



# applying bim to sustainable building design

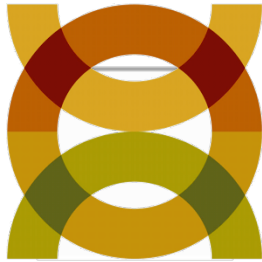
**malcolm davies phd**

# applying bim to sustainable building design



- cad automated the drafting process and bim is improving the design process.

# applying bim to sustainable building design



- but the overall construction process remains firmly embedded in a bygone age.

# applying bim to sustainable building design



- in this seminar, look at ways in which technology will be used to streamline the whole process and by doing so; deliver high quality custom homes, offices, schools and other buildings that are also green and affordable.





## qualifications – pre-usa

- phd in architecture & building science
  - building performance modeling
  - cad
- uk-licensed architect
- practiced architecture for 12 years in europe and middle East.
- chief architect for a prefabricated panel construction company



## qualifications – usa

- vp general electric calma
- svp autodesk
- ceo cadkey
- ceo nemetschek usa
- ceo ea systems
- coo hyprotech
- gm intuit building systems
- ceo gehry technologies
- ceo michelle kaufmann designs



## qualifications – green

- mkd
- green life style
  - solar hot water
  - pv system
  - minimize energy use
  - minimize water use
  - recycle
  - compost
  - hybrid car
  - grow own organic fruit and vegetables



technology  
can give us  
the time and  
tools to  
optimize for  
sustainability

**design for sustainability**



construction  
is evolving  
towards  
component  
assembly

**faster, better, cheaper**



We can use the  
implementation  
of BIM as a  
catalyst for  
changing the  
way we work

**design and build better**



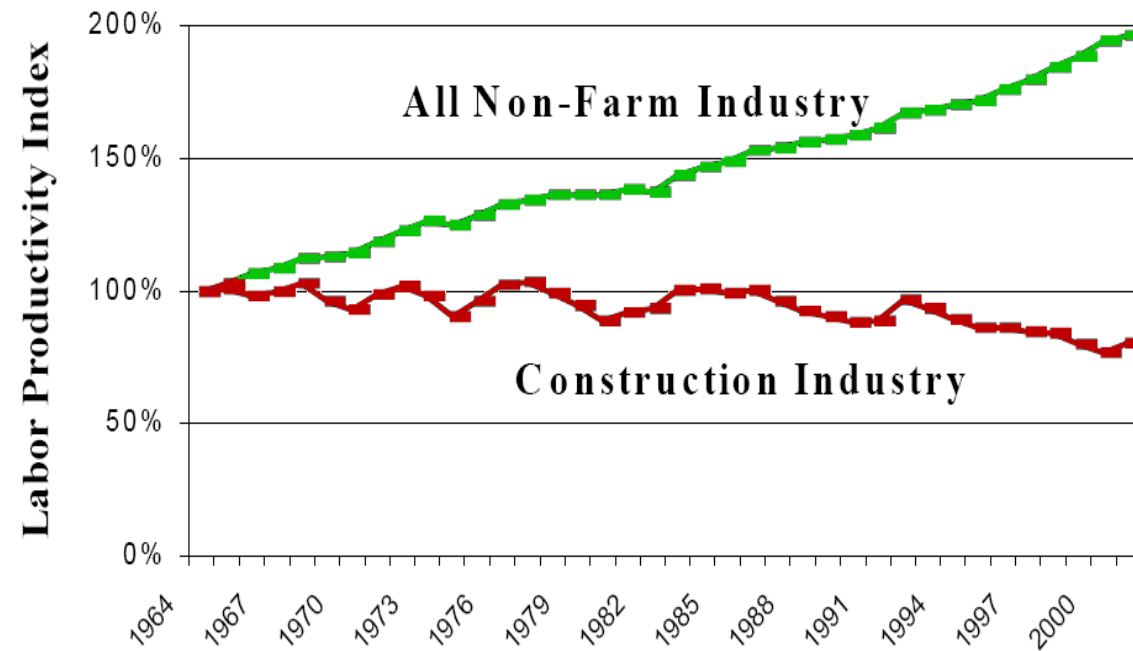
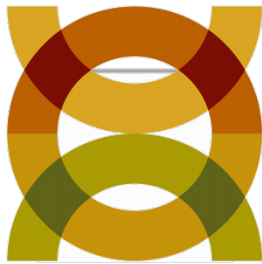
**construction is US\$3trillion worldwide**

- **30% of construction is rework**
- **40% of the manpower used on construction sites can be wasted**
- **at least 10% materials are wasted**
- **over 40% of projects are completed late or over budget.**

*“Rethinking Construction” by Sir John Egan. 1998.*

**\$ hundreds of billions** are wasted every year





Sources: U.S. Bur. of Labor Statistics, U.S. Dept. of Commerce

## Construction Productivity



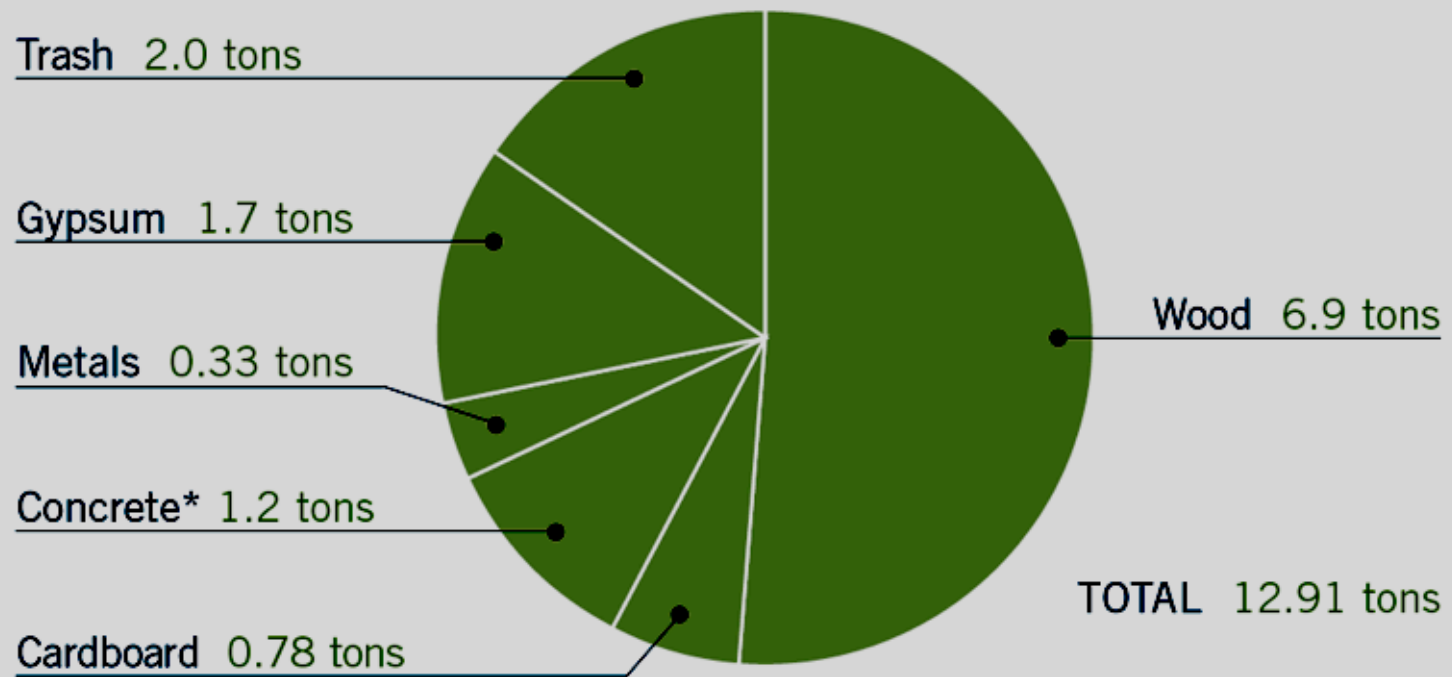


## buildings contribute to:

- **20% 30% of landfill waste** (at least half could have been recycled)
- the waste during construction of an average homes equals **3 to 7 tons**
- at least 30% of new and renovated buildings in the U.S. have **poor indoor air quality** (with off-gassing materials that make people sick.)
- buildings account for more greenhouse gas emissions than automobiles

\*data from USGBC

### Construction Waste Generated from a 2,000 Square Foot New Home



Source: Alameda County Waste Management Authority Case Study of Citation Homes (1999)

\* Concrete figure includes waste generated by sidewalk pour.

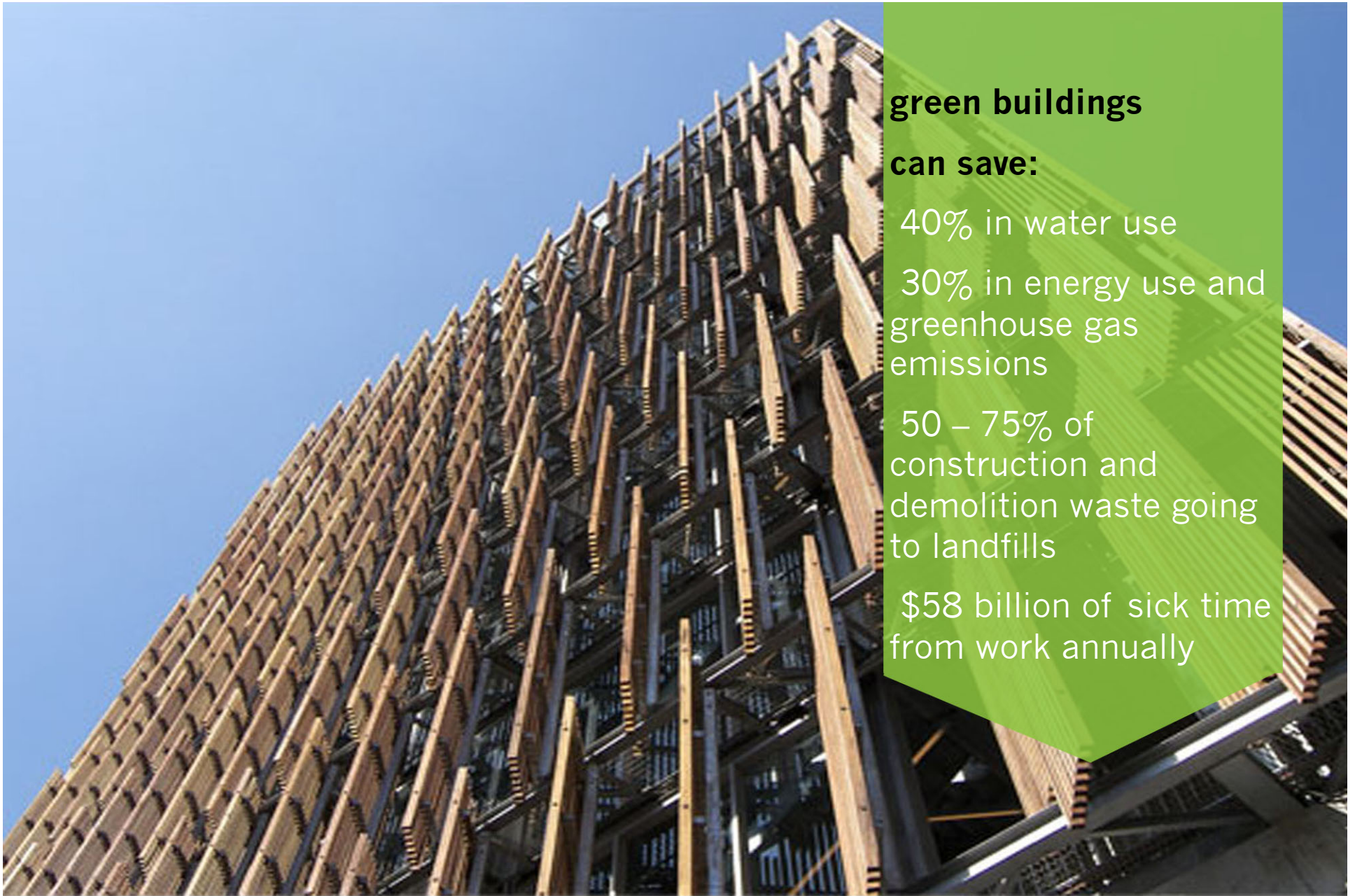


## **buildings consume:**

- **54% of U.S. energy** consumption is directly or indirectly related to buildings and their construction.
- **40% of raw materials**
- **48% of U.S. carbon emissions**
- **70% of U.S. electricity**
- According to recent estimates, the United States consumes more energy than any other nation, accounting for 22.8% of the world's total energy use. Nearly one quarter of that share of that is used to power our homes.

\*data from USGBC + National Building Museum





## **green buildings**

### **can save:**

40% in water use

30% in energy use and  
greenhouse gas  
emissions

50 – 75% of  
construction and  
demolition waste going  
to landfills

\$58 billion of sick time  
from work annually

\*data from USGBC



## PROBLEMS:

- We are building inefficiently and wasting a lot of materials, and time and money, and
- We are not designing for sustainability in everything that we do.
- Current Design /Build Processes:
  - Create Conflict
  - Increase Risk
  - Increase Costs
  - Create Delays
  - Create Lawsuits

## areas for improvement



- process
- information flow
- design
- construction

## improve the **PROCESS**



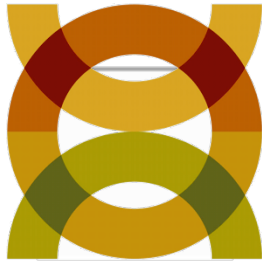
- replace conflict with collaboration
- replace low-cost bidding with negotiation
- early appointment of contractor and key suppliers
- create design/build/facilities (lifecycle) management team



## improve **INFORMATION FLOW:**

- create a digital model
- replaced paper based collaboration with digital collaboration
- owner, consultants contribute to model
- resolve design issues before construction





## CAD > BIM > BLM

- The first technology revolution (CAD) automated the drafting process.
- This second technology revolution (BIM) further improves the efficiency of the drafting process.

**BUT, it can and should be a LOT more.**



## Current BIM benefits

- Improved drawing coordination
- Improved drawing productivity
- BUT, we are still using the tools to improve existing processes

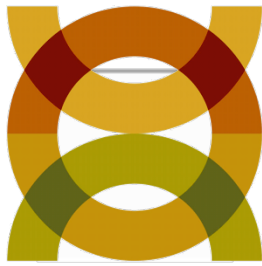
## CIFE Report, 2002



### ■ Object-Oriented Project Modeling Benefits:

- **50% reduction in Drafting and DD.**
- More time for Constructability
- Design Alternatives
- Life-Cycle Analysis
  
- Project Risks were reduced
- Cost over-runs were reduced.
- Occupant Satisfaction was increased

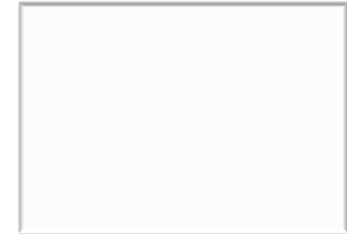
[http://www.stanford.edu/group/4D/  
download/c1.html](http://www.stanford.edu/group/4D/download/c1.html)



## effectively used bim can:

- provide better design tools leading to design for sustainability and **more creative designs**.
- support more detailed analysis leading to **better energy performance and lower costs**
- improve design coordination between the design team, leading to **higher quality** design.
- improve the accuracy of estimating leading to **more competitive bids**.
- improve the construction process by **reducing errors, rework, waste, rfi's and change orders**.
- enable more off-site prefabrication leading to **improved quality and lower costs**.
- deliver higher quality buildings, leading to **lower lifecycle costs**.

# the “NEXT LEVEL” is: blm = building lifecycle management



schematic design

Design development

issued for construction

Shop drawings

manufacturing

delivery & site logistics

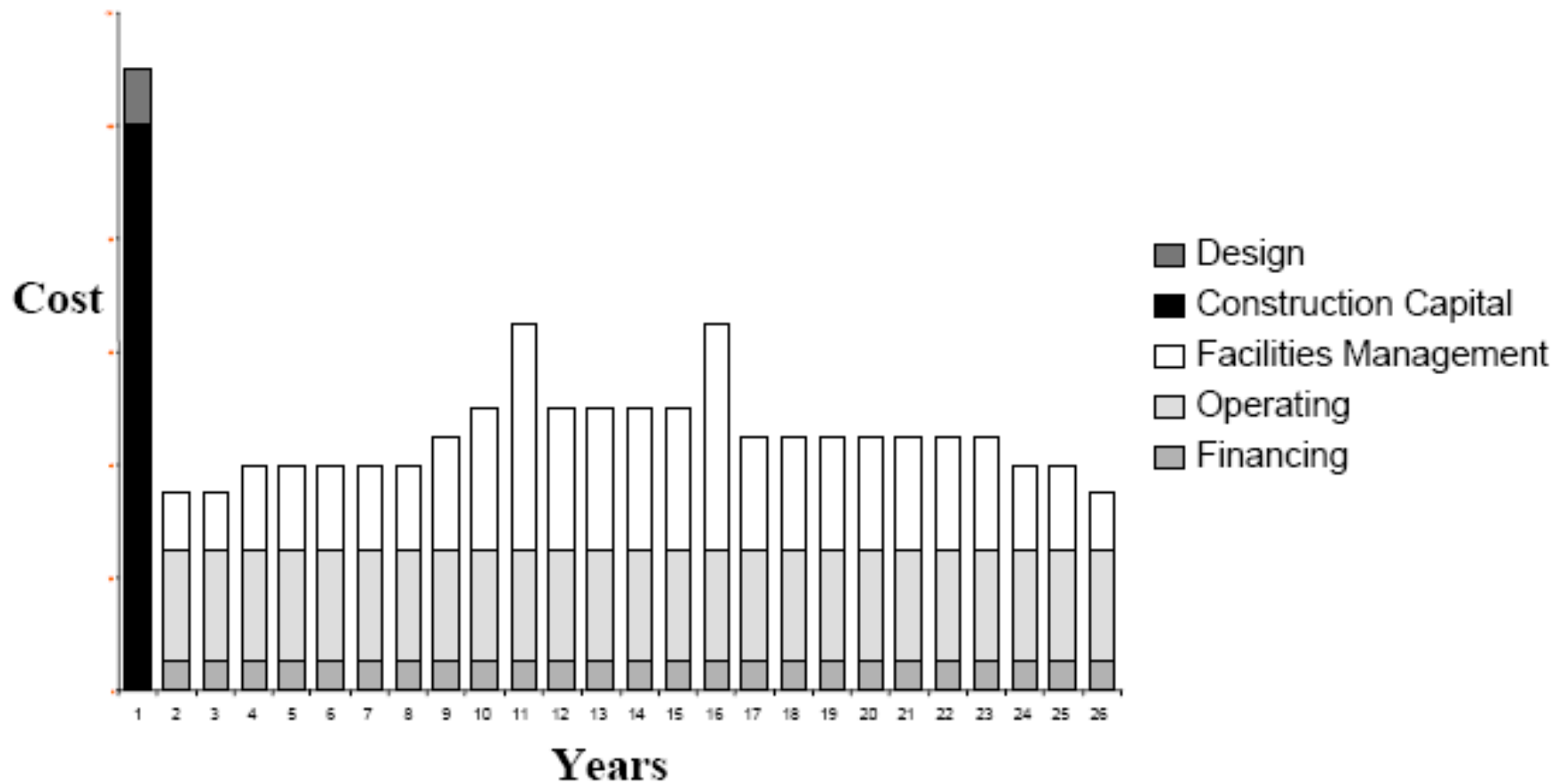
Site construction

operations & maintenance

**Typical focus of  
modeling efforts**

**Building Lifecycle Management (BLM)**

# Lifecycle costs





## checking & approvals

- there are a number of automated-checking initiatives in Finland, The USA and Singapore
  - Corenet (Singapore)
  - just as we can spell and grammar-check WORD documents, we should also be able to code-check models
  - approvals will be digital.



## why do we need drawings?

- to communicate:
  - within the design and construction teams
  - to clients
  - to regulatory agencies
- as records
  - Stamps
  - Approvals
  - contract documents

**all above can be achieved better, faster  
and with more security in digital format.**



# drawings



- why do we need drawings?
  - “the beauty of REVIT is that it lets you think like an architect again....I find I can work in REVIT as I work with pen and paper.” (Stephen C. Wright, AIA)\*

# drawings

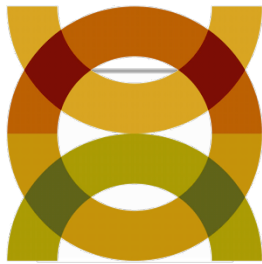
## – there is a better way



- the model should become:
  - the basis for communication
  - the basis for approvals and
  - the contract document
  - the basis for construction management
  - the basis of facilities management and maintenance

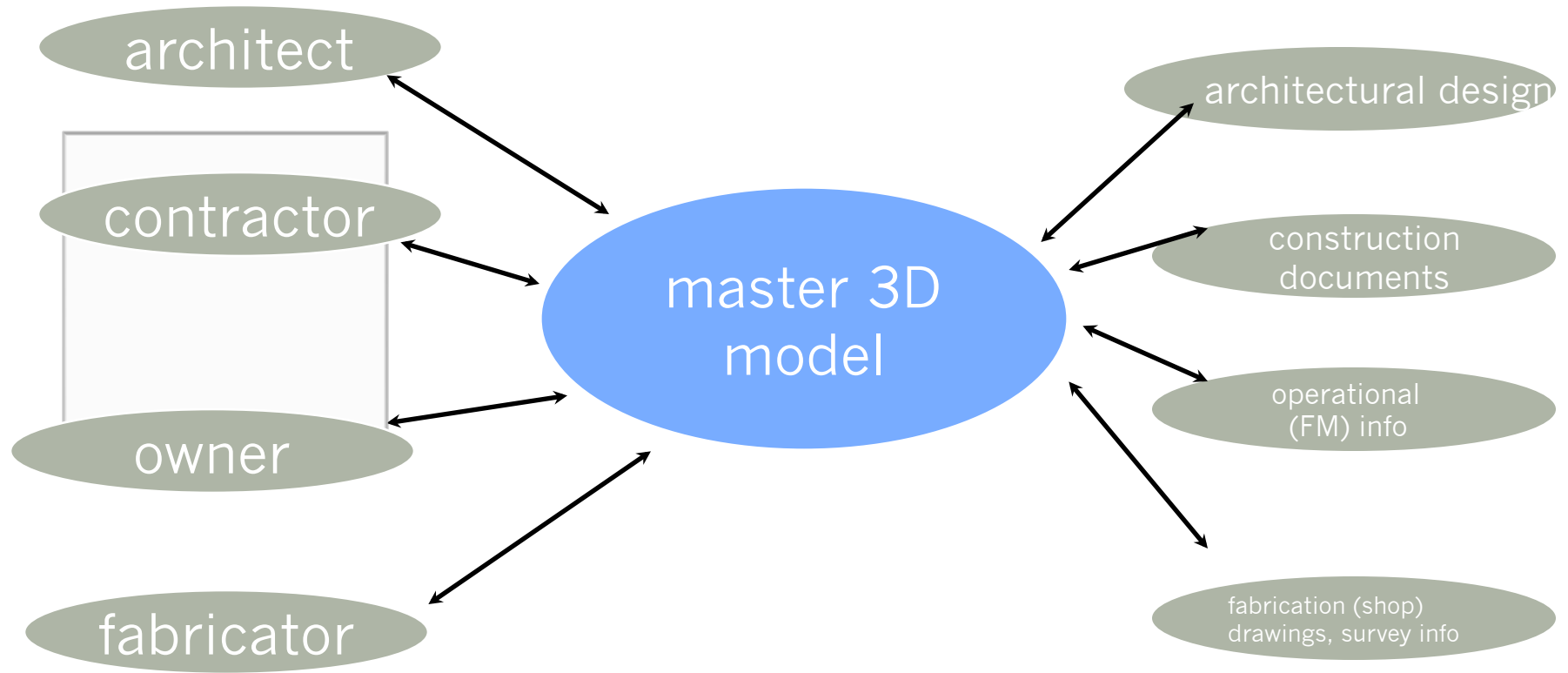
# drawings

## – there is a better way

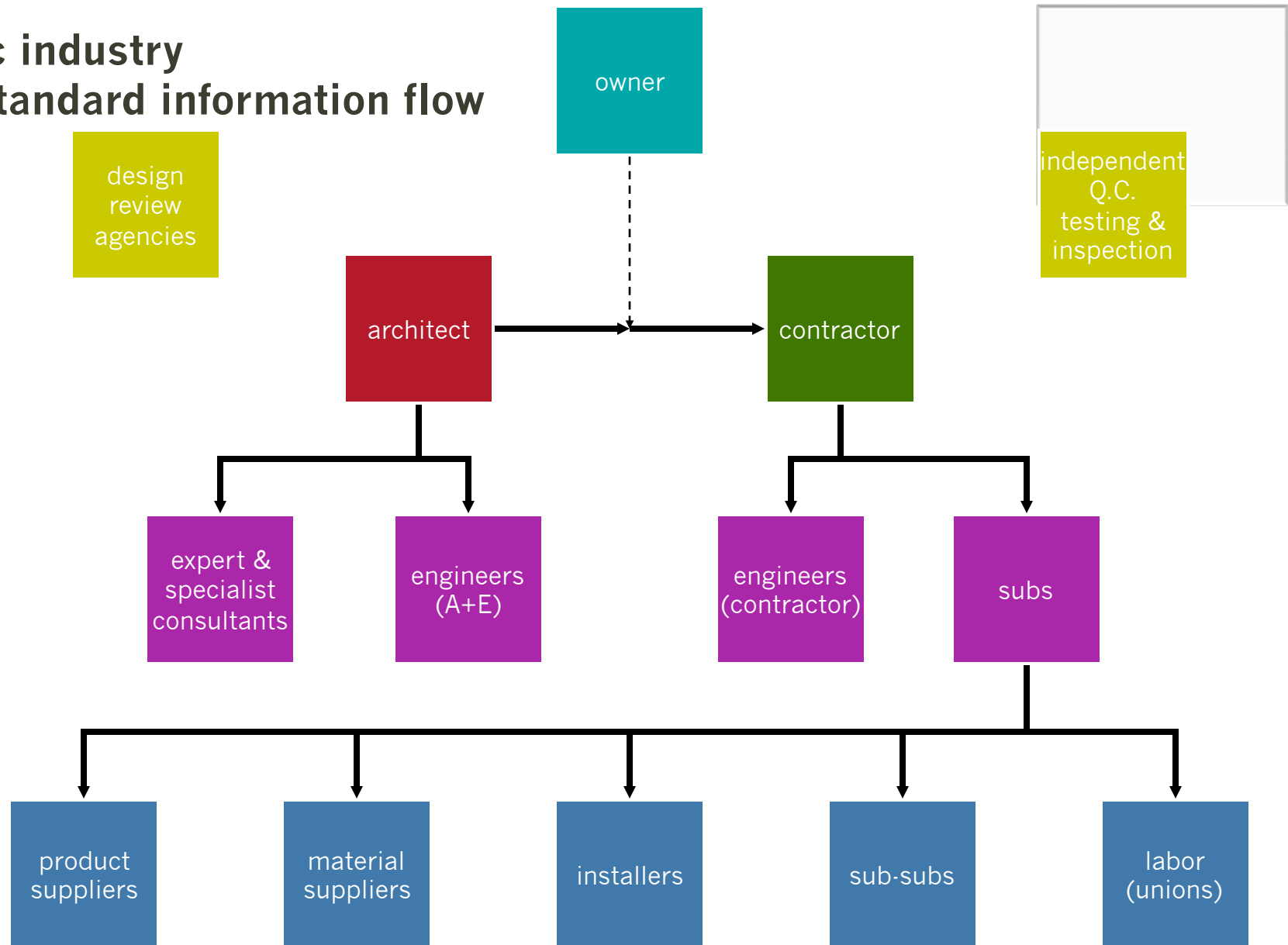


- the model should **also** become:
  - the means to improve **design**
  - the means to optimize **performance**
  - the means to assure **sustainability**

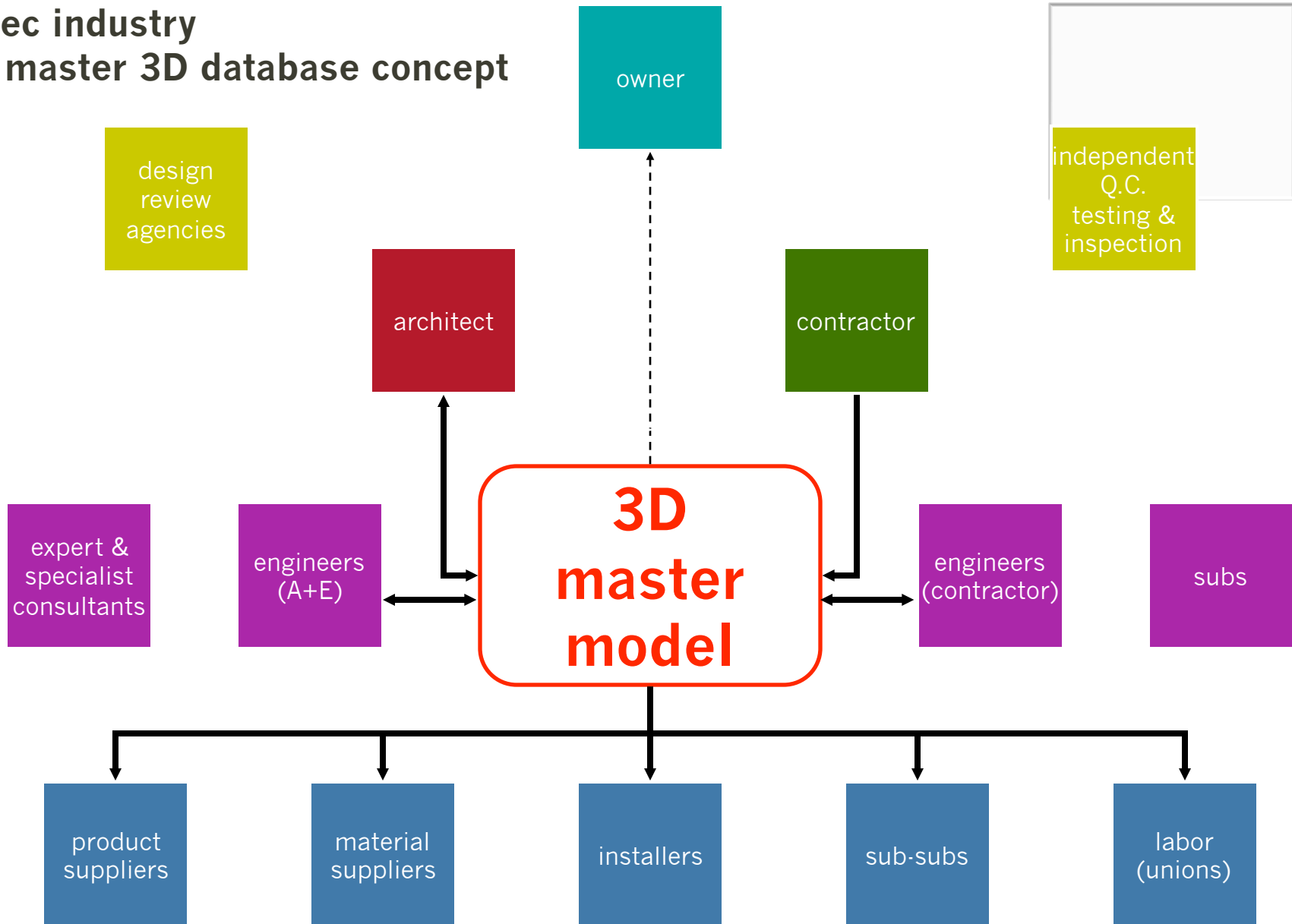
# master model concept



## aec industry – standard information flow

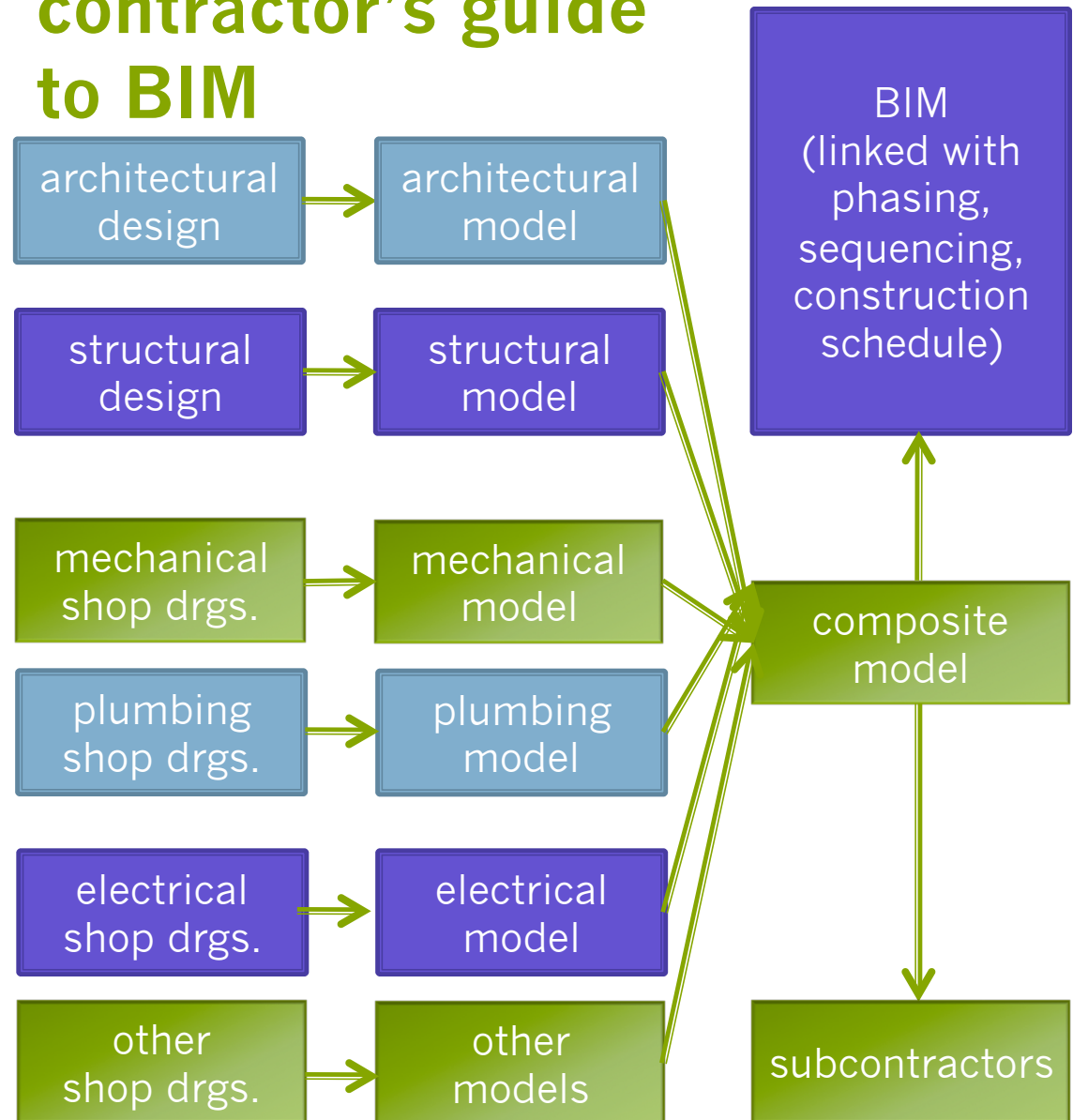


**aec industry**  
**- master 3D database concept**





## contractor's guide to BIM



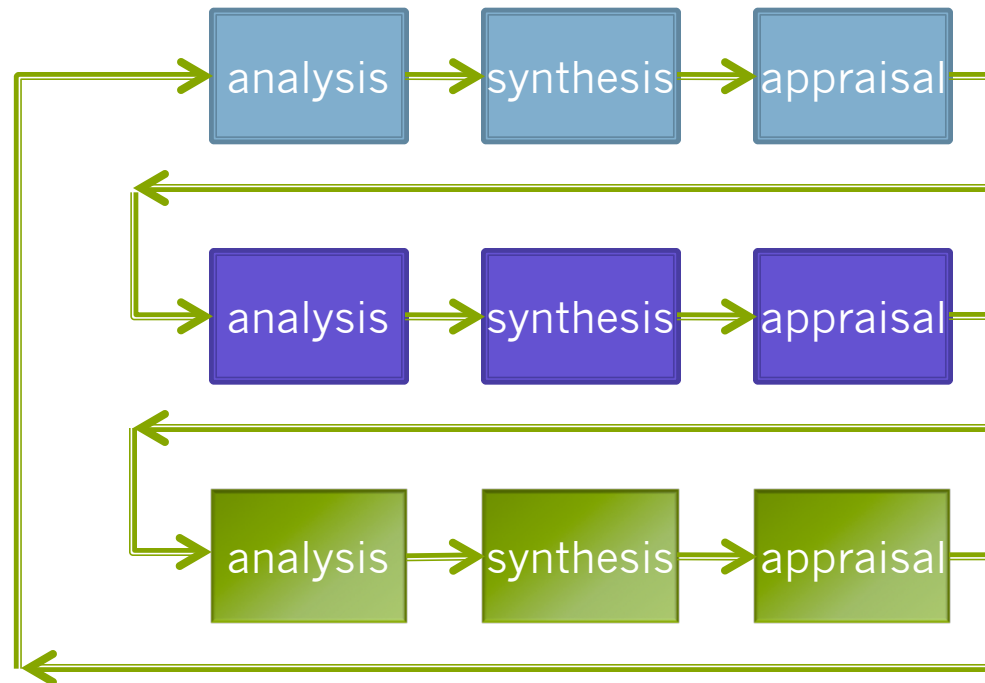
## improve **DESIGN**:



- design in 3d
- fully utilize building performance analysis tools
- many iterations
  - to optimize
  - to explore



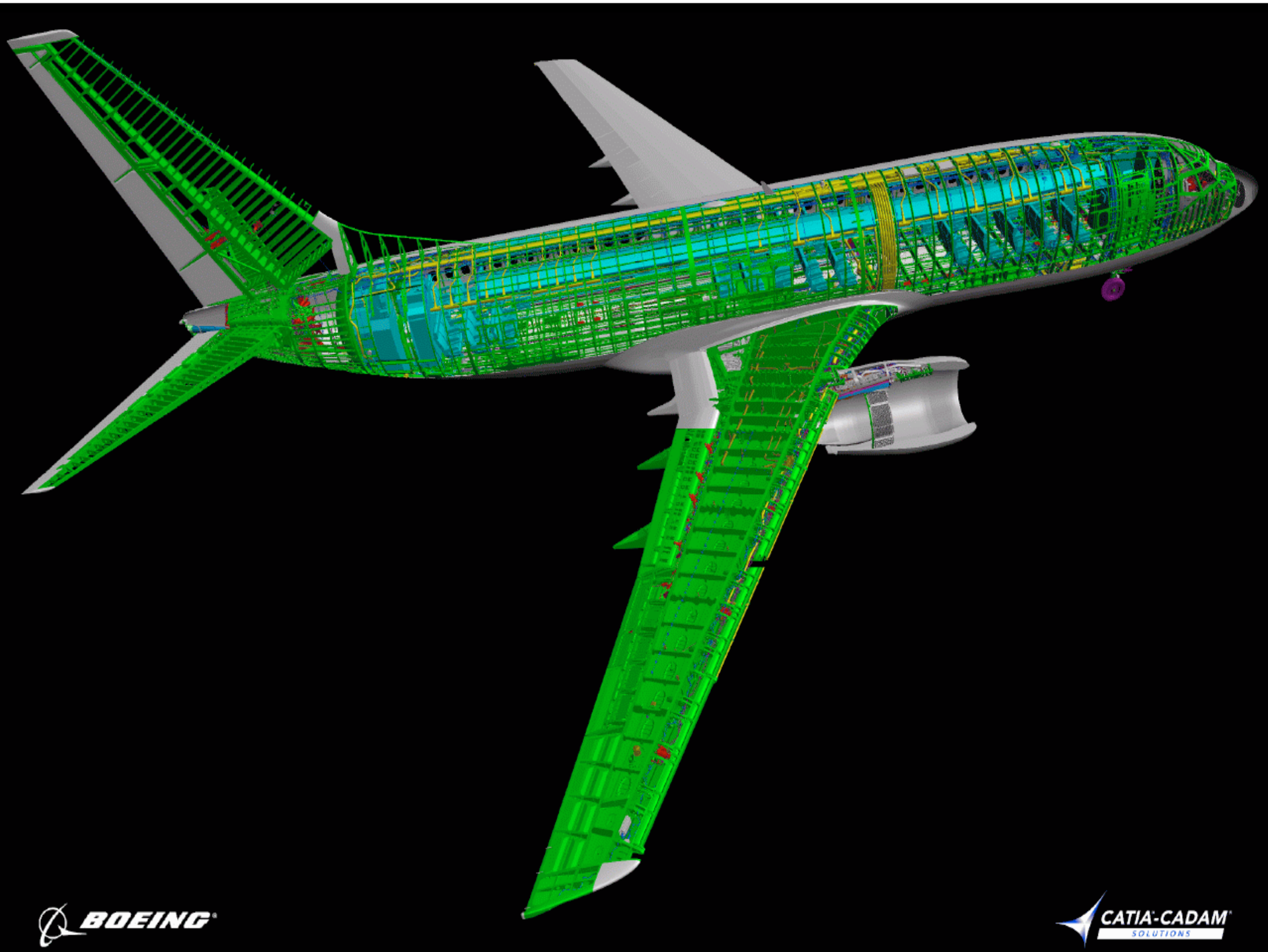
# design process



## improve **CONSTRUCTION:**



- work off BIM model
- simulate construction process in 3D



 **BOEING®**

 **CATIA-CADAM®**  
SOLUTIONS







# Swire – one island east Hong Kong



© gehry technologies

## **SWIRE challenge:**

deliver a new 69 story commercial project ahead of schedule, below cost, optimize performance, minimize waste!

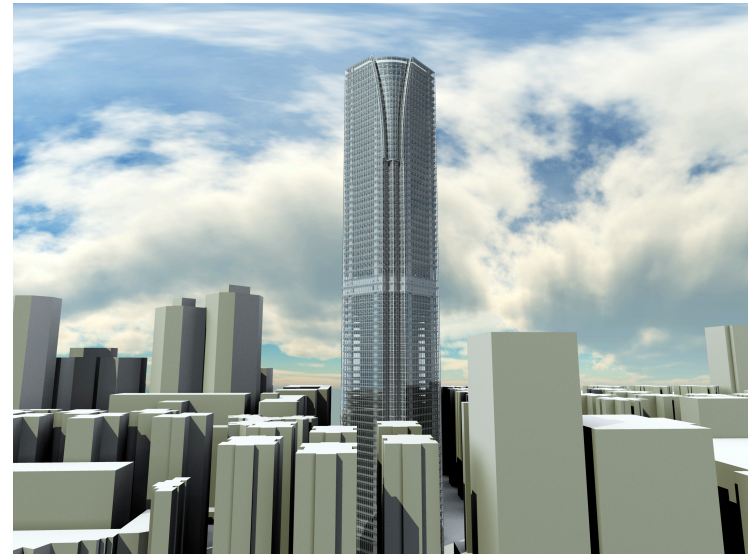
Swire appointed GT as process and modeling consultants for the detailed design and construction and into facilities management.

## **Swire + Gehry Technologies:**

- opened a project office
- specified computers, software
- hired internal project team
- provided office, computers,  
software, training, for:
  - architects
  - mep engineers
  - structural engineers
  - quantity surveyors
  - contractors

## gehry technologies

- created the initial 3D model, handed it over to architects
- trained owner, consultants, contractors
- advised all on effective model management
- set up project standards, libraries, protocols
- created a model management process
- Embedded
  - Model manager
  - Structural modeler
  - mep modeler
- advised on the creation of a digital contract
- provides on-going services support





improve **CONSTRUCTION**  
through off-site fabrication



# off-site construction

components



✓

panelized



✓

manufactured



✗

modular



✓

© mkd



steel frame panels

# cold-formed structural steel framing









© mkd



**buildpods™**  
advancing the built environment

Copyright 2008, BuildPods, LP, All rights reserved.  
BuildPods is a trademark of BuildPods, LP- Version: 0208



# transportation



# improve **CONSTRUCTION** through project management

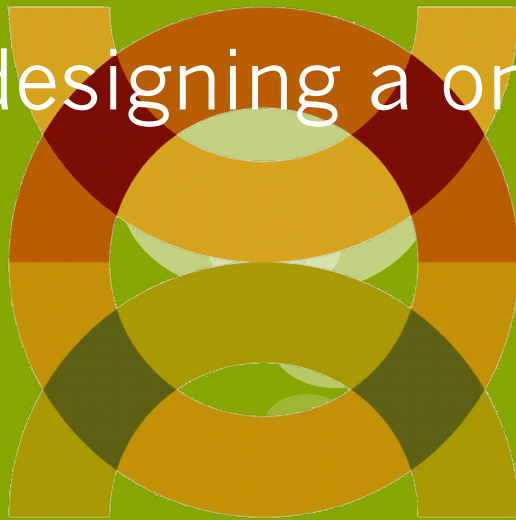


- intelligent links to
- project tools
- accounting tools
- rfi's
- change order management





designing a one planet community











ONE  
PLANET  
COMMUNITIES





BioRegional

- 1. Zero Carbon**
- 2. Zero Waste**
- 3. Sustainable Transport**
- 4. Local & Sustainable Materials**
- 5. Local and Sustainable Food**
- 6. Sustainable Water**
- 7. Natural Habitats and Wildlife**
- 8. Culture and Heritage**
- 9. Equity and Fair Trade**
- 10. Health and Happiness**

## 5 Minute Lifestyle

Housing

Work

Groceries

Restaurants

Services

Sports, gardens, gym

Shops, theater, hotel









## **LOCAL ▪ LOW-ENERGY ▪ REPAIRABLE**

minimize waste; use on-site resources; repair and maintain

FSC lumber, recycled & salvaged steel, clear lake clay

need a lot more material re-use centers / salvage yards

focus is on cement (75% reduction from typical)

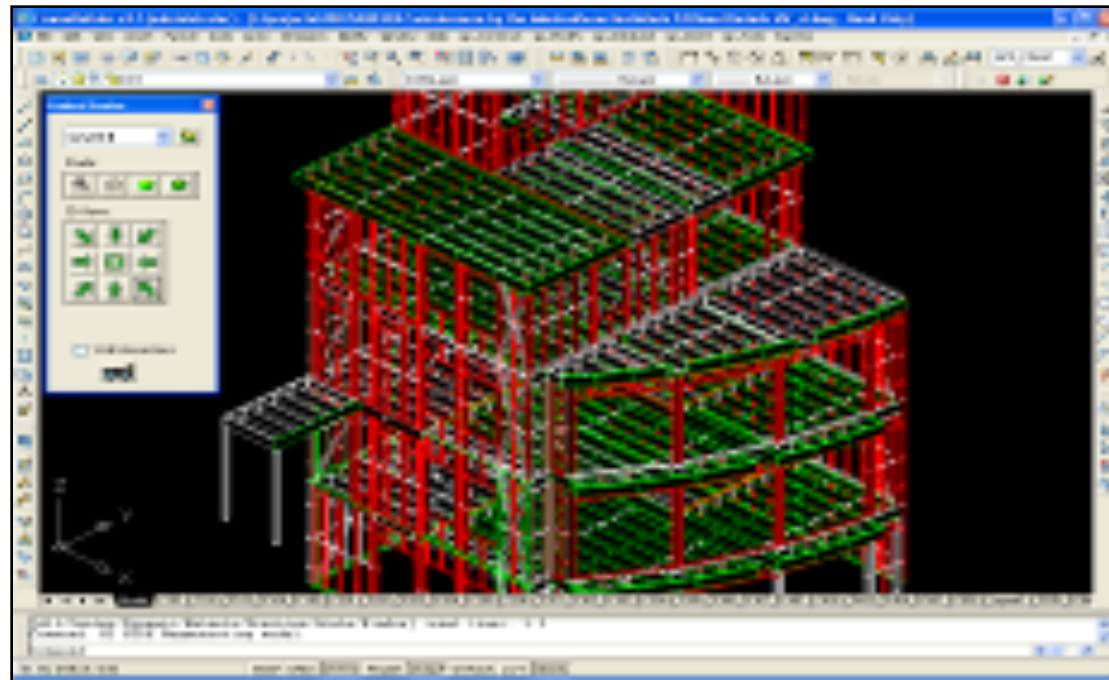
Year	Percent Manufactured Within...		
	500 miles	50 miles	On Site
2010	35%	12%	10%
2015	45%	25%	15%
2020	60%	30%	20%

# steel framing

- on site manufacturing facility
- local jobs
- recycled steel
  - 8 recycled cars or 40 trees
- solar powered















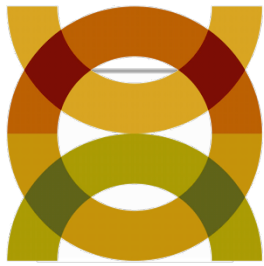
SONOMA MOUNTAIN  
VILLAGE

## summary



**bim can be the catalyst for  
change in our methods of  
working leading to better  
design and construction**

thank you



**malcolm davies**

**mld@md265.com**