



Caltech

Data-Driven Decision Making in Facilities Management

The Right Metrics and Innovative Reporting Formats to
Reflect Tighter Budgets and Inform Tough Trade-Offs

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Caltech at a Glance

Caltech

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- Pasadena, California
- Private, Very-High-Research University
- 4.4 million SF of buildings
- 125 acres in urban setting
- 6 Academic Divisions
- 2,300 Undergraduate and Graduate students
- 300 Faculty Members, 600 Post docs
- 35 Cross-Disciplinary Research Institutes and Centers
- 37 Faculty/Alumni have won 38 Nobel Prizes
- Manages NASA Jet Propulsion Laboratory



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Source: California Institute of Technology, Pasadena, CA.

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EAB

► **Start with best practices research**

- Research Forums for presidents, provosts, chief business officers, and key academic and administrative leaders
- At the core of all we do
- Peer-tested best practices research
- Answers to the most pressing issues

► **Then hardwire those insights into your organization using our technology & services**

Enrollment Management

Our **Enrollment Services** division provides data-driven undergraduate and graduate solutions that target qualified prospective students; build relationships throughout the search, application, and yield process; and optimize financial aid resources.

Student Success

Members of the **Student Success Collaborative** use research, consulting, and an enterprise-wide student success management system to help students persist, graduate, and succeed.

Growth and Academic Operations

Our **Academic Performance Solutions** group partners with university academic and business leaders to help make smart resource trade-offs, improve academic efficiency, and grow academic program revenues.

1.2B+

Student interactions annually

1M+

Individuals on our student success management system

1,200+

Institutions we are proud to serve

1

Goal: Make education smarter

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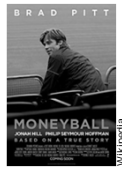
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Winning on a Shoestring Budget


Oakland A's Use "Moneyball" Metrics to Make Playoffs, Despite Low Budget

Oakland Athletics Recruit Undervalued Players Based on Key Metrics


Following 2001 season, Oakland Athletics **lose three talented free agents** to larger market teams



Rather than traditional **scout observations**, A's recruit inexpensive players based on **data analyses** of key metrics



A's General Manager Billy Beane identifies on-base percentage and total bases earned as **key indicators of player performance**



Oakland A's execute **20-game winning streak** and make 2002 playoffs with one of **lowest budgets in the league**

Source: Mark Adams, "The Man Behind Moneyball" • <https://www.domo.com/blog/the-man-behind-moneyball-the-billy-beane-story>; Ryan Wright, "Moneyball" • <http://bleacherreport.com/articles/958470-moneyball-a-look-inside-major-league-baseball-and-the-oakland-as>; Facilities Forum interviews and analysis.

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Data Overload

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Facilities Struggles to Translate Reams of Data into Actionable Insights



Facilities Tasked With Tracking More Data...

- Utilities
- Sustainability
- Building Condition
- Facilities Workforce
- Operating and Capital Costs
- Campus Cleanliness
- Work Orders and Maintenance
- Space Management
- Capital Projects
- Safety and Compliance



...and Has More Data Sources to Manage

- Computerized Maintenance Management Systems (CMMS)
- Geographic Information Systems (GIS)
- Space Information Management Systems (SIMS)
- Building Meters
- Project Management Databases
- Customer Satisfaction Surveys
- Post-Work Order Surveys
- Fiscal Management Systems

1) Computerized Maintenance Management System.
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Source: Facilities Forum interviews and analysis.

The Power of Data

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Work Order Dashboard Facilitates Targeted Interventions at OSU



Slow Work Orders Frustrate Customers



Multiple Facilities shops not meeting service call lead time expectations



Shops not following standard procedures for planned work



Delayed work orders fuel customer dissatisfaction

SFO Implements New Dashboard and Processes



Facilities develops real-time work order aging dashboard



Dashboard helps SFO pinpoint new processes and procedures to accelerate work orders



Begins sending automated monthly aging work order report to maintenance zone leaders to facilitate continuous improvement

Changes Save Time and Money at The Ohio State University (OSU)

374 Fewer annual trips to stockroom

422 Labor hours recouped annually



20% Reduction in service call lead time (from 49 to 39 days)

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Source: The Ohio State University, Columbus, Ohio; Facilities Forum interviews and analysis.

Differentiating Dashboards from Scorecards

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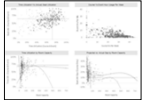
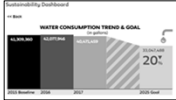



		
	Dashboard	Scorecard
Capsule Description	Overview of performance on core operational measures	Overview of progress toward strategic objectives
Audience	SFO, Facilities leadership, and CBO; in some cases, campus-wide audience	President, Provost, CBO, and other institutional leaders
Principal Aim	Uncover meaningful trends in core metric performance that merit responsive action	Demonstrate the alignment between unit activities and institution's strategic goals
Contents	Data on metric performance relative to targets, historical performance, and related metrics	Strategic objectives, initiatives, and performance on associated progress measures
Limitation	Does not measure strategic initiative impact on advancement of key priorities	Does not allow for analysis of pace of progress or of non-strategic indicators

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Source: Facilities Forum interviews and analysis.

Three Major Types of Facilities Dashboards

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	Facilities Management 	Function/Department 	Sustainability 
Description	Tracks most critical Facilities metrics; SFOs use to gauge and improve operational performance	Tracks function-specific operational metrics; department leaders use to assess performance	Tracks institution- and unit-level energy/utility metrics; shared with broad campus audience to track sustainability efforts
Number of Metrics	15-20	8-12	6-30
Industry Prevalence			
Examples	<ul style="list-style-type: none"> • Northwestern University • California State University-East Bay 	<ul style="list-style-type: none"> • Western Michigan University • University of Minnesota 	<ul style="list-style-type: none"> • The New School • Arizona State University • Columbia University

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Source: Facilities Forum interviews and analysis.



Select Key Performance Indicators (KPIs)

SECTION

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Bringing Metric Selection to Life

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Screening Process Helps Narrow Core Metrics from Long Starting List

Four-Step Metric Selection Filtering Process

Consideration	Description
1 Apply a Reality Check	Set aside metrics not readily accessible, regularly tracked, supported by reliable data, or easily communicated to others
2 Map to Strategic Objectives	Identify metrics that most directly measure progress on Facilities' strategic objectives
3 Ensure Balance of Metric Categories	Force trade-offs in over-represented areas by sorting metrics by function or strategic perspective
4 Account for Unit-Specific Imperatives	Add "hot-seat" metrics that shed light on pressing yet temporary areas of concern

100's of Potential Metrics



15-20 KPIs

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Source: Facilities Forum interviews and analysis.

Consideration 1

Apply a Reality Check

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Four Pragmatic Screens to Determine Metric Viability

Suggested Screens

Metric Screen	Description	Rationale
Accessibility of Data	Information system must possess the capability to generate data on metrics.	Time-consuming to manually pull and analyze data for each metric.
Frequency of Tracking	Metrics elevated to unit dashboard should be monitored at regular intervals (e.g., monthly or quarterly).	Infrequent (e.g., annual) data updates hamper ability to assess performance at regular intervals.
Reliability of Data	Data available from information system should be accurate, consistently defined, and measured across the institution.	Absence of trustworthy data results in stakeholder suspicion toward performance, often resulting in inaction.
Communicability of Data	Definition and rationale for metrics should be easy to communicate and understand.	Lack of understanding about metric drivers and relevance hinders ability to inflect performance.

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Source: Facilities Forum interviews and analysis.

Tool: Reality Check Screening for Metrics

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Ideal Metrics Prompt “Yes” for Every Question in List

Accessibility of Data

1. Is the data for this metric collected via an automated system?
2. If not, can someone collect and report the data within a few hours?
3. Is the system capable of calculating and reporting the results for this metric?

Frequency of Tracking

4. Can this metric be tracked more than once a year?
5. Can this metric be tracked frequently enough to inform action?

Reliability of Data

6. Do all departments use the same definition for this metric?
7. Is the metric calculated by an automated system?
8. Can you ensure the accuracy of the reported data?
9. Do managers trust the data for decision making?

Communicability of Data

10. Is this metric easily explained to and understood by leaders outside your unit?
11. Do managers typically agree on the definition of this metric?
12. Are managers aware of the importance of tracking the metric?
13. Do managers understand how performance on this metric impacts institutional goals?

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Source: Facilities Forum interviews and analysis.

Consideration 2

Map to Strategic Objectives

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Confirm Metrics Directly Measure Strategic Objectives Rather than Initiatives

Framework to Map Metrics to Institutional Strategic Priorities

	Strategic Priorities	Strategic Objectives	KPIs	Targets	Strategic Initiatives
Description	<ul style="list-style-type: none"> Backbone for strategy; roughly four to eight Usually derived from mission statement 	<ul style="list-style-type: none"> Stem from strategic priorities; typically 40 to 60 Adapted annually to every few years 	Indicators that track progress toward objectives	<ul style="list-style-type: none"> Indicator goals that motivate performance Frequently reset to ensure continuous improvement 	Set of actions to raise metrics above target levels
Example	Operational Efficiency	Prioritize preventive maintenance (PM) work to decrease resources spent on reactive work	PM/RM Ratio (Ratio of preventive maintenance to reactive maintenance tasks completed)	70%/30%	Develop prioritized PM schedule that reflects condition and strategic importance of assets

Metrics should flow directly from strategic objectives

Many institutions mistakenly track metrics that assess strategic initiative progress

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Source: Facilities Forum interviews and analysis.

Consideration 3

Ensure Balance of Metric Categories

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Equitably Distribute Metrics Across Facilities Functions or Strategic Pillars

**Option 1:
Function or Capability**

The most straightforward categorization scheme is to group metrics based on Facilities functions or capabilities, ensuring a balance of metrics across all responsibilities.

Sample Facilities Functions

- > Campus Operations
- > Fiscal Management
- > Service Delivery
- > Safety and Compliance

**Option 2:
Strategic or Institutional Perspective**

A second categorization scheme sorts metrics by institutional strategic pillars, which helps illustrate the link between Facilities initiatives and overall institution success.

Sample Strategic Pillars

- > Student Success
- > Enrollment
- > Research and Scholarly Excellence
- > Financial Strength and Stewardship

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Source: Facilities Forum interviews and analysis.

Consideration 4

Account for High-Priority Imperatives

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Elevate "Hot-Seat" Metrics in Response to External and Internal Pressures

Example Pressures that Drive New Metrics to Dashboard



New president appointed; identifies workforce diversity and sustainability as high priorities



State budget cuts force Facilities to identify operational efficiencies



Facilities turnover rate spikes; SFO develops employee training and engagement initiatives



2015 Dashboard

Metric	Status
Work order cycle time	
Campus safety rating	
Acre per grounds FTE	
MBTU/square foot	
Waste diversion rate	
Leadership roles filled by underrepresented minorities	

2016 Dashboard

Metric	Status
Work order cycle time	
Campus safety rating	
Acre per grounds FTE	
MBTU/square foot	
Operating budget execution	
Capital project spending per gross square foot	

2017 Dashboard

Metric	Status
Work order cycle time	
Campus safety rating	
Acre per grounds FTE	
MBTU/square foot	
Internal promotion rate	
Percentage of managers completing training hours	

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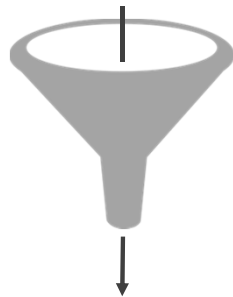
Source: Facilities Forum interviews and analysis.

Getting from Metrics to KPIs

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Metrics that Measure Progress Toward Strategic Objectives Become KPIs

100's of Potential Metrics



15-20 KPIs

Metrics are quantifiable measurements collected to track organizational activities and processes

Key performance indicators (KPIs) are metrics that indicate progress toward strategic and operational objectives. KPIs should break down to be:

20% Volume indicators: raw numbers that provide information on volume or scale (e.g., number of work orders completed annually)

80% Relative indicators: calculations of multiple metrics that provide relative information (e.g., percentage of work orders categorized as emergency)

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Source: Facilities Forum interviews and analysis.

Introducing EAB's Dashboard Guide

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Compendium of Facilities Metrics

700+ distinct metrics, organized into nine functional categories



Functional Quick-Start Guides

EAB's take on the ~15 most impactful metrics within each category to accelerate dashboard implementation



Metric "Shortlist" by Audience

Recommendations on ~12 metrics to share with CBO, academic leaders, President, and Board



Metric Selection Exercise

Four-step filtering process to identify core metrics and KPIs

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Source: Facilities Forum interviews and analysis.



Employ User-Friendly Layout and Format

SECTION

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More Questions Than Answers

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Effective Dashboard Design Critical to Convey Information and Drive Action

Three Major Dashboard Design Mistakes Lead to Stakeholder Confusion



Insufficient Context



Too Much Information



Overly Complex Visualizations

Representative Stakeholder Questions

- *Is the metric above or below the target?*
- *Should the metric increase or decrease?*
- *How does this compare to historical data?*
- *Where should I focus my attention?*
- *What are the most important metrics?*
- *Can you summarize this for me?*
- *What do the different colors mean?*
- *How do I interpret this graph?*
- *What's the difference between the trend lines?*

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Source: Facilities Forum interviews and analysis.

Maximizing Dashboard Impact

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Characteristics of Effective Dashboard Layouts

Characteristic	Description	Sample Dashboard
Concise	Static dashboards limited to three pages or less; interactive dashboards include drop-down menus or variable inputs to allow audience to display desired amount of information	<ul style="list-style-type: none"> • Arizona State University • Columbia University • Western Michigan University
Accessible Data Visualizations	Uses visualizations to simplify complex metrics and trends; most effective elements are bar charts, pie graphs, and trend line graphs	<ul style="list-style-type: none"> • Columbia University • The New School • University of Washington
Metrics in Context	Includes trends over time, performance targets, action triggers, clearly labeled graphic titles, and brief metric definitions when necessary	<ul style="list-style-type: none"> • Northwestern University • The New School • University of Washington
Directionality	Uses arrows or icons to convey metric trend and/or goal directionality	<ul style="list-style-type: none"> • Northwestern University • University of Washington
Color-Coded	Deploys color-coding to indicate progress and enhance visualizations; binary color scheme (e.g., red and green) the simplest way to track progress, but multi-chromatic scheme can enable more complex data visualizations	<ul style="list-style-type: none"> • The New School • Northwestern University • CSU-East Bay
Consistent Time Frame	Clearly indicates time interval for metric collection and assessment; timeframes may differ based on metric type and goal (e.g., monthly work order completion rates, annual customer satisfaction scores)	<ul style="list-style-type: none"> • Northwestern University • University of Washington • University of Minnesota
Mapped to Strategic Goals	Where possible, maps metrics to broader Facilities themes or goals; some dashboards signal metric owner (i.e., Facilities staff member accountable for metric)	<ul style="list-style-type: none"> • University of Washington • Northwestern University

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Source: Facilities Forum interviews and analysis.

Microsoft Suite

Northwestern University (NU)

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NU Relies on Microsoft Suite for Simple Yet Effective Dashboards

Northwestern

Screenshot of Vertical Transportation Equipment (VTE) Dashboard in Excel

Northwestern FACILITIES MANAGEMENT				
FY17 VTE Monthly Metrics Report				
VTE Goals:	Baseline (FY16)	FY17 Goal	This Month's Result	
VTE G1: Install SCADA 20 cabs by end of FY2017	0	20	0	
VTE G2: Achieve and maintain entrapment rate of 0.05 entrapments per cab	0.04	0.03	0.04	
VTE G3: Reduce % cabs with controllers over 20 years old	26%	15%	19%	
VTE G4: Achieve and maintain maximum callback rate of .25 per cab for controllers <20 years old	0.16	0.25	26%	
VTE G5: Achieve and maintain maximum callback rate of .3 for controllers >20 years old	0.23	0.5	0.23	
VTE Key Performance Indicators - Informed by the volume indicators.				
	Baseline (FY16)	FY17 Target	Sep 14	
VTE 1: % SCADA installed	0.0%	5%	0%	
VTE 2: % cabs, age of controller, <20 year	75.2%	80%	77.5%	
VTE 4: % cabs age of controller >20 years	25.6%	15%	22.0%	
VTE 5: Avg # WOT/cab (WOT: ELEVATOR, CHSELEV, & elevator related ENG & EVENG)	0.33	0.10	0.41	
VTE 6: Avg # Entrapments/cab	0.04	0.03	0.04	
VTE 7: Avg # Repairs/cab	0.17	0.10	0.09	
VTE 8: Avg # Callbacks/cab (Controller <20 years old)	0.16	0.25		
VTE 9: Avg # Callbacks/cab (Controller >20 years old)	0.23	0.5		
VTE 10: % time out of service	0.1%	0.5%	0.5%	

Screenshot of Facilities Management Dashboard in PowerPoint

Key Performance Indicators				
KPI Description	Annual Goal	Dec 1st Goal	Actual	Trend
SDa: Service Request Closure	90%	89%	89%	-1%
SDa: Preventative Maintenance Closure	75%	66%	66%	-2%
SDa: Proactivity: FM Identified Work Orders	30%	30%	30%	3%
LOa: Common Space Program	10%	5%	6%	1%
LOa: Facilities Content Implementation	90%	95%	95%	3%
LOg: Engagement: Sustainability Outreach	15%	5%	1%	1%
CEa: Energy Use Intensity (kBtu/SF)	-5%	-5%	-5%	0%
CEa: Recordable Injury Incident Rate	2.99	2.99	3.51	+0.52
CEg: Injury-Related Lost Workday Rate	1.34	1.34	0.96	-0.00
CEa: Waste Diversion Rate	42%	42%	38%	-1%
CEg: Overruns	<5%	<5%	1%	0%
CEa: Minority and Female Enterprise Use	15%	15%	TBD	TBD
CEg: Local Business Enterprise Use	15%	15%	TBD	TBD
CEa: Executive Resident Employment	5%	5%	1%	-1%
Fa: Capital Project Cash Flow Execution	+/-2%	+/-2%	-1%	-3%
Fa: FM Operating Budget Execution	+/-1%	+/-1%	3%	-2%
Fa: Utility Commodity Budget Execution	+/-5%	+/-5%	14%	4%
Fa: Invoicing: Number of Days to Pay	90%	90%	97%	-10%

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Source: Northwestern University Key Performance Indicators. Northwestern University, Evanston, IL. Facilities Forum interviews and analysis.

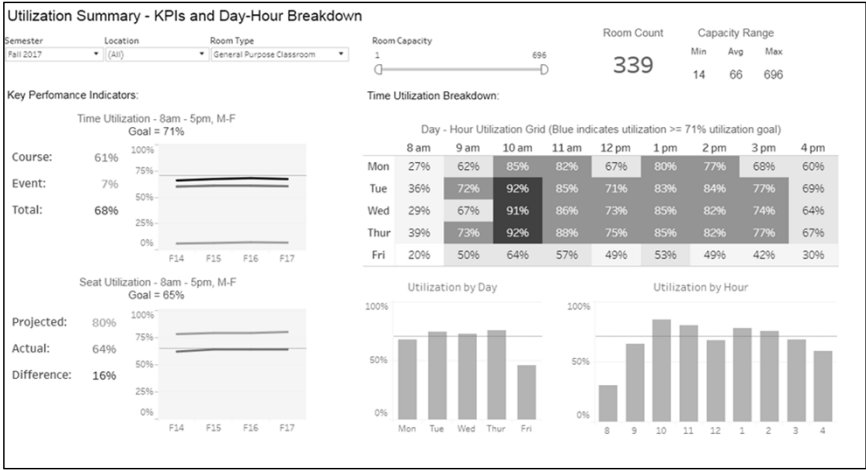
Tableau

University of Minnesota (UMN)

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UMN Uses Tableau for Interactive Classroom Utilization Dashboard

Screenshot of UMN's Classroom Utilization Dashboard



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Source: University of Minnesota Classroom Utilization Dashboard. University of Minnesota, Minneapolis, MN. Facilities Forum interviews and analysis.

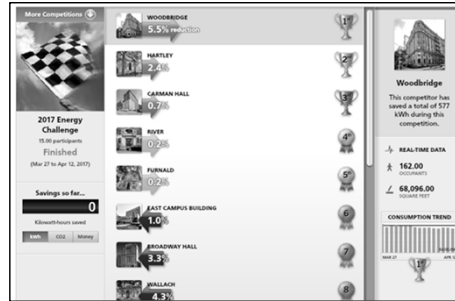
Lucid

Columbia University (CU)

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External Software Generates CU's Interactive, Public Sustainability Dashboard

Screenshots of Columbia University's Sustainability Dashboard



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Source: Columbia University Building Dashboard, Columbia University, New York, NY. Facilities Forum interviews and analysis.



Case Study: Caltech

Four Facilities Management Decisions Informed by Data

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Space Utilization - Crunching the Numbers

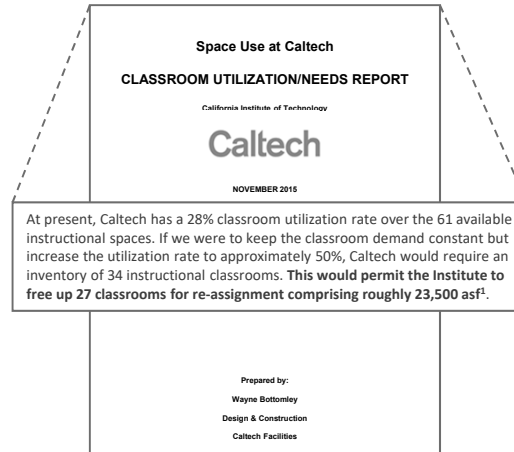
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Analysis 1: Making the case for better space utilization

Caltech's Classroom Analysis

- 1 Assessed room scheduling and seat utilization in all general purpose classrooms
- 2 Compared average section size to room size, identifying mismatches between existing inventory and actual need
- 3 Used layman's terms to summarize conclusions and key takeaways from graphs and analyses
- 4 Quantified amount of space that could be recaptured through improved course scheduling and classroom rightsizing
- 5 Compared size of space savings to well-known buildings on campus



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Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.

Checking EAB Criteria

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Analysis 1: Making the Case for Better Space Utilization

Metric Screen	Description
Accessibility of Data	Medium; maintained by space information manager
Frequency of Tracking	High; updated every semester
Reliability of Data	High; space utilization metrics defined by space policies and enforced through governance process
Communicability of Data	Medium; comparison to well known spaces across campus makes opportunity more accessible
Strategic Alignment	High; supports Caltech's goal of controlling unbridled space growth

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Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.

Parts Supply – Crunching the Numbers

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Analysis 2: Identifying and eliminating process wastes

Source of Inefficiencies



Procurement

Lack of mature procurement practices; technicians and supervisors spend time researching, ordering, and even traveling to pick up necessary materials



Distribution

Inefficient distribution of materials,
causes technicians to spend
valuable wrench time traveling
between central stockroom and
work site

Pinpointing Waste in Supply Distribution



Caltech estimated that ordering and obtaining materials consumed as much as **27%** of work hours for tradespeople

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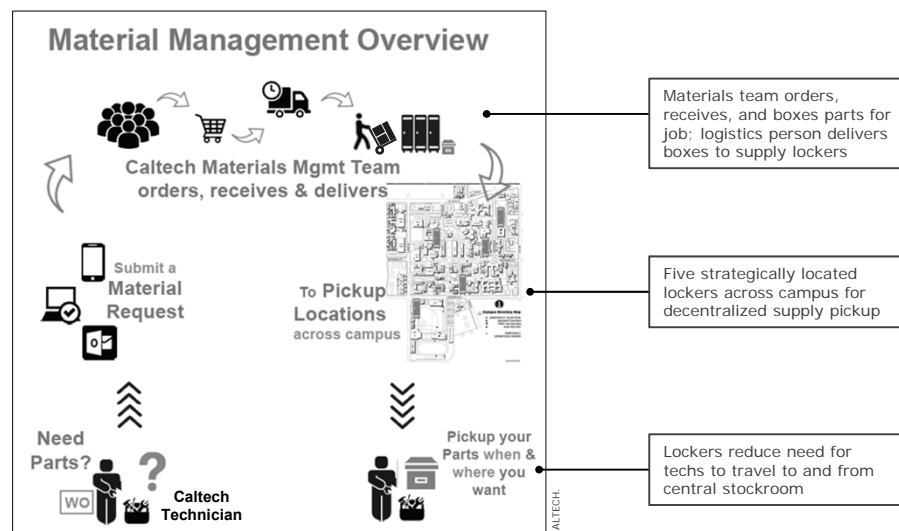
Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.

Distributed Supply Pickup Points

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Analysis 2: Identifying and eliminating process wastes



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Source: California Institute of Technology, Pasadena, CA: Facilities Forum interviews and analysis.

Space Reduction - Crunching the Numbers

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Analysis 3: Demolishing Unused or Underutilized Space

Table of Demolition and Payback Options, April 2011

Building	Size (GSF)	Demo Cost (\$15/SF)	Reduction in Annual Utility & Operations Cost (\$10/SF)	Simple Payback (Years)	Deferred Renewal Eliminated
Sloan Annex	8,650	\$200,000	\$86,500 ¹	2.3	\$900K
Ticket House	1,450	\$21,750	\$14,500	1.5	\$180K
DCAA House	790	\$11,850	\$0 ²	--	\$90K
Public Events Building	2,180	\$32,700	\$21,800	1.5	\$250K
Two Carriage Houses	4,055	\$60,825	\$15,550 ²	4	\$210K



"Once my provost understood the total cost of ownership, he wanted to tear down more buildings than I did."

Jim Cowell
Associate Vice President for Facilities

1) Loss of ICR reimbursement offsets some savings to general fund.
2) Savings reduced since units will move to a space that is now mothballed.

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Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.

Strategic Benefit of Building Demolition

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Analysis 3: Demolishing Unused or Underutilized Space

By the Numbers:

25K

Square feet demolished since 2012

0.84

Average FCI of demolished facilities

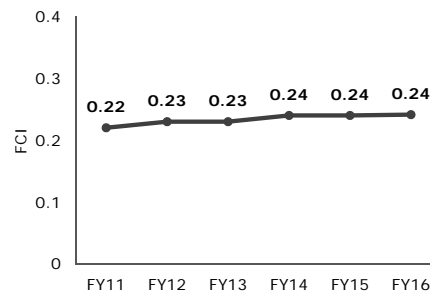
\$4.7M

DM of demolished facilities

\$250K

Avoided annual O&M¹ expenses

Caltech Facilities Condition Index



1) Operations and maintenance.

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Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.

Reimbursable Svc – Crunching the Numbers Caltech

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Analysis 4: Cost vs Price of Chauffeur Service



Caltech Airport Chauffeur Service

\$110

Flat-rate price of trip
from campus to
Hollywood-Burbank
Airport

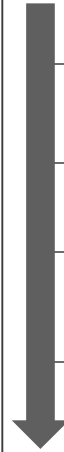
\$140

Flat-rate price of trip to
Los Angeles
International Airport

"Chauffeured vehicles for general use and airport trips are available to all faculty, staff, students, official guests and academic guests."

Facilities Transportation Website

Caltech Validates Price Against Actual Cost of Chauffeur Service



Trip price based on manager's estimate of average trip time; includes driving, waiting for passenger, traffic, flight delays

Implemented new IWMS¹ (AIM from AssetWorks)

New software enabled Caltech to track actual (not estimated) time to complete trips and to bill fixed price

Analysis determined Caltech price too low and **did not cover actual cost of trip; adjusted rates comparable to private limo services**

1) Integrated workplace management software.
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Source: California Institute of Technology, Pasadena, CA; Facilities Forum interviews and analysis.



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Questions?

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