75 tend to have additional capacity. Institutions with ratios less than 0.5 tend to have a shortage of space.

- Total office ASF divided by number of offices. Reasonable station targets tend to be between 100 ASF and 120 ASF for private offices, and between 45 ASF and 60 ASF for shared stations. Since we do not have access to station counts, our numbers cannot explore this distinction. Again, hard targets are not advisable, but numbers around an average of 100 ASF or slightly below likely indicate appropriately sized rooms.

- The ratio of total office ASF to FTE employees (faculty and staff). The logic here is similar to that used above. We include this metric as a useful cross-check against the first two.

The office data has additional limitations. We did not investigate potential miscoding and excluded support and conference spaces. (FICM 310 is the standard office designation, but some campuses differentiate. We include only main campus office space but did not ask institutions to indicate which employees are affiliated with the main campus only. Not all campuses consistently track FTE. Where we could only get headcount of full-time and part-time employees, we created an FTE through a 3:1 part-time conversion (after consulting with the institutions). Note also that institutions use inconsistent employee categories and did not always specify who was included. Following standard practices, we excluded student workstudy employees, but included graduate students.

## STUDY/SOCIAL

Traditional space metrics separate study and general use rooms; however, in the modern campus, this distinction is increasingly blurred as collaboration and social interaction define the millennial student experience. Studying occurs in cafes and dining halls, while libraries become more like student unions. For this analysis, we therefore consider study, lounge, dining spaces, and assembly rooms and auditoriums in a single metric. The metric is the total available square footage in these categories divided by the number of student FTEs (we have in the past included a factor for the institution's collection size, but have not made that distinction in this analysis).

We do provide a breakdown of each institution's space across these various sub-categories.

In our experience, variances in this metric can be very high, and we do not propose a standard. Rather, the metric is best used to evaluate relative need across institutions.

## UNANALYZED SPACE

This analysis provides high-level metrics for a limited number of key space types. The following list describes potential metrics or data sources that could be used to analyze other space types:

- **Open Labs (FICM 220)**—Open labs are unscheduled labs usually needed by specific departments (although open-access computer labs also fall into this category). Utilization tracking requires student sign-in or card-swipe access information. There can be significant amounts of square footage in this category.

- **Research Labs (FICM 250)**—Metrics for research labs usually relate research expenditure data to a particular room, usually via a primary investigator space assignment. Our conversations with UMass Medical indicate that they track expenditures in this way. This metric is likely most important for the UMass institutions.

- **Conference Rooms (FICM 350)**—Conference rooms are group meetings rooms, often associated with an office suite. Utilization metrics usually require a centralized room scheduling system.

- **Specialized Spaces (FICM 500)**—This analysis did not account for specialized spaces, usually dominated by athletic facilities. They also include greenhouses, vivariums, and media production spaces. Few standardized metrics exist for these spaces, especially across multiple venues or institutions.

- **Support Spaces (FICM 700)**—Support spaces in the 700 category serve a central unit, such as IT. These spaces do not include rooms such as teaching lab prep rooms (FICM 215) or office copy rooms (FICM315). Few standardized metrics exist for these spaces, especially across multiple venues or institutions. The most used approach is to explore the percentage of support ASF to ASF in FICM 100-600.

## CAPITAL RENEWAL MODEL

We present historical data from 2008-2015 for each institution (except as noted above), and a 20-year "middle of the road" projection for the system as a whole. The data focuses on three key areas:

- **Net asset value (NAV).** This is a (reverse) percentage of a building's deferred maintenance liability to its replacement value (both measured in dollars). For example, a $10 million dollar building with a $1 million backlog would have a NAV of

90%. Portfolio NAV targets vary by institutional sector, but as a general guideline more complex building portfolios like that of UMass and some of the state universities should target a portfolio NAV of 80%. Less intensive building portfolios like that of the community colleges could target a slightly lower portfolio NAV (Sightlines recommends 70%).

- **Backlog.** The backlog is the total amount of deferred maintenance in dollar terms.

- **Target spend vs. actual spend.** Appropriate target spending depends on the sophistication of the building stock. This number is a pure "keep-up" number. It does not include an allocation for catching-up on previously deferred maintenance. A rule-of-thumb range for consideration is typically 1.5% to 2.5% of replacement value. System-wide the historical level between 2008 and 2015 was about 1.5%. This number represents an absolute bare minimum to hold a steady-state. The 20-year projection uses a more reasonable 2% target.

For the model, replacement values are calculated using the previous year value plus any new spend. In the historical data, the growth rate system-wide was approximately 2.4%. The model assumes a more modest 1% growth rate. The backlog is calculated to be the previous year's backlog plus the difference between total spend and target spend. The model assumes that future spending is fixed at current levels. For those institutions missing data, placeholder values were calculated using these methods. For UMass Medical (2008), since this was the first year, applied a factor to the 2009 data. For Salem State / Mass Maritime / Framingham State, the target spend was calculated using the default percentage of replacement value, and the actual spends were calculated using the average historical ratio of actual to target. Replacement values and backlogs were calculated using the model methodology.