



## ASHRAE Philadelphia Chapter

# Sustainability: Un-definable Success in a Defined World

10 March 2011

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## *Program Overview*

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- Overview of Green/Sustainable Design
- Overview of LEED Rating System
- Issues and Risks in Green Building Design
- Tools for Project Execution
- Summary
- Questions & Answers

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*A hallucination is a fact,  
not an error;  
what is erroneous is a judgment  
based upon it.*

*Bertrand Russell*

What is...



- 'Sustainable development: meeting the needs of the present without compromising the ability of future generations to meet their own needs.'
- Reshaping the Built Environment Ecology, Ethics and Economics – Edited by Charles J. Kilbert Island Press, Washington, D. C. USA 1999

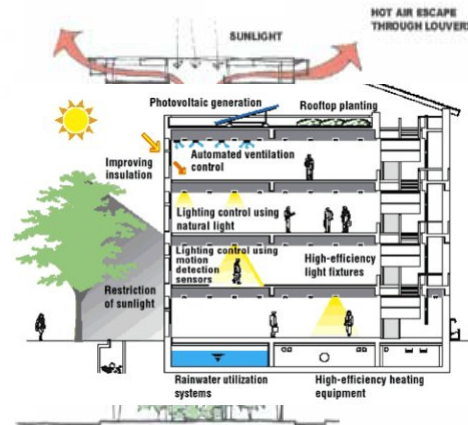
*Definitions – High Performance Building*

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- "A building that integrates and optimizes on a lifecycle basis all major high performance attributes, including energy [and water] conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations" – (Energy Independence and Security Act 2007 401 PL 110-140).

## Green Building Objectives

- greater efficiency
  - Energy
  - Resources
- lower life cycle cost
  - Total Cost of Ownership
    - Operations
    - Maintenance
    - "Cradle to grave"
      - "cradle to cradle"
- healthier environment
  - IAQ/IEQ
  - waste management
  - increased productivity(?)
    - "enhanced wellness"
- better performance



## Balancing Expectation and Intent

### Performance

- Design
- Construction

### Certification

- By Contract
- By Statute

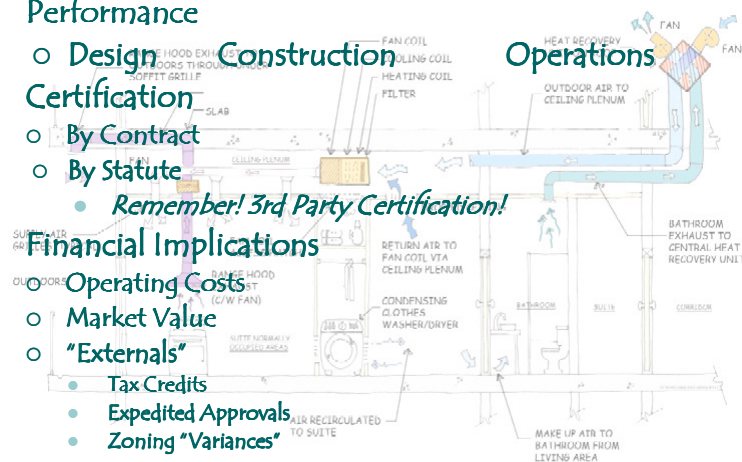
- *Remember! 3rd Party Certification!*

### Financial Implications

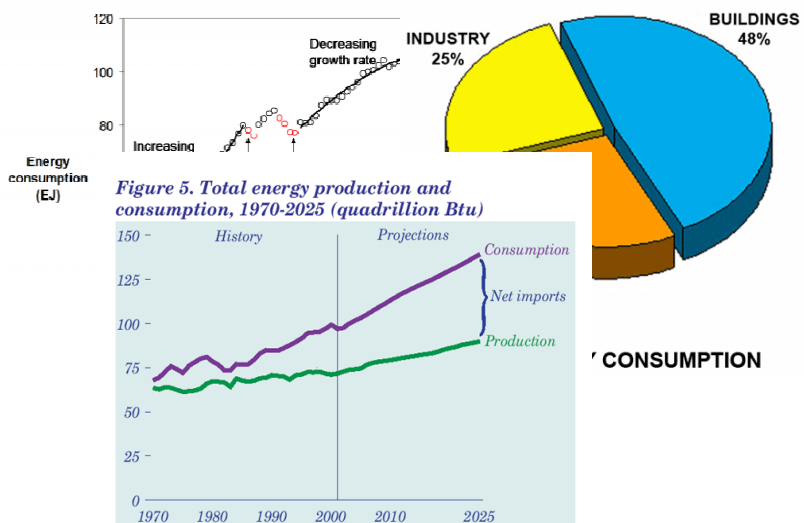
#### Operating Costs

- Market Value
- "Externals"

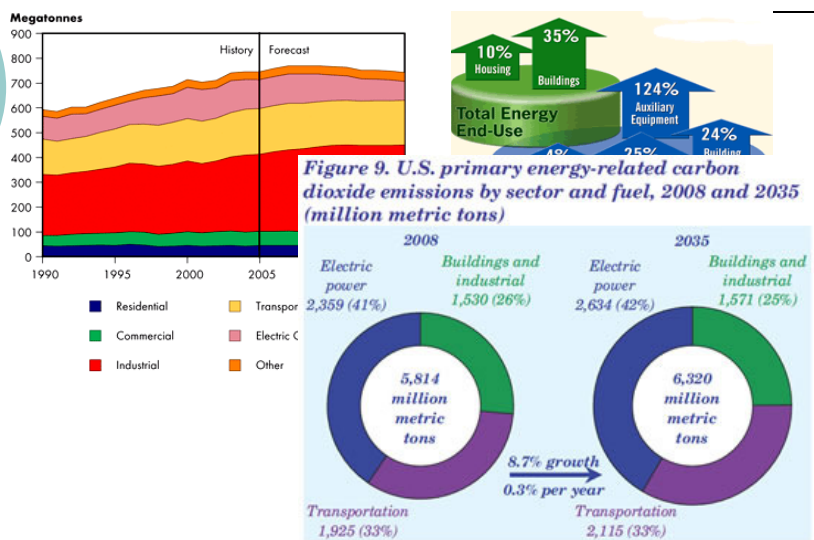
- Tax Credits
- Expedited Approvals
- Zoning "Variances"



## Some context - Energy Trends

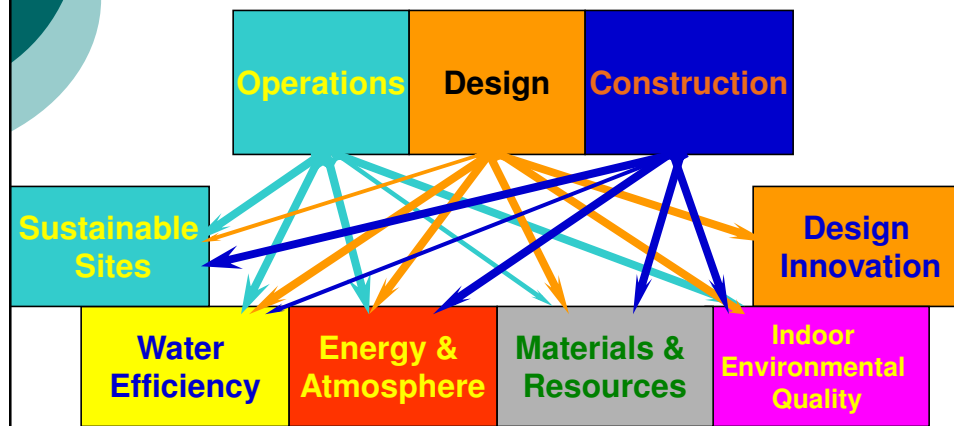


## Energy Use & Outcomes



## "Unpacking" LEED®

Certified = 40-49; Silver = 50-59; Gold = 60-79; Platinum = 80+



\* "Operations" is assumed to be 'by Owner'

## LEED Concentrations

in the ASHRAE context...

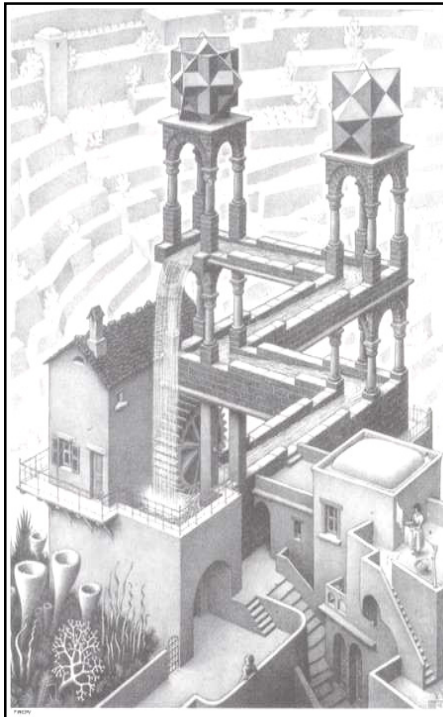
### Prerequisites

- Fundamental Commissioning
- Energy Performance
  - ◇ ASHRAE 90.1 -10%
  - ◇ Whole Building Energy Model (Appendix G)
  - ◇ ASHRAE AEDGs
  - ◇ Advanced Buildings Core Performance Guide (NBI)
- ASHRAE Std 62.1
- ASHRAE Std 55
- Submit Performance!!!!

### Credits

- Enhanced Commissioning
- Enhanced Energy Performance
  - ◇ By 12% = 1 point;
  - ◇ By 48% = 19 points
- Meet ASHRAE 62.1 with CO<sub>2</sub> Control
- Verify ASHRAE 55 performance.
- Measurement & Verification Protocol





***And the risks...?***

## Failure Risks

### Performance

...but Sustainability = performance over time

- Does the owner have 'the right' to evaluate the building's performance over time? How long?

### Certification

Is it valuable? To whom? Why?

- If the 'gold' comes in silver is there 'damage'?
- Should there be compensation? Who pays?

## What does the contract say?

- ...about time
  - The duration of the project; doesn't include post-occupancy!
- ...about "Completion"
  - at "Beneficial Occupancy"? at "project completion"?
    - (possibly validation or certification – hospitals, pharma)
- ...about 3<sup>rd</sup> Party Certification
  - Code compliance is a must, but...
    - ...codes are static – a 'snapshot'
  - ...GBCI evaluates an evolving target
- Operations!!!!??
  - Your Mileage May Vary!!!

## The Design Context

### *The "Standard of Care"*

- ...[to] "exercise the average degree of skill, care, and diligence exercised by members of the same profession (or specialty within that profession), practicing in the same or a similar locality in light of the present state of the profession"

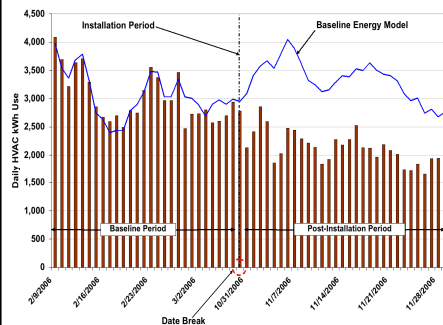
(Gillette v. Tucker). See Black's Law Dictionary, 6th edition. 1404-5.



## Where are you going?

with all the “average skill... and diligence” a professional can muster

### Establishing ‘reasonable’ performance targets:



- ...targets should accommodate some “misbehavior”.
- ...learn what is “customary” based on industry ‘norms’ including first cost.
- Model quality is key!
  - It forms the basis of design decisions and operations protocols

## How will you get there?

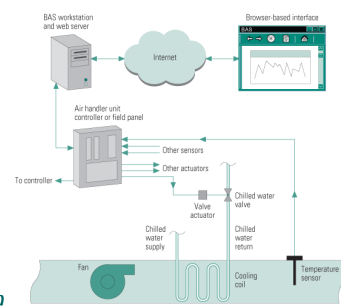
### Performance...

- original input, assumptions & criteria...
  - Statement of criteria
  - Basis of design
    - include weather data ‘basis’
      - with some acceptable deviation

- Modeling, monitoring & optimization.

### Documentation...

- Intent – design specs and drawings
- Expectation/Understanding – Training & Operations



© E SOURCE, adapted from Portland Energy Conservation Inc.

## How do you know if you've arrived?

### *Monitoring, Measurement & Verification*

#### ○ *Building Automation Systems*

- Use the BAS to facilitate verification & audit
- Data Monitoring, Retention and Trending

#### ○ *Audit*

- “notice”
- opportunity to “cure”
- 3<sup>rd</sup> Party Auditor?

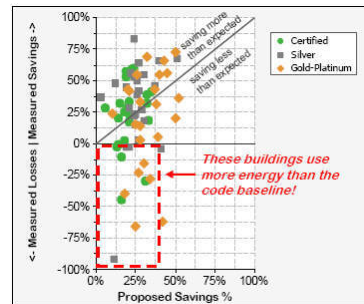


Figure ES- 5: Measured versus Proposed Savings Percentages

## The Construction Context

Construction:

“...in accordance with plans and specifications”

“...the custom and practice of the industry...”

“... in a workmanlike manner...”

“...shall verify prior to commencing with the work...”

## Getting there is half the fun!

(that depends on what you call 'fun')

Materials, means & methods

- Product substitutions
  - pricing, delivery, compatibility
- [Sub]contractor Defaults
  - "suitable replacement"
- Schedule Delays
  - 'time is of the essence'
- Performance Bond
  - to cover remedial work



## But what about Operations ??

What impact does operations  
have on a  
successful sustainable building?

What obligations?

What is the 'standard of care'?

## Operations Training Programs

Beyond traditional  
operating programs

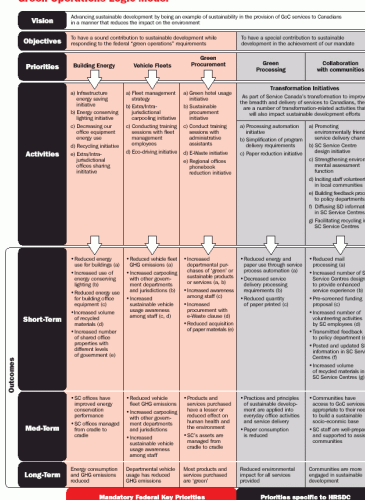
### ○ Training Programs

- include methods, modes and schedules of operation;
- maintenance guidelines.
- integral with project execution
- require sign-off

Consider...

- Videotaping sessions
- 'fault-tree' studies and analysis (up front!)

Green Operations Logic Model



## Risks revisited



### ○ Performance

- Via design
- Via construction
- Via operations

### ○ Certification

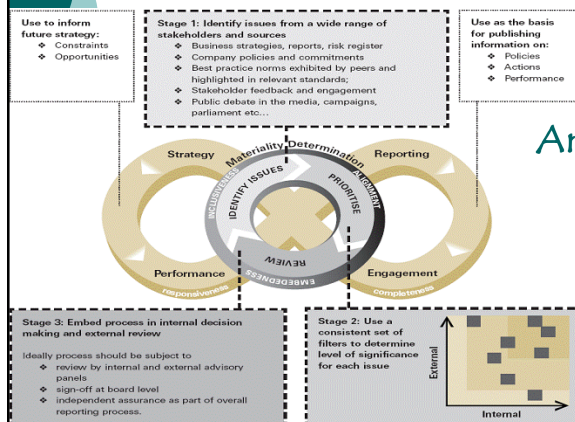
- Financial impact
- Regulatory impact
- 3<sup>rd</sup> Party Certification

## Some new thinking required in... Contracts...

- Project specific targets and set time period.
  - 'Reasonable' goals relative to costs and 'complexity';
  - Include criteria for operations & maintenance
    - facilitate 'best use';
  - Performance measured over time;
- Impact of operations relative to...
- ...design
  - ...construction

*Performance measurements  
will control 'value' perception.*

## ...in execution philosophies... Systems Thinking/Integrated Project Delivery...



Analysis & Execution  
Process that...

...addresses changing  
context,

...leverages prior  
knowledge.

## Integrated Project Delivery

Buildings are an assembly of systems;

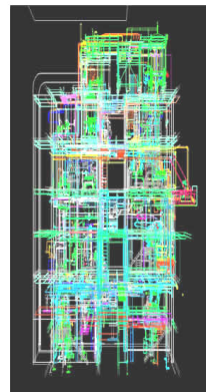


IPD is a system of assembling those systems.

...and some new tools...

## BIM (Building Information Modeling)

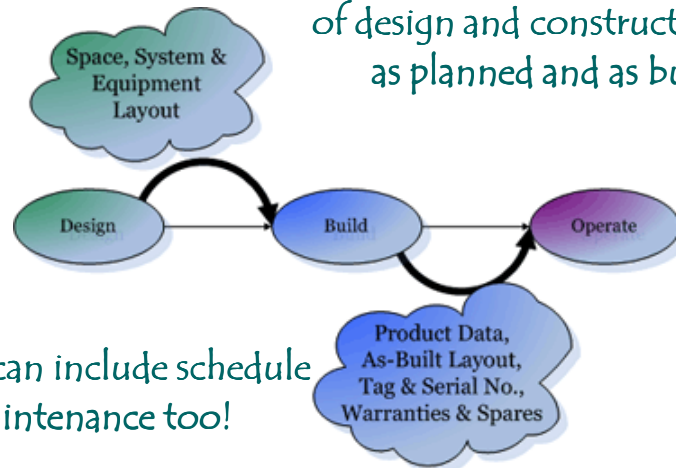
- enhanced evaluation of design options
  - "see it before its built"
- improved coordination between design and construction;
  - reduced rework in the field.
- Improved facility management and operations
  - Real time documentation & information





## BIM can create a seamless knowledge base

of design and construction  
as planned and as built;



...and can include schedule  
and maintenance too!

But GIGO still applies!

## Success Defined – ASHRAE Std. 189.1

### The Design of High Performance Building

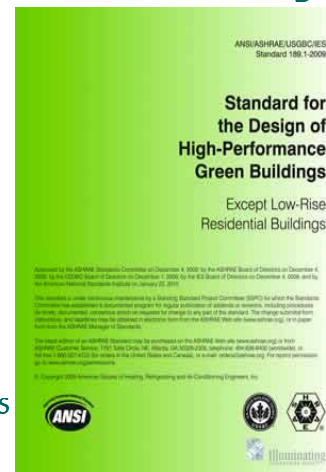
#### Focus Areas:

##### Comparable to LEED

- sustainable sites,
- water use efficiency,
- energy efficiency,
- indoor environmental quality,
- impact on atmosphere, materials & resources,
- construction and operations.

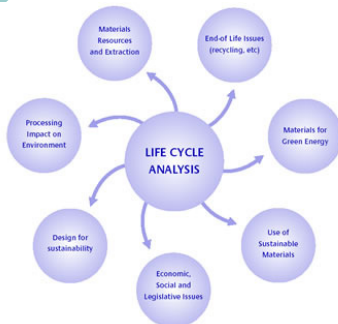
#### Objectives:

To put numbers to expectations



## The Big 189.1 Analysis Tools

Energy & Resource Modeling  
 ○ *performance quantified*



Life Cycle Assessment  
*Balancing Social, Environmental  
 & Economic Impacts*

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**A-**  
AS DESIGNED



Stand and deliver!



### Building Energy Labeling

- Mandatory labeling:
  - European Union
  - California
  - Washington, DC
- *As Designed Asset Rating*
- *In Operation Rating*
- obtain asset rating to get permits!
- Disclose past energy use/rating upon sale or lease!
- Report energy use with schedule for [upgrade] implementation!

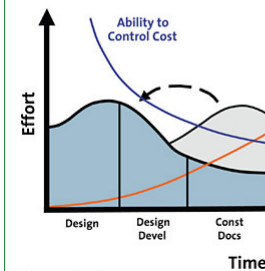
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## Moving the 'thinking' up front

### Integrated Project Delivery: The Future of Construction

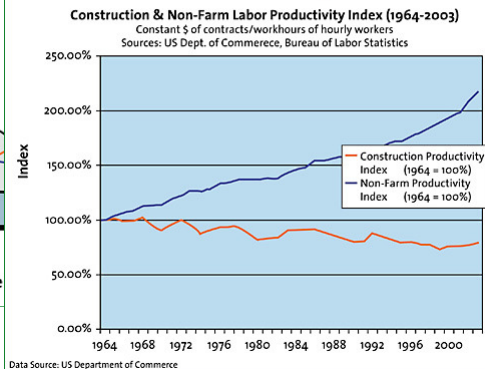
#### Integrated Project Process

- Documenting as the model is built
- Involving Construction/Suppliers
- Eliminating clashes



### Integrated Project Delivery: The Future of Construction

#### Poor Productivity

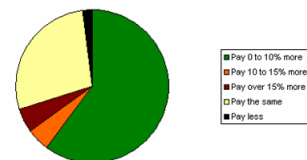


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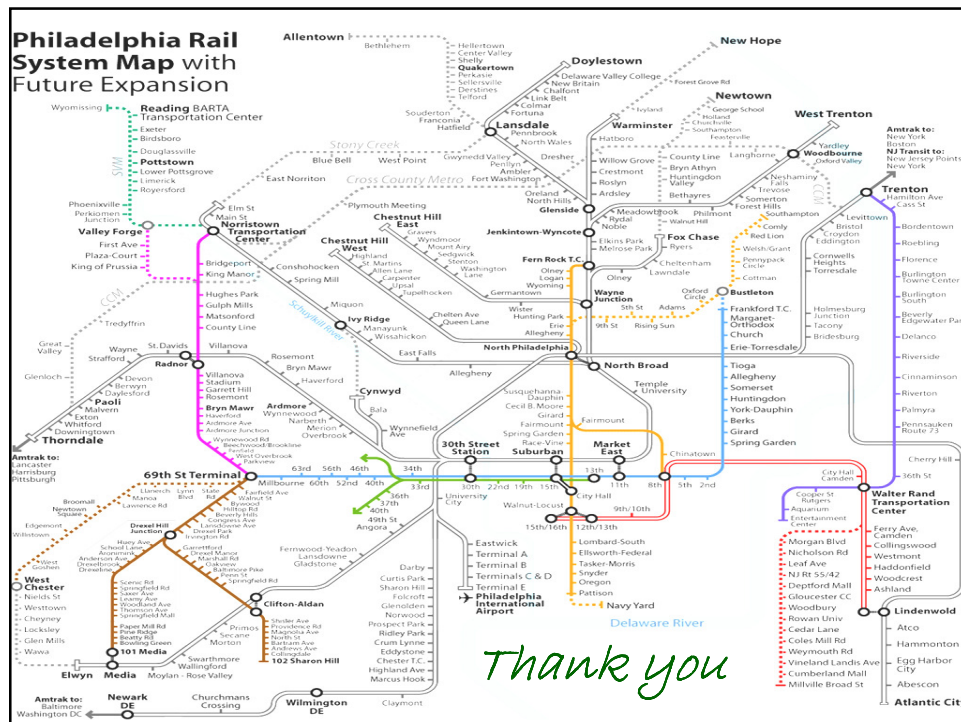
## What becomes of Sustainability?

- value will increase as demand increases;
- increased value will increase importance of measurement.
- integration into 'the custom and practice';
  - the new 'normal' -
    - New execution philosophies & context required?
- Differences in execution, delivery and evaluation of sustainable projects will require new approaches to defining a successful project.

#### Sustainable Rent Premium

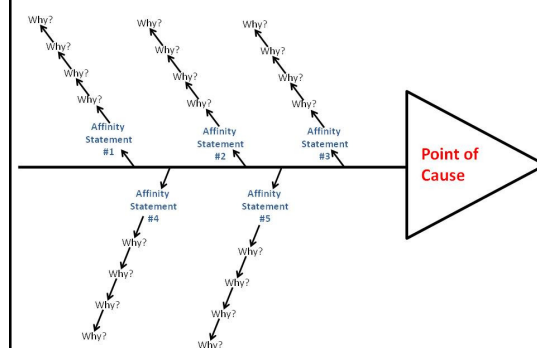


Source: Jones Lang LaSalle  
CoreNet Global



## Systems-based Thinking

## Fishbone Analysis

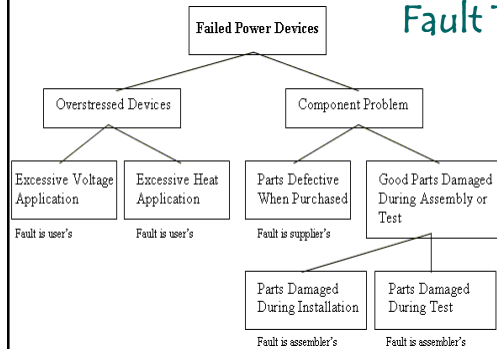


Dissect a problem to understand what you want and what is connected to what you want.

"Make things as simple as possible, but NO simpler!" – Albert Einstein

## Systems-based Thinking

### Fault Tree Studies

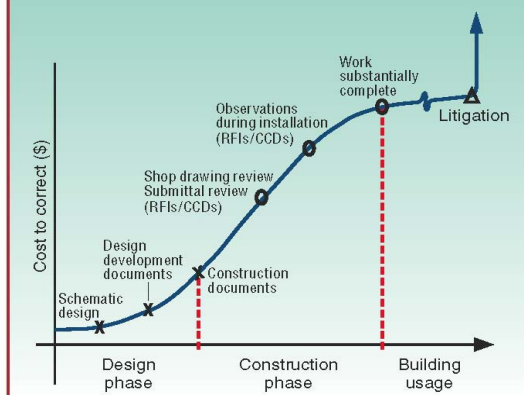


Identify and understand what is "necessary" and what is "nice to have".

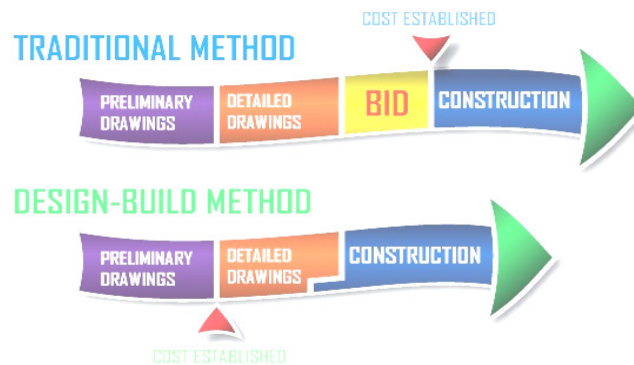
"value engineering" without \$\$\$

## Measure twice, cut once.

**Figure 1: Cost to correct a specification error or conflict**



## Design-Build Execution



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## Design-Build Defined

The Design-Build entity...

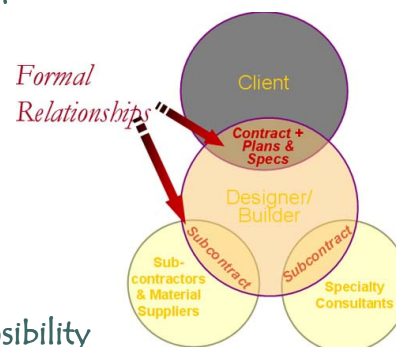
- holds all the contracts.
- carries the risks of...
  - Performance
  - Design & Workmanship
  - Cost

The Owner gets..

- a single point of responsibility

..and expects to save...

- ...time and money.



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Licensed Professional Engineer:  
 Pennsylvania, New Jersey, New York, Connecticut, California, Michigan, Illinois, Georgia, Kentucky  
 US Green Building Council LEED Accredited Professional

Mr. Swann has over 20 years of extensive experience on both domestic and international projects in the areas of management consulting and problem solving, engineering design, project and construction management, forensic engineering and construction claims analysis. Mr. Swann's career includes the analysis, evaluation and design of complex systems across a wide range of industries and buildings types including commercial, institutional and industrial facilities, hospitals laboratories, pharmaceutical manufacturing, microelectronic operations and data centers. Mr. Swann has chaired technical committee within national and international organizations and been a contributing author and editor for a number of technical publications and journals. He is a frequent speaker both nationally and internationally and is a listed member of the speakers' bureau in the Distinguished Lecturer program of ASHRAE. He has recently presented on Green Building issues in Abu Dhabi, Dubai, Delhi, Detroit, Chicago, Seattle, New York City, Indianapolis, Kansas City, Virginia and Delaware. He is a contributing author to the ASHRAE "Green Guide - The Design, Construction and Operation of Sustainable Buildings" and co-author of the ASHRAE Survival Guide to Design/Build Project Execution.

Professional Affiliations:  
 American Bar Association, American Society of Heating, Refrigeration, and Air Conditioning Engineers, International Society of Pharmaceutical Engineering, US Green Building Council, Defense Research Institute

Other Activities:  
 Pennsylvania Environmental Council - Board  
 The Engineer's Club of Philadelphia - Board of Directors  
 Enterprise Heights CDC - Board Chair  
 Drexel University - Alumni Board of Governors  
 National Association of Asian American Professionals (Philadelphia Chapter) - Board of Directors  
 National Society of Black Engineers Greater Philadelphia Chapter - President Emeritus

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*Providing Expert Project Delivery Solutions Worldwide*

**MDC Systems** is a project and construction management consultancy with over 40 years of experience serving a wide array of clients and industries both nationally and around the globe.

**MDC** has worked on projects as diverse as residential property developments to pharmaceutical plants to highway excavation and construction.

**MDC** concentrates its services in primarily four areas:

program management, project management consulting, forensic engineering and construction claims consulting.

One of the key facets of **MDC's** professional staff is our expertise in the technology driven issues that are so frequently at the heart of today's complex projects.

**MDC's** construction claims consulting practice combines all of the skills inherent to our other service offerings and deploys it for our clients when and where projects don't go quite as smoothly as everyone had hoped. **MDC** is an industry leader in the area of construction schedule development and analysis including delay, acceleration, interruption and extended duration. **MDC** pioneered the court tested and approved Time Impact Analysis methodology for scientifically analyzing construction schedules and the impact of events upon their execution and completion.

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## MDCSystems® Summary of Services

### Program & Project Development including...

- Performance Assessment & Benchmarking

### Project Modeling including...

- "What if..." Scenario Analyses
- Variability/Sensitivity Analyses
- 'Out of Bounds'/'Go – No Go" Limits

### Project Planning including...

- Feasibility Studies
- Master Scheduling including...
  - Resource & Constraint Analysis

### Project Monitoring including...

- Schedule Compliance
- Cash Flow & "Burn rate" projections
- Resource Utilization

### Consulting Services including...

- Sustainability/Green Buildings
- Peer Review
- Practice Management

### Forensic Analyses including:

- Building Systems:
  - Architectural incl. Building Envelope
  - HVAC/Mechanical, Electrical & Piping
  - Structural
  - Instrumentation & Controls
- Design Errors & Omissions (Standard of Care)
- Differing Site Conditions

### Forensic Project Management®

- Schedule Analysis
  - Delay, Disruption, Suspension & Acceleration
- Labor Productivity & Inefficiency
- Scope Definition and Change
- Termination - Default or Convenience
- Procurement - Bid/Award Transparency

### Forensic Accounting including...

- Valuation of Damages
  - Overhead & General Conditions
- Business Interruption & Lost Profit

## Selected Recent Assignments

### Engineering Consulting and Technical Analyses:

- Analysis of Moisture Migration and RH Control in a Microelectronics Product R&D Facility (Colorado).
- Analysis and Improvement of Energy Consumption at a "Green" School (Pennsylvania)
- Peer Review & Design Supervision for a Radiant Heating/Cooling Floor System (New Jersey)
- Peer Review of Schematic Engineering Design Effort for Hospital Complex (Qatar)
- Analysis of Formaldehyde Outgassing from Construction Materials (Pennsylvania)
- HVAC System Failures in Pharmaceutical Packaging Facility (New Jersey)
- Analysis of Process Technology Failure at Waste Treatment Plant (New Jersey)
- Analysis of Piping System Joint Failures at a Hospital central Plant (New Jersey)
- Analysis of Destructive Vibration \ Harmonics on Large Industrial Compressors at a Chemical Plant (Louisiana)

### Project Management, Execution & Construction Claims :

- Excess Rock Excavation Claim on a Highway Project - Unforeseen Conditions (New Jersey)
- Electrical Contractor Inefficiency Claim on Multi-Prime Project (New Jersey)
- Electrical Usage Charge Dispute Between Landlord & Tenant (New York)
- Schedule Delays and Change Orders on multiple Airport Projects for Major Equipment Supplier (various)
- Schedule Delays and Associated Cost Overruns for Underwater Pipeline Project (Ireland)
- "Standard of Care" Defense - Design of a Food Processing Facility (Pennsylvania)
- "Custom & Practice" – Specifications Development and Bid Transparency Issues (California)
- "Standard of Care" Defense – Design and Documentation of a Pharmaceutical Plant using 3D Modeling (Texas)
- "Standard of Care" Plaintiff – Delay and Cost Overruns for a Pharmaceutical Plant using 3D Modeling (Singapore)