







### Construction Cost Management for Science Building Projects

# The Four Luxuries of Lab Buildings







### Goals

This presentation describes a way of thinking about cost control during the early stages of project design.

Cost estimates at this stage in the design are notoriously unreliable, and contain multiple contingencies.

This approach focuses conceptually on key design factors that typically impact costs.

By understanding the relative impact of these factors the owner and design team can evaluate whether the project is tracking above or below benchmark unit costs.

### Importance of Designing to Budget

Why is it important to design to budget in the early design stages?

Early design creates the project's foundation. Problems early tend to be persistent and often haunt the project.

Estimates early are notoriously inaccurate and rely heavily on contingencies.

Design changes for cost savings often lead to compromises and inefficiencies in system performance.

### Difficulty in Designing to Budget

Why is it so difficult to design to budget early in the design stages?

Expectations are high, and enthusiasm drives more ambitious design concepts.

Accurate cost estimates depend on solid and fairly detailed information.

Early design concepts typically don't have enough detail.

Benchmarks are extremely variable.

There are many factors that impact costs.

### Beauty versus Luxury

#### Beauty is an essential aspect of architecture.

It's as essential as function to improve the quality of work, education and life.

#### Beauty should not be confused with luxury.

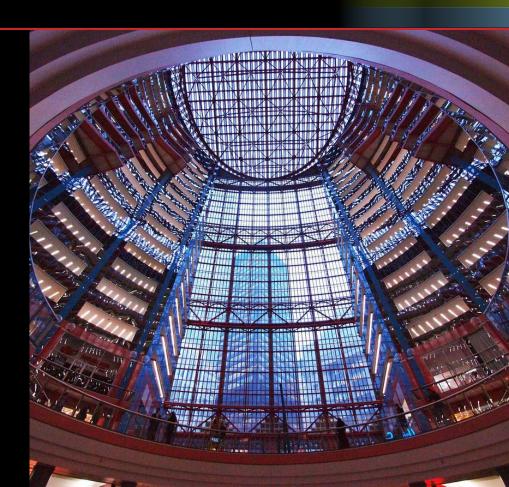
Beauty can be attained at various degrees within a wide range of budgets.

### Conceptual Cost Management:

The Four Luxuries

### Luxury of SPACE

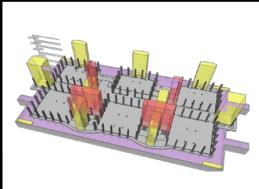
- Space is often referred to as "the coin of the realm."
- All other things being equal, bigger spaces cost more
- Managing costs begins by managing space
- Bigger is not necessarily better
- Smaller spaces mean smaller carbon footprints, reduced initial costs, and improved operating costs



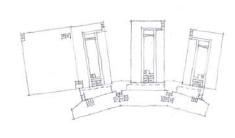
### Strategies for Managing the Luxury of SPACE

- Bigger is not always better
- More efficient space usage means more space
- Combining many smaller spaces into fewer bigger spaces reduces costs
- Making space do multiple duties
- Right sizing the module, and improving net to gross ratios









## Conceptual Cost Management:

#### The Four Luxuries

## Luxury of MATERIAL [element or system]

- Exotic and elaborate materials and systems cost more.
- They are not always more durable, more functional, nor are they always more beautiful.
- Some material decisions can have a significant cost implications.
- Sometimes just a little bit of a fancy material succeeds better than a whole lot of it.



## Strategies for Managing the Luxury of MATERIAL

- Maximize reuse of existing materials/elements/systems
- Making a little go a long way
- Using common materials in uncommon ways
- Design to reduce the length of distribution systems (Ductwork/Piping)





## Conceptual Cost Management:

#### The Four Luxuries

### Luxury of COMPLEXITY

- Complex forms, shapes, and details cost more than simple ones.
- Complexity often adds visual interest to a design, and complexity is often necessary to meet both functional and cultural objectives of a of a building project.
- Smart design decisions often are simple and elegant solutions that make sense.



### Strategies for Managing the Luxury of COMPLEXITY

- Simple is not easy; it takes more design effort
- Manage the complexity of systems
- Manage the complexity of form
- Design using lateral thinking, not linear thinking



#### REDUNDANCY

#### Luxury of REDUNDANCY

- System redundancy and space flexibility are important but potentially expensive
- It is important to study what level of robustness or redundancy is necessary and how and where flexibility is needed
- Flexibility and redundancy should be identified early in the design project and constantly revisited
- Risk analyses and 'what if' sessions provide valuable information



## Strategies for Managing the Luxury of REDUNDANCY

REDUNDANCY

- Pre-investing versus post-investing for flexibility
- Avoid extreme design criteria or requirements
- Additional capacity versus right sizing
- Safety by facility versus safety by protocol





## The Four Luxuries CASE STUDIES

Department of Environmental Quality/Public Health Laboratory

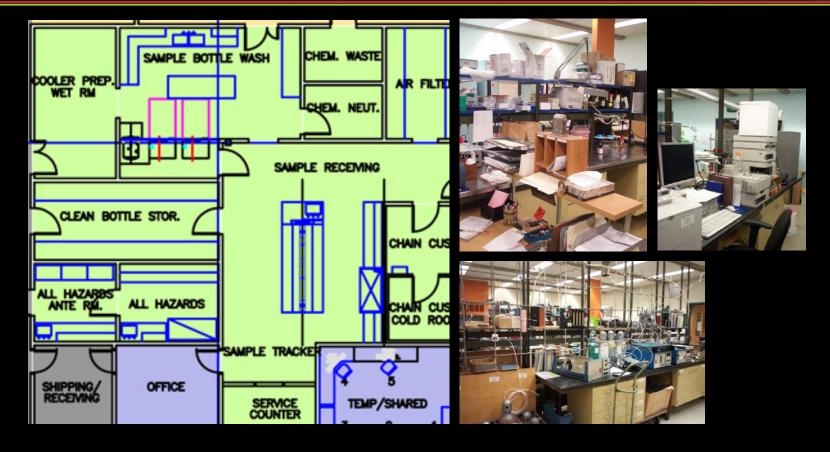


Bigger is not always better

More efficient space usage means more space

Simple is not easy

### Department of Environmental Quality/Public Health Laboratory



## State of Oregon

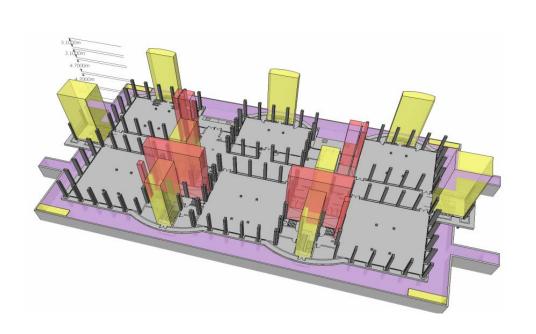
Department of Environmental Quality/Public Health Laboratory



## State of Oregon

Department of Environmental Quality/Public Health Laboratory





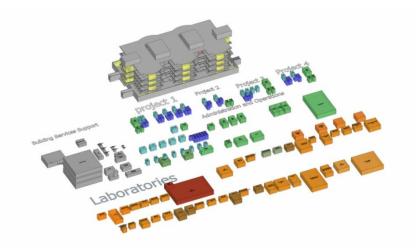
Combining many smaller spaces into fewer bigger spaces

Maximize reuse of existing materials

Manage the complexity of systems

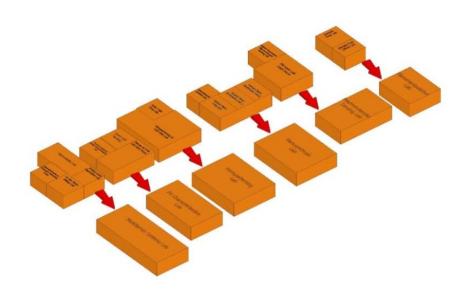


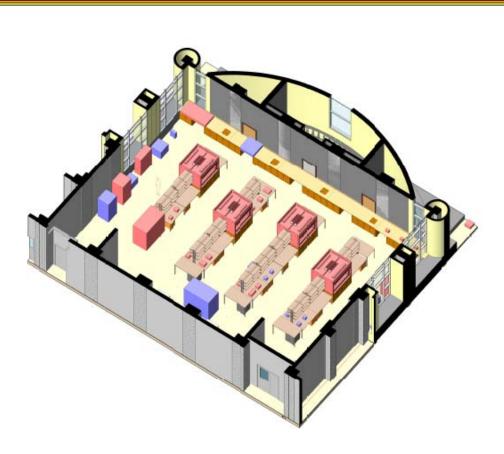


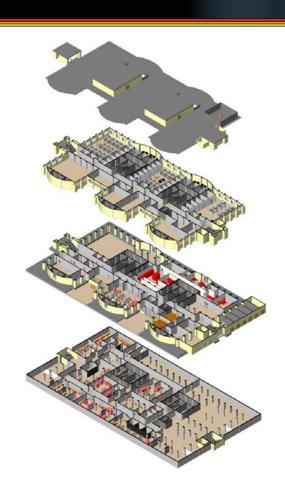


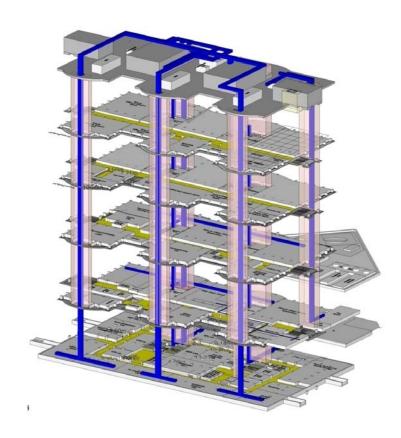
#### Combining small labs into larger labs created multiple benefits:

- · Saved costs by reducing quantity of walls, doors, ductwork, electrical systems
- Increased flexibility by providing more open space and greater equipment sharing
- Improved collaboration by encouraging research teams to share space, equipment and ideas

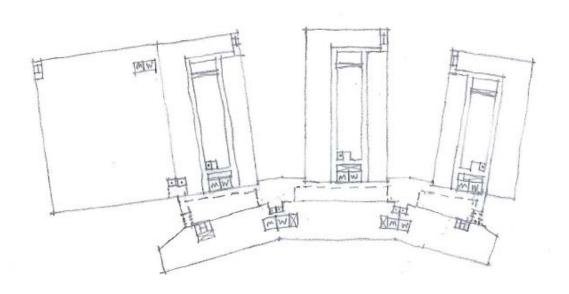








## Confidential Client Advanced Technical Research Facility

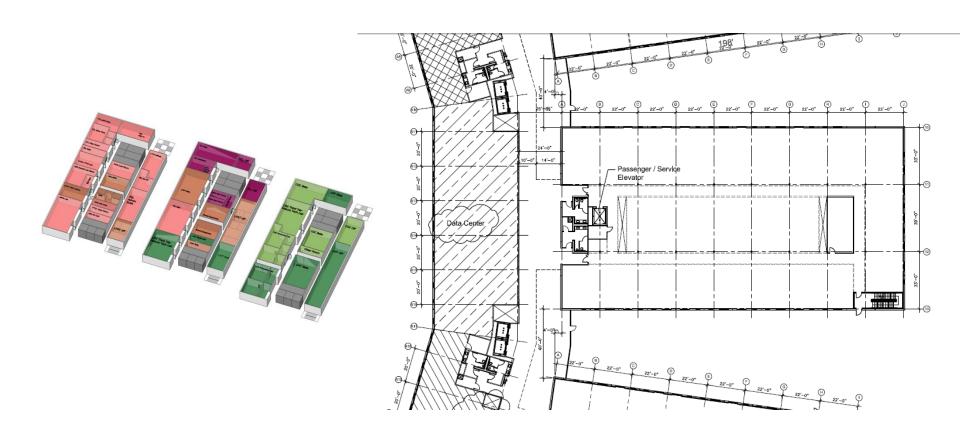


Right sizing the module, and improving net to gross ratios.

Design to reduce the length of distribution systems

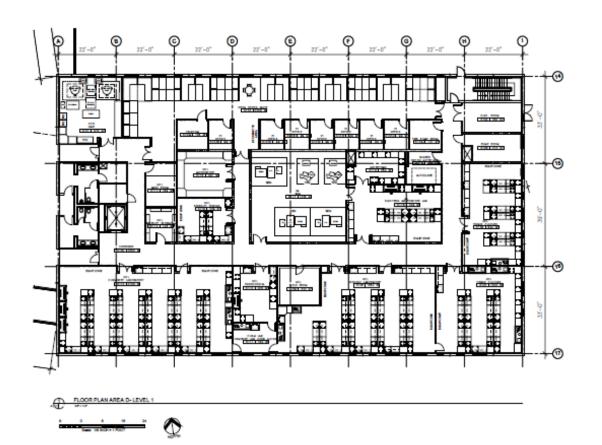
Manage complexity of systems

## Confidential Client Advanced Technical Research Facility

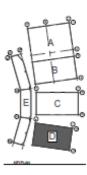


### **Confidential Client**

### Advanced Technical Research Facility

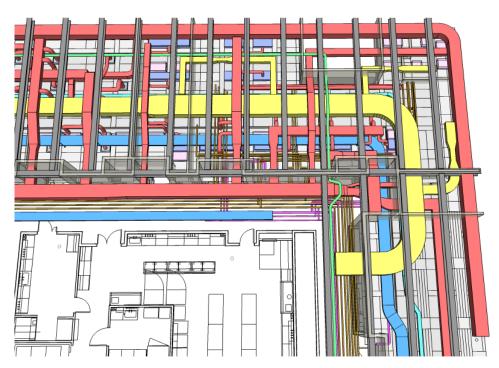






## Confidential Client Advanced Technical Research Facility





Manage the complexity of systems

### **Confidential Client**

Advanced Technical Research Facility



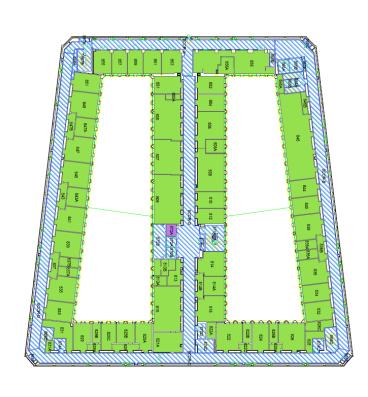


Making space do multiple duties

Maximize reuse of existing materials, elements, and/or systems

Avoid extreme design criteria or requirements



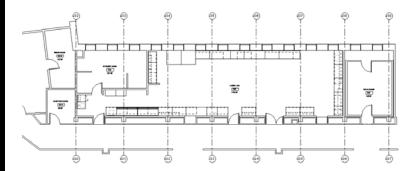


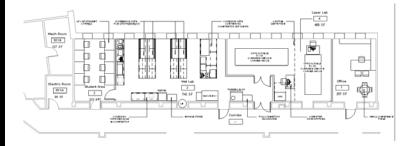
REDUNDANCY





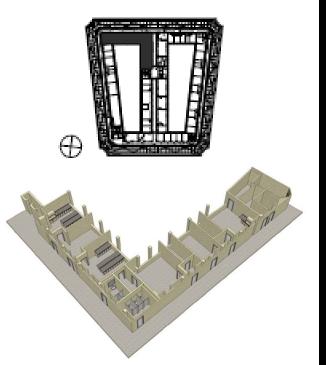


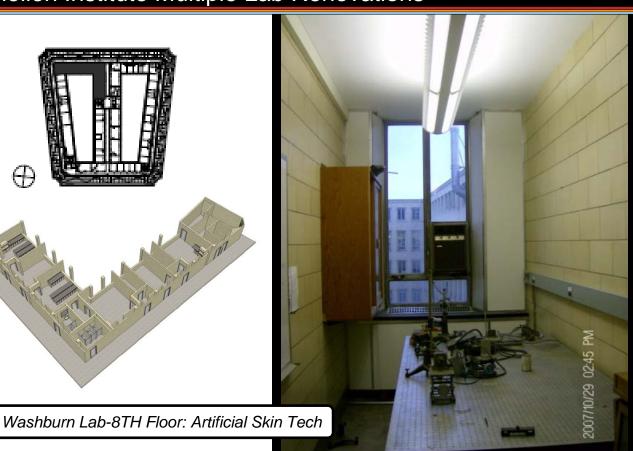




Femtosecond Chem/Laser Lab 5<sup>th</sup> Floor

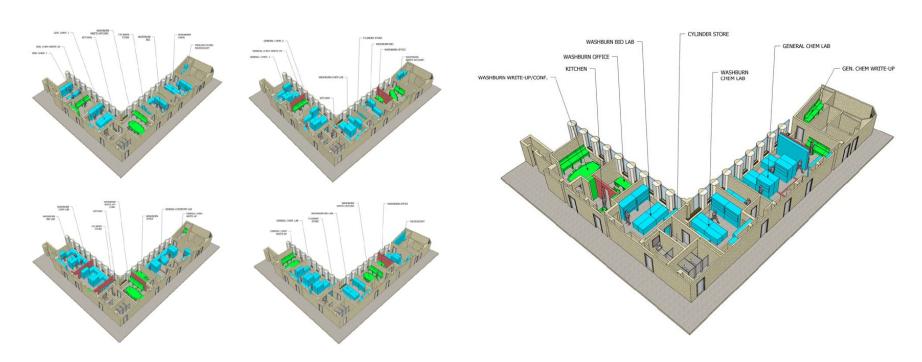
REDUNDANCY











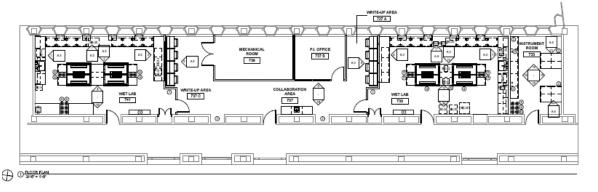
Washburn Lab-8TH Floor: Artificial Skin Tech

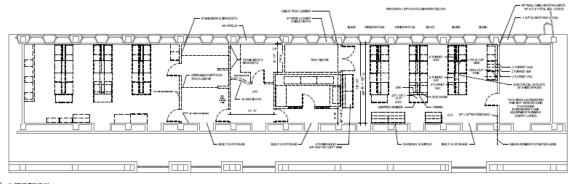
REDUNDANCY





#### REDUNDANCY



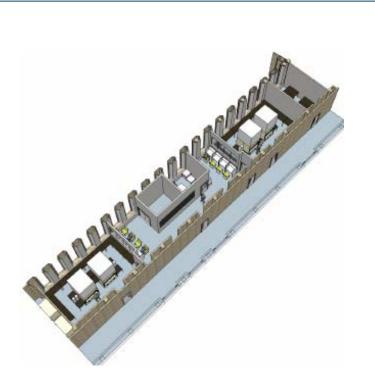


Bernhard Lab, Solar Energy Technologies





REDUNDANCY









Bernhard Lab, Solar Energy Technologies

# Carnegie Mellon University Mellon Institute Multiple Lab Renovations

REDUNDANCY



Science Building 2



More efficient space usage means more space

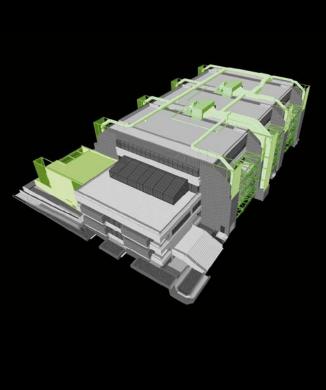
Maximize reuse of existing materials, elements, and/or systems

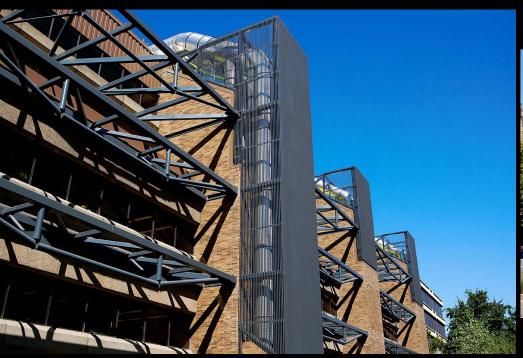
Design using lateral thinking, not linear thinking

Pre-investing versus post-investing for flexibility

Science Building 2









Science Building 2, Portland State University

SPACE MATERIAL COMPLEXITY REDUNDANCY





Science Building 2, Portland State University

SPACE MATERIAL COMPLEXITY REDUNDANCY





### University of Southampton

Mountbatten Nanotechnology Electronics Research Complex



Making space do multiple duties

Using common materials in uncommon ways

Design to reduce the length of distribution systems

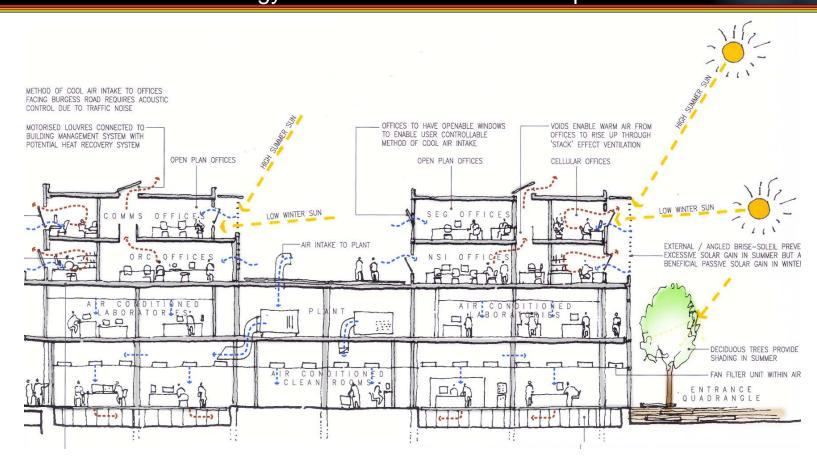
Simple is not easy

Manage the complexity of systems and form





# University of Southampton Mountbatten Nanotechnology Electronics Research Complex



## University of Southampton

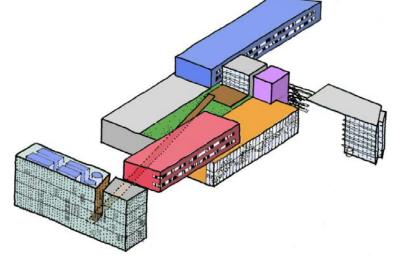
Mountbatten Nanotechnology Electronics Research Complex

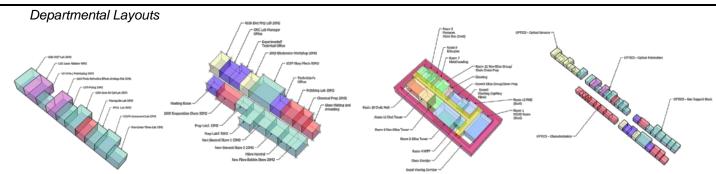


## University of Southampton Mounthatten Nanotechnology Electr

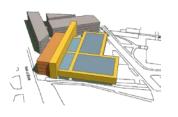
Mountbatten Nanotechnology Electronics Research Complex

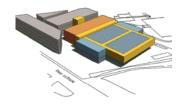
Design Process





Early Massing Studies







## University of Southampton

### Mountbatten Nanotechnology Electronics Research Complex





Manage the complexity of form

#### The Tradeline Three

Start with some solid benchmarks and/or unit cost metrics.

Avoid a contingency laden estimates at this stage of the project

Look at each luxury in turn, and find balance between them to match benchmark targets.

Constantly revisit the issues.

Avoid linear 'Rube Goldberg' designs; think laterally, keep multiple options alive during the process Questions?

F. Jeffrey Murray, AIA, LEED AP™

Director, Design Principal

**IDC** Architects

jeff.murray@ch2m.com