Time for reflection

When both speaker and audience are confused, the speech is profound.

A good speech has a beginning, and end and the least possible in between

— Oscar Wilde

Fading memories

Re-Tirement

“Retired is being twice tired:
First tired of working, then tired of not.”

Looking for some wisdom on the web

Retirement is what you do between doctor appointments

Life is short. Smile while you still have teeth!

Retirement life: seen it all, done it all -
Can't remember most of it!

Nothing is really work unless you would rather be doing something else.

Retirement kills more people than hard work ever did

To be able to fill leisure intelligently is the last product of civilization, and at present very few people have reached this level.
Bertrand Russell

Some pessimism

Retirement is a one-way trip to insignificance.
Mason Cooley

To shake all cares and business from our age,
Conferring them on younger strengths, while we
Unburdened crawl toward death.
William Shakespeare

The human race is faced with a cruel choice: work or daytime television.
Unknown

It is time I stepped aside for a less experienced and less able man.
Scott Elledge

But there is always hope:
I don't feel old. I don't feel anything until noon. Then it's time for my nap.
Bob Hope

Time

Life happens while you are planning other things
John Lennon

Life is what happens between the seconds

Best plan for a happy retirement: “CREATIVE TIME WASTING”

Looking back as an academic

The simplest resume ever:

1976-1996: TU Delft
1997-2019: Georgia Tech

Never formally applied for either job.

Formally applied one time in my life:
New chair position at TU Delft in 2006

I heard David Cameron call somebody in the new UK government a “career psychopath”.

I must be the opposite: “Homo emphaticus”

“Inside” reflections of an academic

For an academic, the grant is the product, not the work delivered: very little accountability

Everything in academia is sold as a success

Funding organizations (NSF, DOE, …) are mostly idiots, gullible for fancy nonsense, fads and red herrings

Building research is especially vulnerable, because 90% of possible improvements are immediately obvious; the remaining 10% isn’t worth chasing because there is no penalty and no realization guarantee

Buildings are the last hand-engineered product

Science doesn’t appreciate the uniqueness of buildings enough

Personal Rewards

Making lifelong connections, working with and for students

Extremely lucky that I have had the pleasure of working with each one of you

I’m proud of your careers and accomplishments

The award I am most proud of is the Ga Tech Institute award of “Outstanding doctoral thesis advisor” (2017)

1976-1996

Finite element method in BSIM: AFEP → BFEP

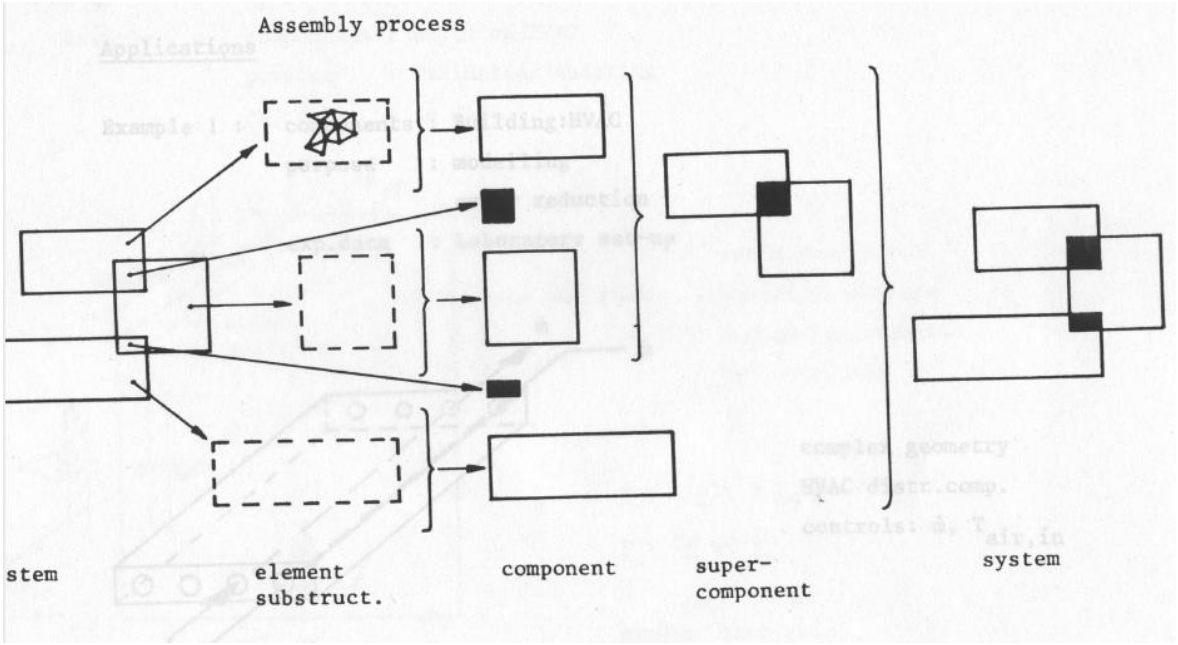
M&V of solar houses

Optimal temperature control of potato storage silos

Next generation BSim (OOP)

COMBINE: BIM-interoperability

Lesson 1: No mature BSim tools



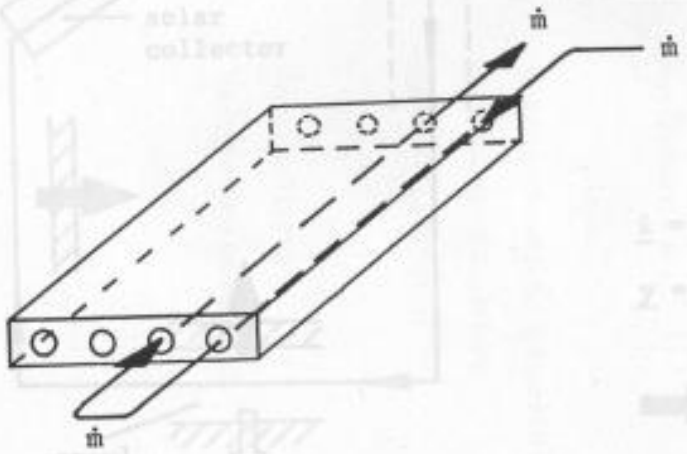
My attempt:

Building = ∑ components (∑ sub-components (∑elements))

Leads to ONE uniform computational paradigm

Lesson 2: Nobody reads “old” papers

Example 1 : components : Building:HVAC
purpose : modelling
order reduction
exp.data : Laboratory set-up

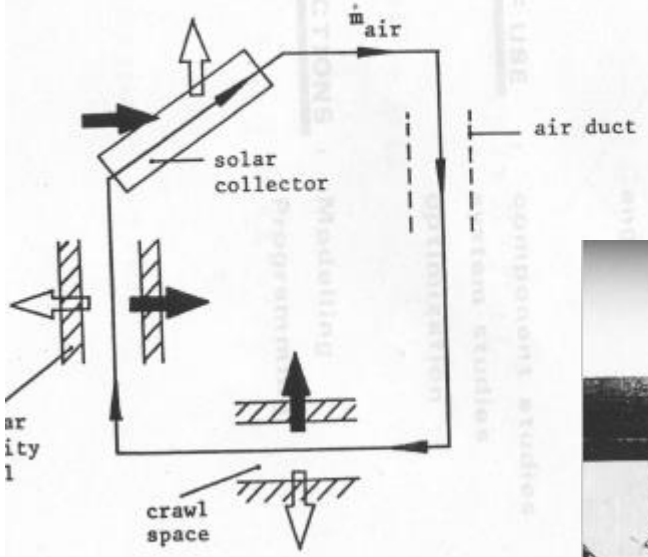


complex geometry
HVAC distr.comp.
controls: $\dot{m}$, $T_{air,in}$

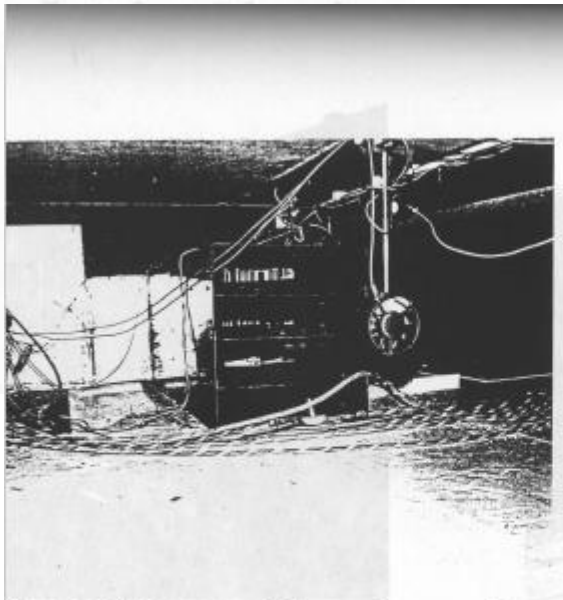
Actively controlled thermal mass (1985):
ERGON system

Lesson 3: Better risk analysis

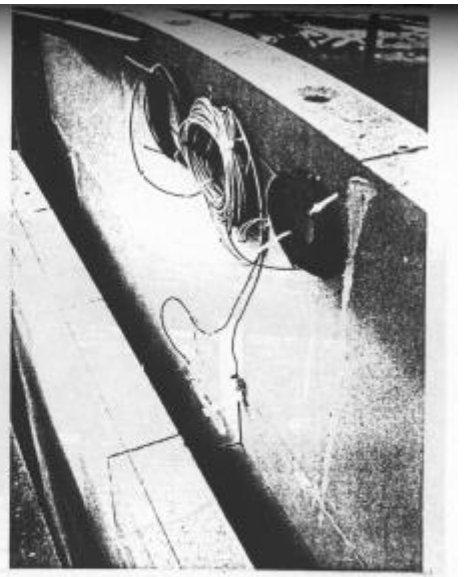
Example 2 : components : Building/HVAC
purpose : Validation/Auditing
exp.data : in situ



estim.comp.par.
parasitic effects
design improvements
opt. controls



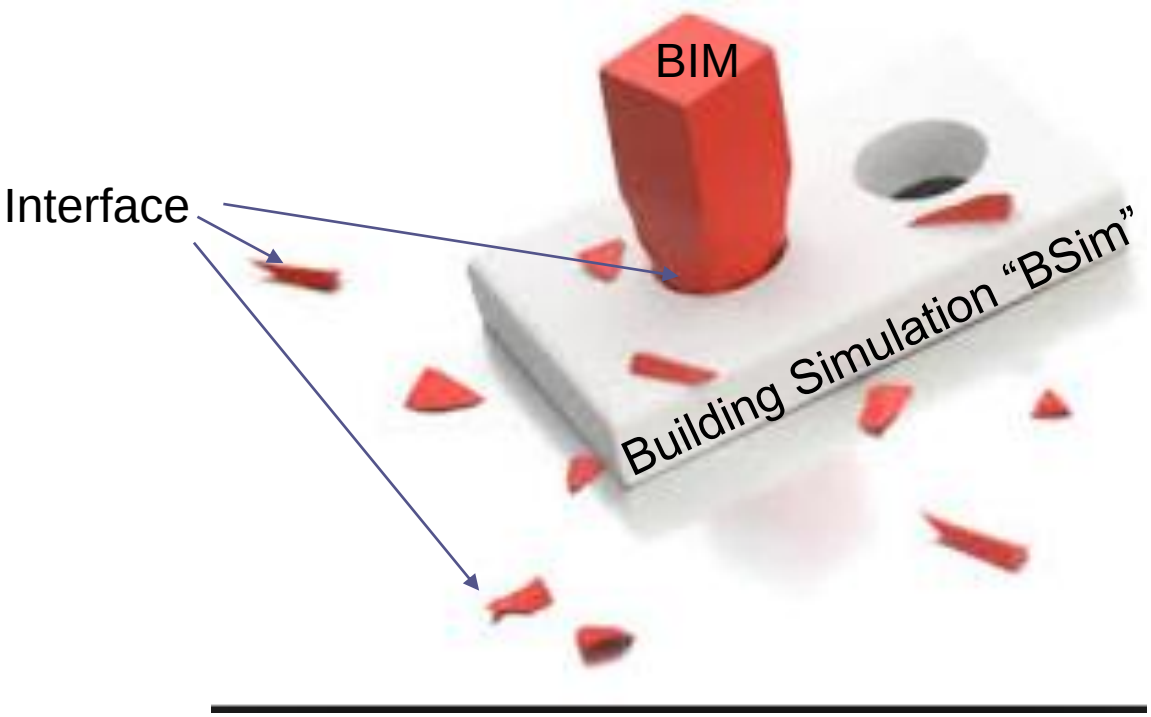
The crawl space with a view on the air fan



The cavity wall on the first floor with mounted temperature probes

Moving boxes (1996)

BIM-BSim interface: not ready



Interface toolkit

What is missing: a generic BSim representation: "BEM"

"I can break any BIM-BSim interface in one hour"
Augenbroe, 1996-2019

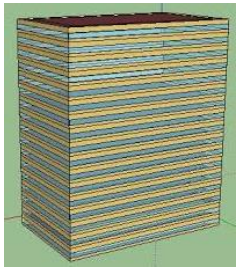
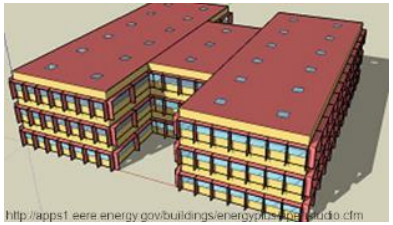
1997-2009 (pre HPB lab)

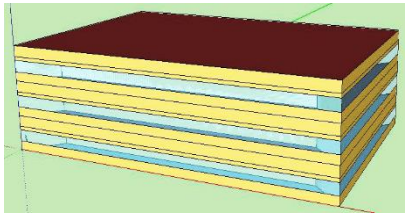
- **Hans Verhey**: Process-mediated Planning of AEC Projects through Structured Dialogues (2005)
- **Jose Solis**: A Systems Theoretic Exploration towards a Post-Forrester Model for Taming Unsustainable Exponentialoids (2006)
- **Clarissa Lima:** The use of formal methods for decision making in the planning of healthcare facilities (2007)
- **Hyunjun Moon**: Assessing mold risks in buildings under uncertainty (2005)
- **Jason Brown**: CFD in an equation based acausal modeling environment (2007)
- **Huafen Hu:** Risk conscious design of off grid solar houses (2009)
- **Yan Zhang:** A method to predict reverberation time in a concert hall early design (2005)

2010+: Back to BSim; creation HPB lab

Do we need better BSim tools?

The Iconic buildings that we test our tools on:



"You can simulate anything until you apply it to a real building"

"There is too much dark matter inside building simulation tools"
Augenbroe, 2003

Starting point

“All models are wrong, some are useful”

George E.P. Box

The performance gap revisited

Does this tell us how wrong BSim is?

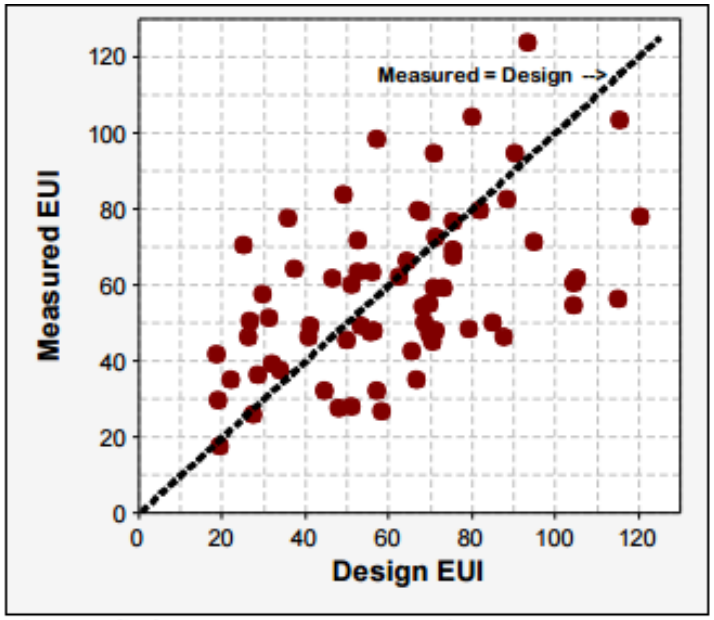


Figure ES- 4: Measured versus Design EUIs
All EUIs in kBtu/sf

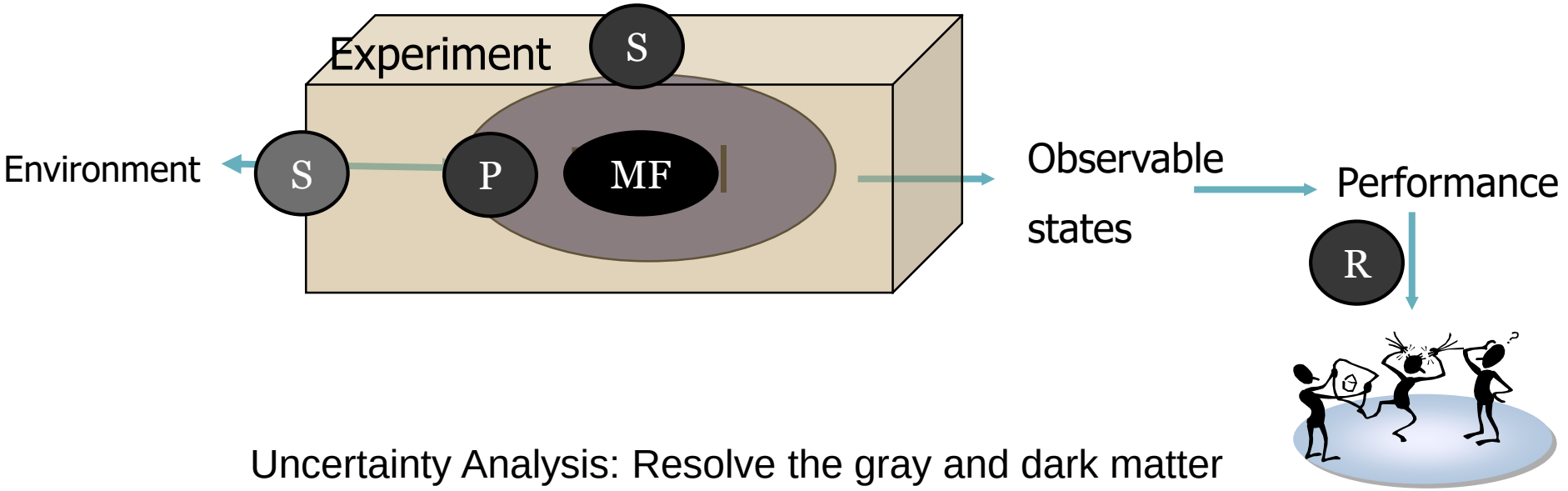
PG: compare design-predicted with actual measured

Expectation:

PG= modeling uncertainty + operation uncertainty

A view on simulation

Definition: Perform an experiment on a virtual or real artifact

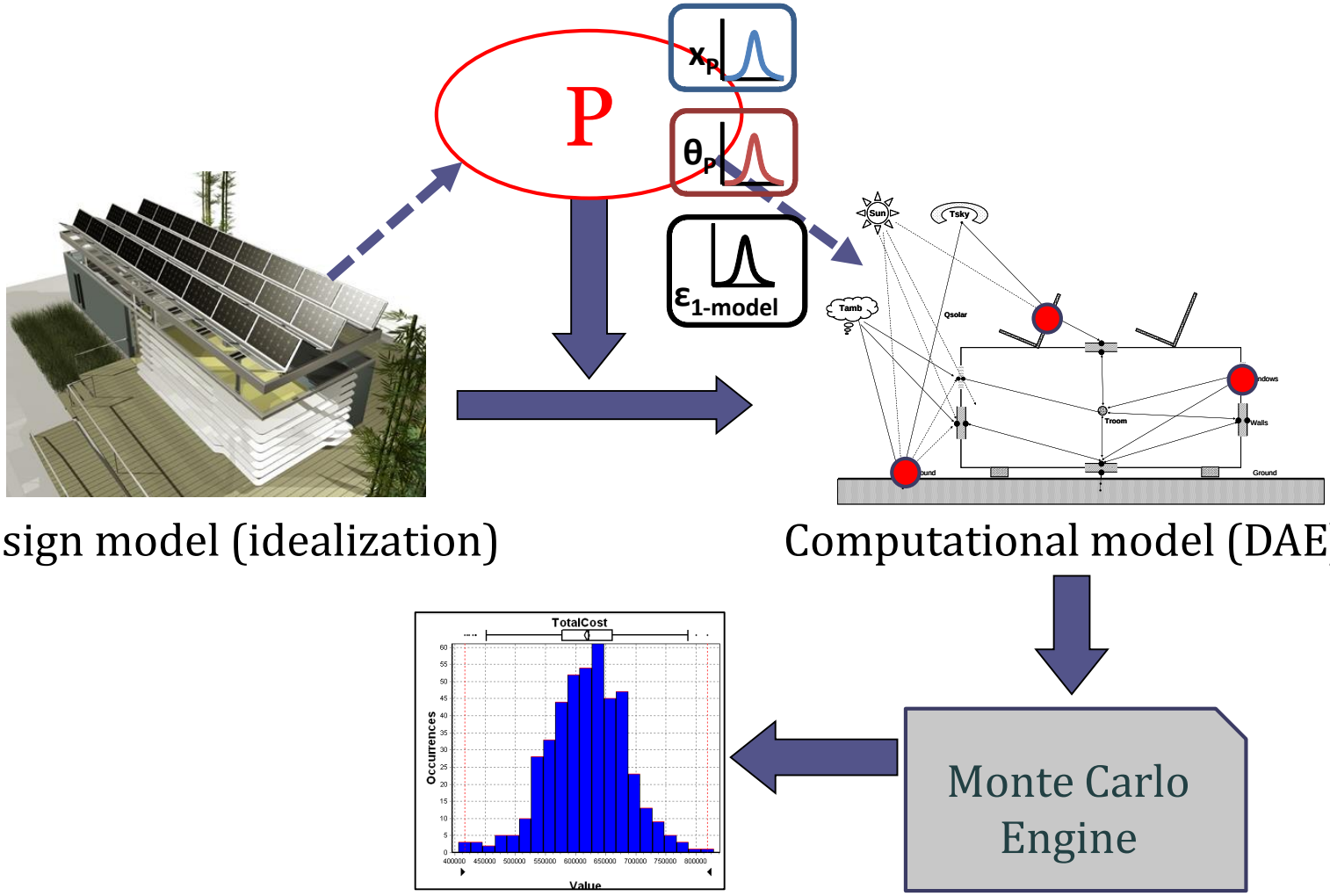


Uncertainty Analysis: Resolve the gray and dark matter

MF different for every BSim tool

R different for every decision context

Early Attempts at UA

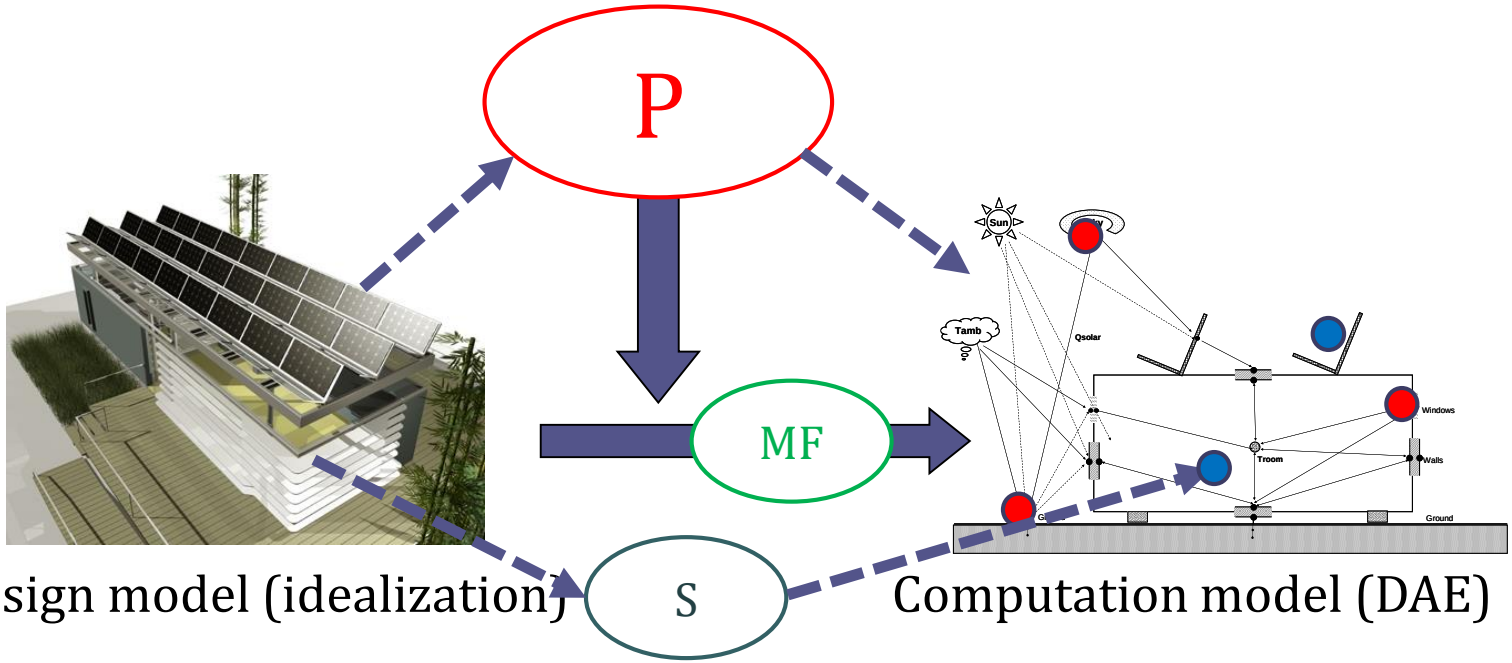


Design model (idealization)

Computational model (DAE)

"It may still be garbage in, garbage out.
But at least now we have quantified garbage".
Augenbroe, 2005-2015

Full implementation of UA

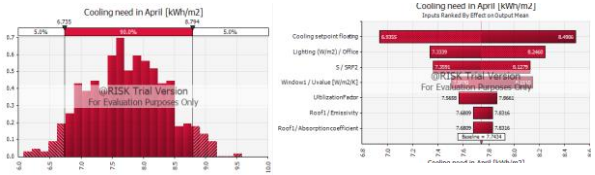


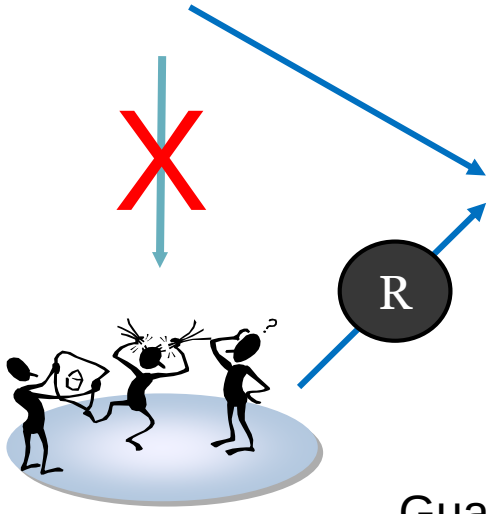
P: Model parameters (imprecise physical knowledge)

MF: Model discrepancy (intrusive, moving target)

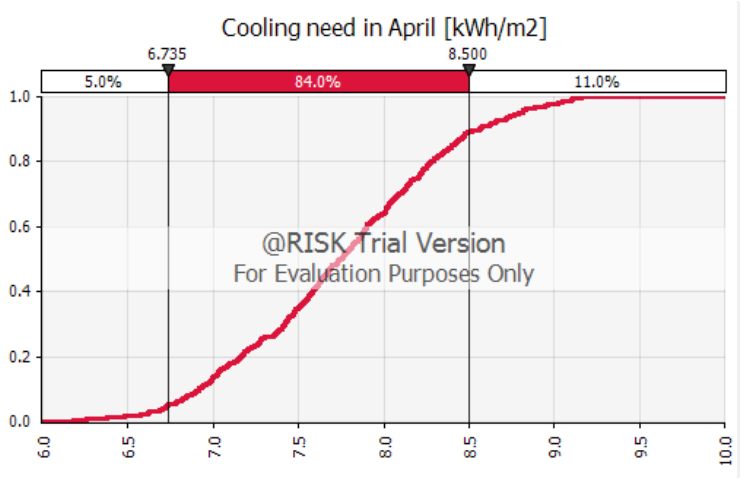
S: Scenario uncertainty

Is UA relevant to practice?





Risk measures



Risk-conscious decisions

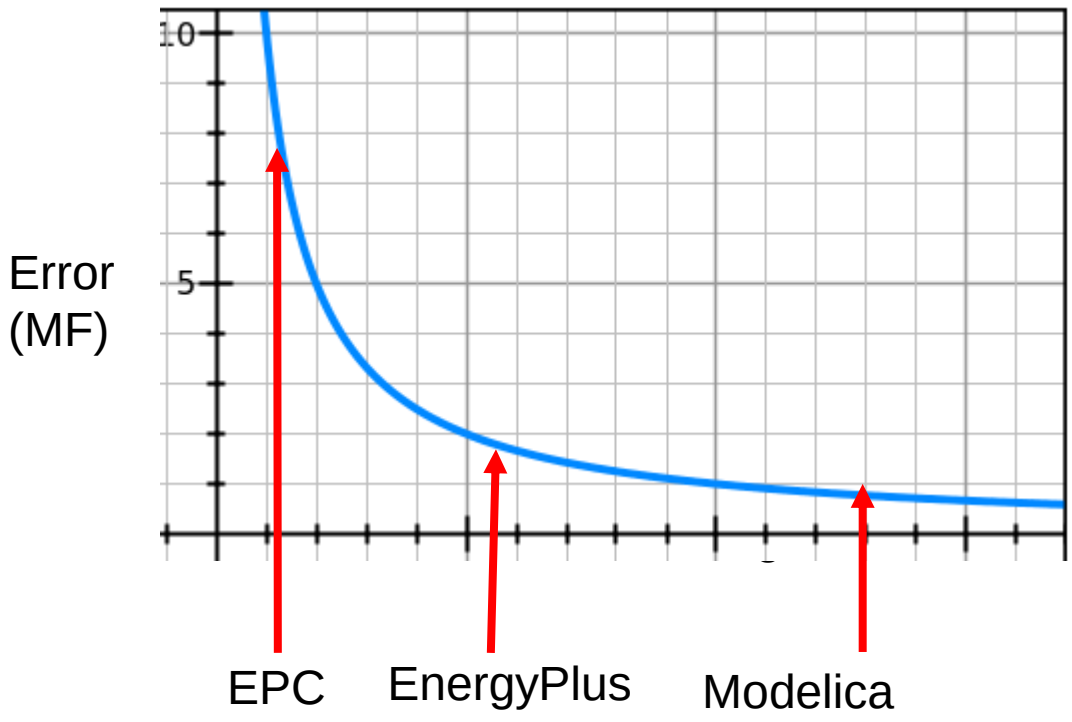
- Guarantee with confidence that a building meets energy target after 2 years in operation: LBC example
- Guarantee with confidence that occupants will not go to court because the natural ventilation cooling is inadequate
- Make ESPC with transparent risks for client and ESCO

What does all this mean for the PG?

What we found (or at least we got close):

PG= Modeling Uncertainty + Operation Uncertainty

The efficiency issue



But: should we still care about models?

Everything will be data driven soon, right?

But the true question remains

What model is fit enough to
perform a given assessment or prediction?

How do we define model fitness?

Model fitness (P, S, MF, OU; Decision Conf.)

Creative time wasting ideas

Revisit the “All X = Y” proposition

Read the old philosophers again and this time understand them

Publish the ultimate book:
“The No-nonsense book on building simulation”

More ideas needed……

Parting thoughts

In a few months my attempt at creative time wasting starts!

People tell me that you can waste a lot more time in the company of others.

Consider this an invitation!!