Energy Institute
Aston Building, de Montfort University, Leicester
10 March 2020

MAKE IT SIMPLER AND DO IT BETTER

Bill Bordass

USABLE BUILDINGS TRUST
www.usablebuildings.co.uk

and the
DO IT NOW FOUNDATION

Structure of the talk

1. **Context**
2. **Background**
3. **Where we are today**
4. **What can we do about it?**

1

CONTEXT

Context

- We're in a declared **Climate + Environment Emergency**
- Energy used in buildings is responsible for about 30% of global greenhouse gas emissions. *UK currently 26% - 17% from heating etc., 9% from electricity* (ref CCC 1019).
- Building construction+alteration accounts for another 10%.
- Poor building location could well add much the same again.

In the 20th Century ... we built a really inefficient environment with the greatest efficiency ever known to man.

ANDY KARSNER, Assistant Secretary, Department of Energy, USA (2007).

Antecedent September 2007

Architect Rab Bennetts and Usable Buildings consultant Bill Bordass put forward a modest proposal for sustainable design

'Keep it simple and do it well'

Rab Bennetts, the architect behind the iconic Wessex Water Operation Centre in Bath, and consultant Bill Bordass aren't from the "stick a turbine on the roof" school of green design. Here, they debate the challenges facing the industry.

SOURCE: Building Magazine Sustainability Supplement, *Digging beneath the greenwash,* pps 8-11, (28 September 2007).

and from the 1800s and 1980s

- *To define it rudely but not ineptly, engineering is the art of doing for 10 shillings what any fool can do for a pound* – THE DUKE OF WELLINGTON

- *Thousands of engineers can design bridges ... but the great engineer can tell whether the bridge … should be built at all.* – E. G. GRACE

Simplicity is not …

- Simplistic.
- Technologically backward.

Is often sophisticatedly refined.

2

BACKGROUND

In 1990, *15 years after the oil crisis*

Tales of the unexpected

Office buildings claimed to be energy efficient, in reality often fall short of their quoted performance because of simple calculation errors and unknown energy-consuming extras. Matthew Coomber *reports.*

BUILDING owners beware – your energy-efficient building may not be as efficient as you have been led to believe.

Bill Bordass, an independent energy consultant and something of a guru in the field of energy efficient design, claims many offices are touted as energy efficient, but turn out not to be on closer examination.

He is helping to prepare a series of case studies of energy use in offices as part of the Energy Efficiency Office's Best Practice programme.

The studies detail energy usage and cost figures for each energy consumption elements missing or had recorded building areas much larger than that actually serviced," he says.

Errors in calculation had arisen either through mismeasurement of floor area or a failure to understand what constitutes the treated area, that is, the area of a building that consumes energy, in whatever form.

"We found that energy researchers have a tendency to look in great detail at where the energy goes, but will often ask somebody else for a building area." Usually rounded up or

Bordass says some people measure energy consumption by the whole building, some by building services only, and some by landlord's building services only. "This can produce great discrepancies when you come to measure the floor area and the devices properly," Bordass notes.

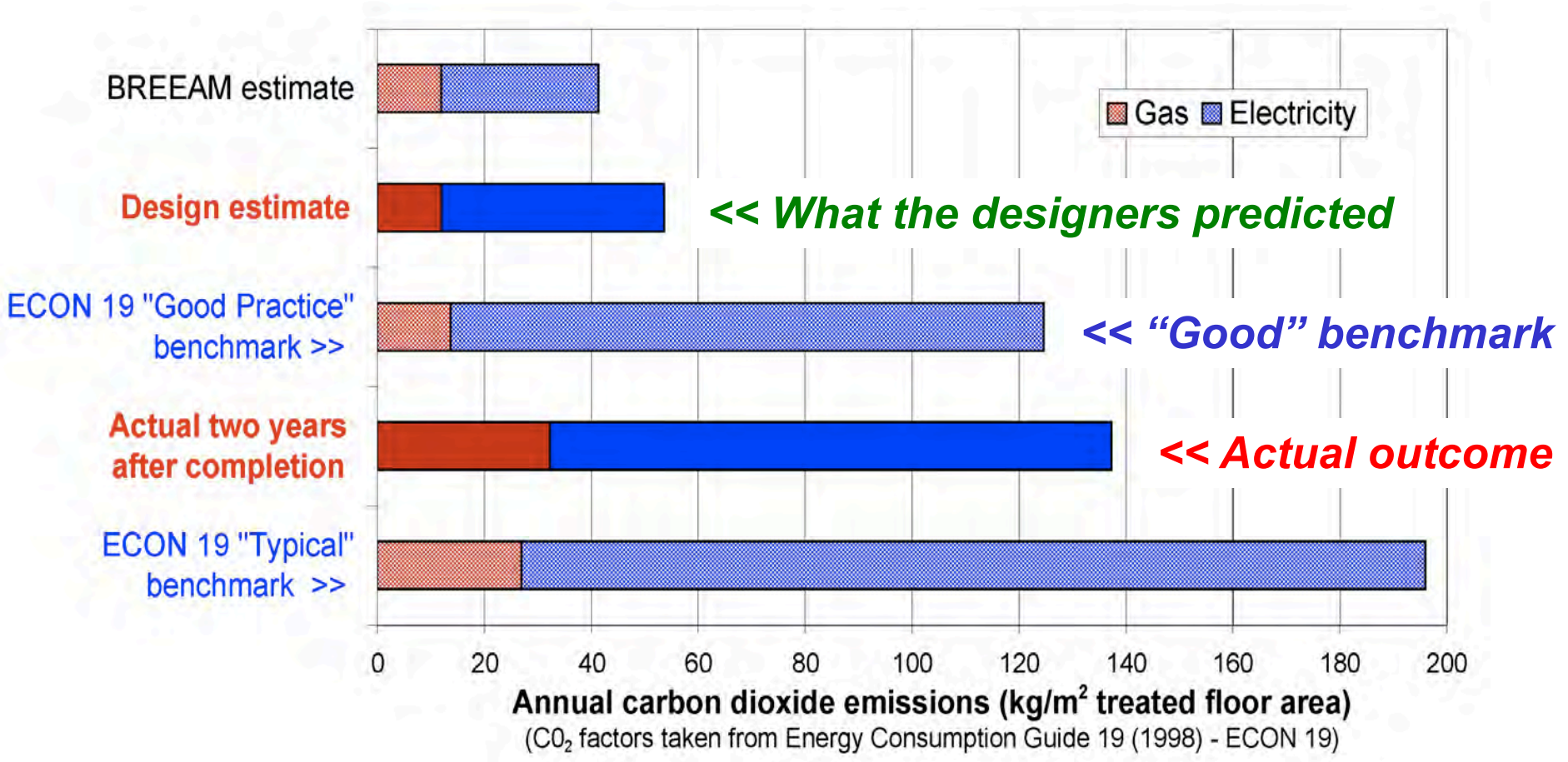
In addition, tenants can be confused about who pays for services, resulting in the doubling-up or omission of important elements of the energy bill.

The next problem concerns the assumptions that the people

SOURCE: M Coomber, *Tales of the Unexpected,* Building Magazine 38-39 (17 August 1990).

BREEAM for offices was introduced in 1990, *but performance gaps persisted…*

Data from the winner of the Green Building of the Year Award 1996



SOURCE: see discussion in S Curwell et al, *Green Building Challenge in the UK,* Building Research+Information **27**(4/5) 286 (1999).

In 1993, we found that people were ignoring the simple things

Optimising the irrelevant

by Bill Bordass

Why is the hi-tech office failing to meet users' needs? Is it the technology or the design process that's at fault? Bill Bordass identifies some of the problems and offers some solutions.

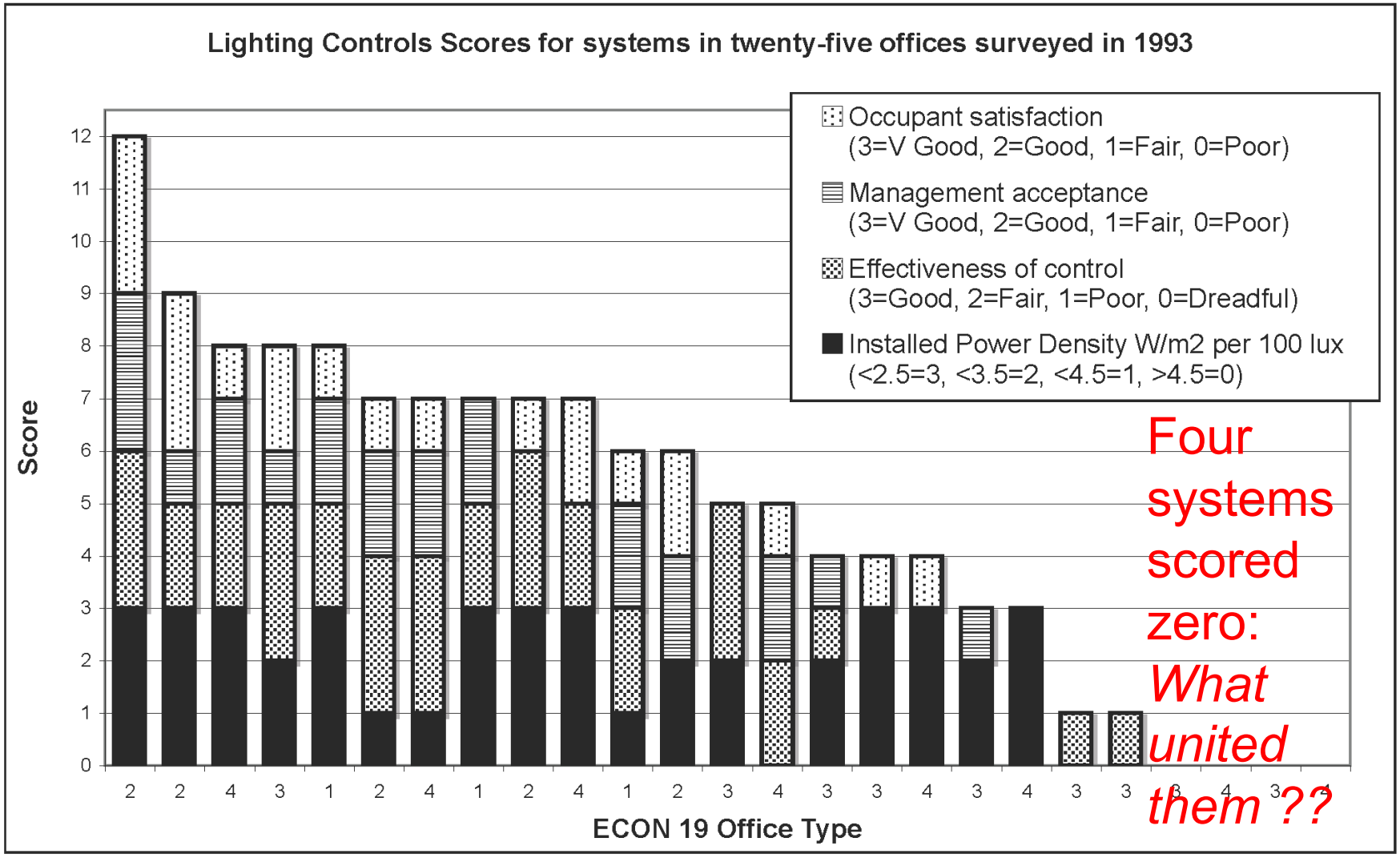
When people think of designing low energy buildings, they tend to fall into one of two traps. One is: "If we get the principles right, everything will automatically follow" or, "all you need is a lovely new bit of technology and it will solve the world's problems".

However, when you actually start looking at and analysing buildings they don't tend to give you the same messages. For example, when designing an energy efficient building, do we know what is meant by 'energy efficiency'? Evaluations on the basis of delivered energy consumption give misleading results, as all fuels are weighted

Figure 1: Lighting at the NMB Bank in Amsterdam, proving that lighting control problems are not confined to the UK.

SOURCE: Bill Bordass, *Optimising the Irrelevant,* CIBSE Journal, 32-34 (February 1993)

Results from lighting controls case studies – *25 offices in 1993*



SOURCE: unpublished, but see A Slater, W Bordass and T Heasman, *People and lighting controls,* BRE IP 6/96 (July 1996).

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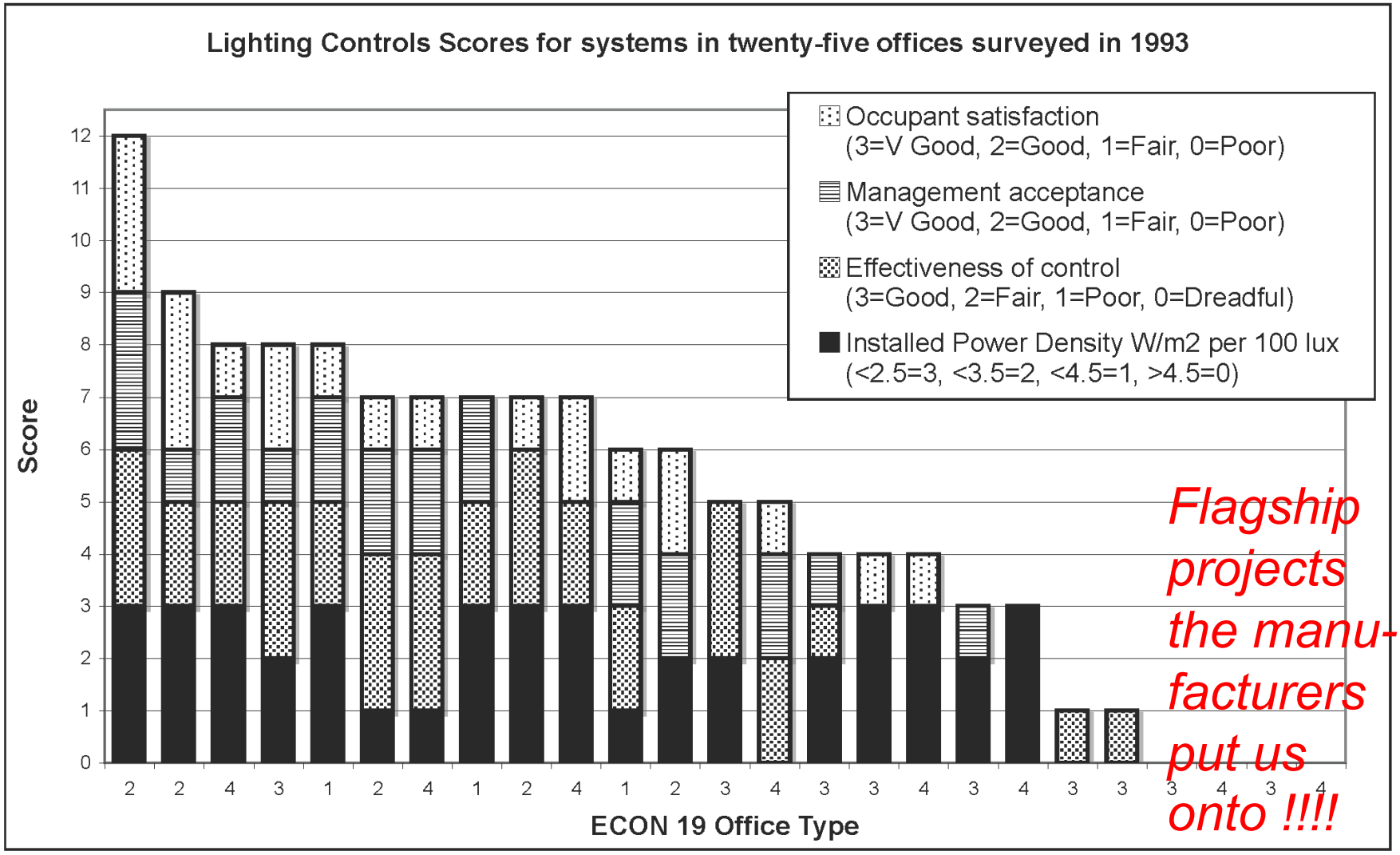


SOURCE: unpublished, but see A Slater, W Bordass and T Heasman, *People and lighting controls,* BRE IP 6/96 (July 1996).

We published twenty case studies of 2-3 year old buildings in CIBSE Journal (1995-2002).

What we found:

- They often perform worse than predicted, notably for energy and occupant satisfaction.
- Unmanageable complication is the enemy of good performance.
- Design intent is seldom communicated clearly to users and operators.
- Buildings are seldom tuned-up properly. Controls are often difficult to understand.
- Modern procurement systems make it difficult to pay attention to critical detail.

"The English spare no expense to get something on the cheap" ... NIKOLAUS PEVSNER

KEEP IT SIMPLE, DO IT WELL, FOLLOW IT THROUGH, TUNE IT UP, CAPTURE THE FEEDBACK

SOURCE: For more information, go the Probe section of www.usablebuildings.co.uk

Technology - management interactions:
conclusions from the Probe studies of public and commercial buildings and confirmed by later work

		Technological complexity	
		More	**Less**
Building management input	**More**	*Type A* Effective, but often costly	*Type D* Rare, not replicable?
	Less	Risky with performance penalties *Type C*	Effective, but often small-scale *Type B*

Diagram first appeared in: *Probe 19: Designer Feedback,* Building Services, the CIBSE Journal, page E21 (March 1999).

Technology - management interactions:
Strategic conclusions from the Probe studies of public and commercial buildings in use

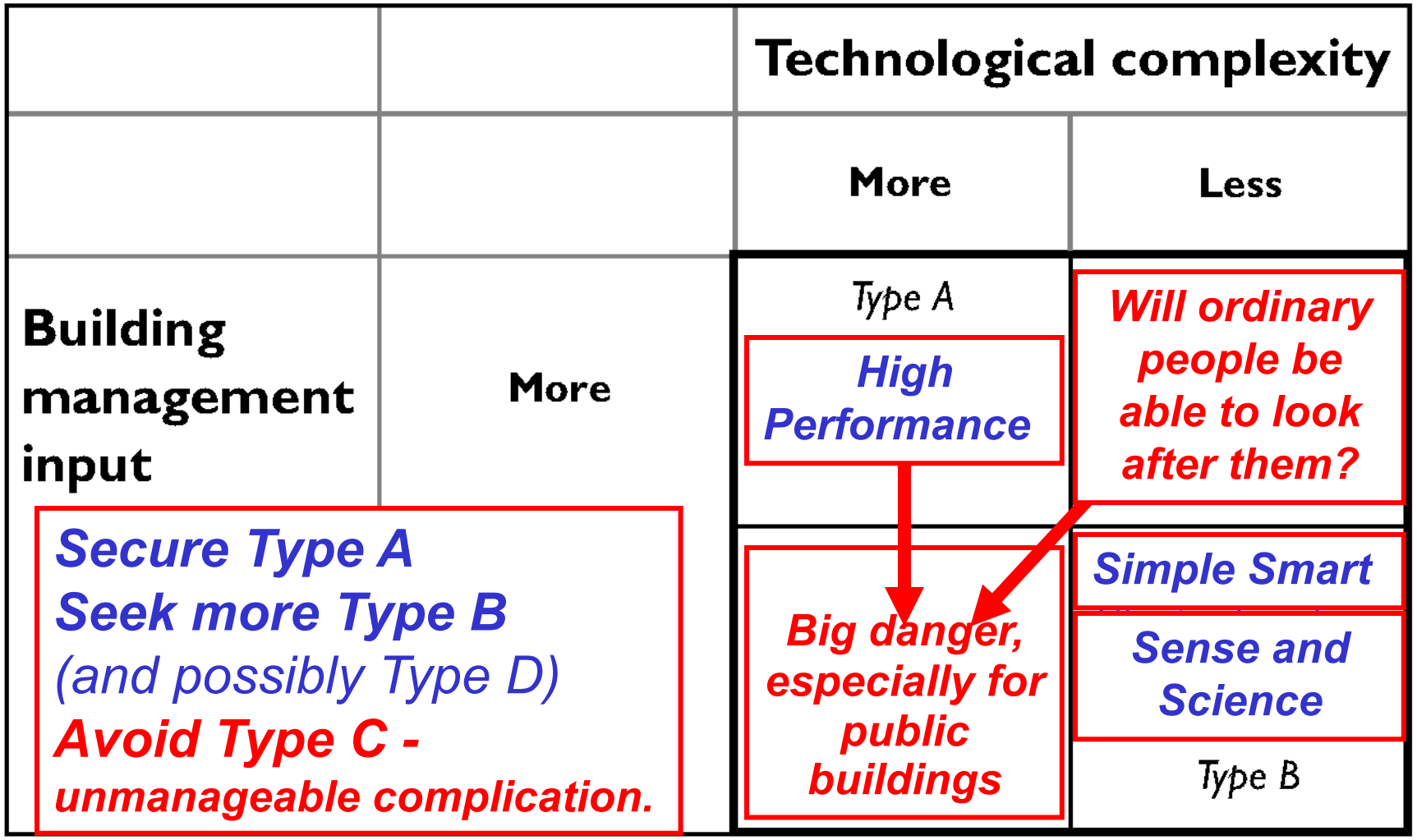


Diagram first appeared in: *Probe 19: Designer Feedback,* Building Services, the CIBSE Journal, page E21 (March 1999).

2
WHERE ARE WE TODAY?

More like a Forgetting Curve
than a Learning Curve.

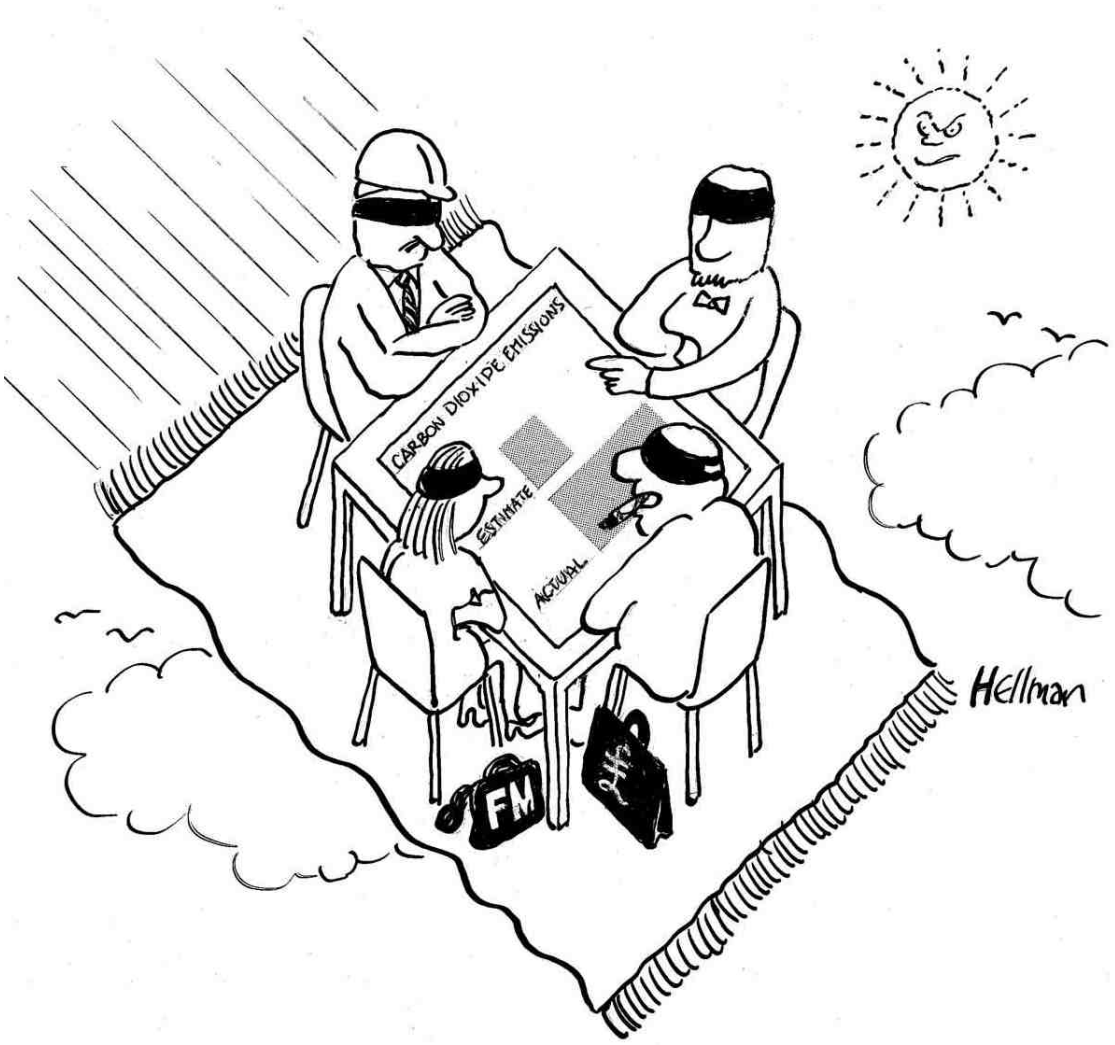
What the industry has been missing:
The evidence under our noses

"in theory, theory and practice are the same, in practice they aren't"
SANTA FE INSTITUTE for research into complex systems

"unlike medicine, the professions in construction
have not developed a tradition of practice-based user research …
Plentiful data about design performance are out there, in the field …
Our shame is that we don't make anything like enough use of it"
FRANK DUFFY Building Research & Information, 2008

"Architects prefer to learn through direct personal experience.
Engineers prefer principles and established rules."
PORTSMOUTH SCHOOL OF ARCHITECTURE: How do we learn?

"I've seen many low-carbon designs,
but hardly any low-carbon buildings"
ANDY SHEPPARD Arup, 2009



SOURCE: by Louis Hellman for cover of W Bordass, *Flying Blind,* Association for the Conservation of Energy, London, (2001).

So, in spite of the insights from the 1990s, *complication has burgeoned in recent years*

- Technical complication
- Legislative complication
- Contractual complication
- Bureaucratic complication
- Tick-box procedures: feature creep
- Complication for building users and managers

So less money to spend on basics

The complication disease has now spread to housing too!

AND NOTHING JOINS UP PROPERLY!

"Complexity is profitable, [it] makes people believe you understand it."
JON DANIELSSON

F Stevenson et al,: *The usability of control interfaces in low-carbon housing,* Architectural Science Review, 1-13 (2013).

The disease of unmanageable complication has spread to domestic buildings too …

SIGMA HOUSE, BRE *(illustrated)*

- Extensive feedback from occupants, including comfort, ergonomics, space.
- Complicated, confusing and unreliable technologies and renewables.
- Energy use much higher than predicted.

ELMSWELL, ORWELL

- Two-thirds of residents could not programme their thermostats.
- Mechanical ventilation with heat recovery was present, but 95% of people had windows open in winter.
- Design air change was 0.5 to 1 ac/h. One open window could provide 17 ac/h!

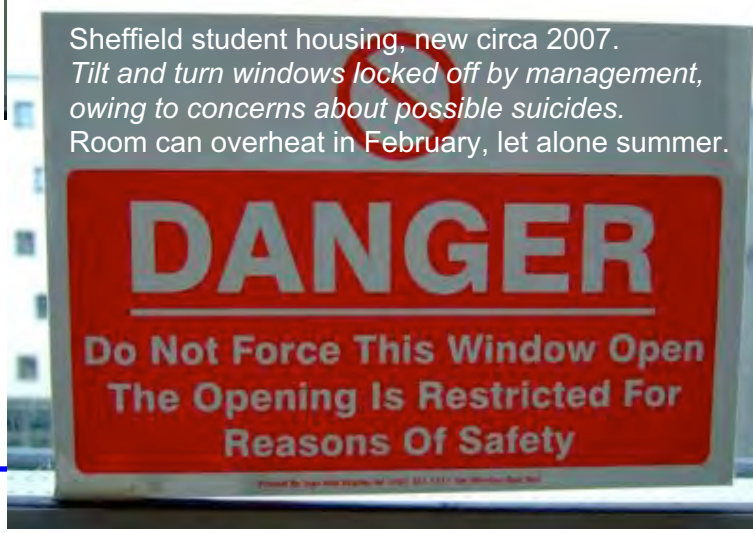
SOURCE: Sigma monitoring by Oxford Brookes University, Elmswell by Buro Happold in KTP with Bristol University.


… while simple things
go unrecognised
EC1
1707
lux
x 100
x 10
x 1
x 0,1
HOLD
Hagner®
Made in Sweden
Wasteful overprovision in new buildings:
In a “low energy” building’s kitchen

Simple dysfunctions in recent buildings:
Poor window design, leading to overheating

Cambridge sheltered housing, opened 2011. *No secure, fine control ventilation available: could easily have been small windows in the panel between the doors. Doors need two hands to operate: not clever if you have arthritis!*

Sheffield student housing, new circa 2007.
Tilt and turn windows locked off by management, owing to concerns about possible suicides.
Room can overheat in February, let alone summer.

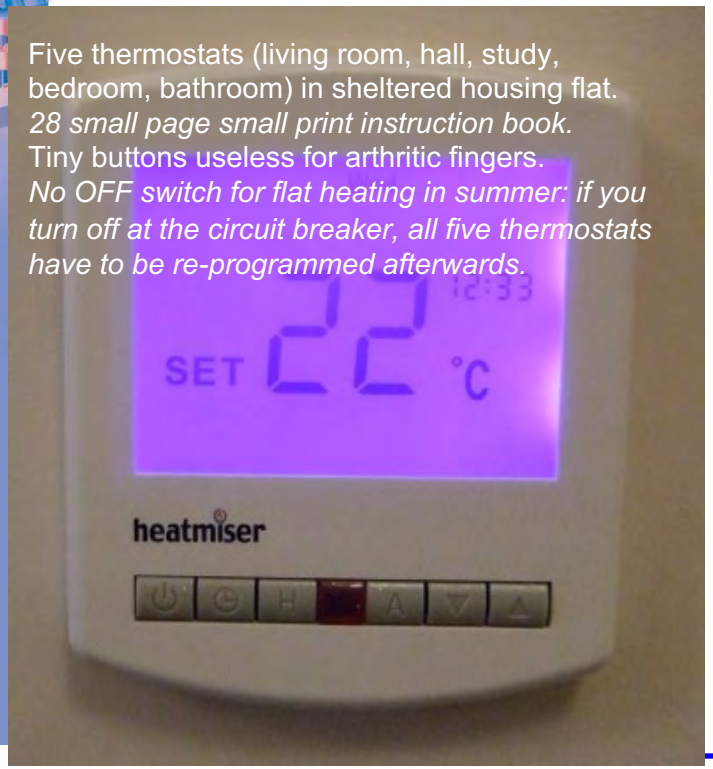


… and widely dysfunctional controls

BCIA
Building Controls Industry Association

Controls for End Users

Five thermostats (living room, hall, study, bedroom, bathroom) in sheltered housing flat.
28 small page small print instruction book.
Tiny buttons useless for arthritic fingers.
No OFF switch for flat heating in summer: if you turn off at the circuit breaker, all five thermostats have to be re-programmed afterwards.



Usability criteria	Ranking (controller as supplied) Poor … Excellent
Clarity of purpose	●
Intuitive switching	●
Labelling and annotation	●
Ease of use	▬
Indication of system response	▬▬
Degree of fine control	●

This control for lighting has clear switching with four settings clearly illuminated, plus an off setting. The numbers by the setting are arbitrary.

Apart from the numbering, the switch is not labelled as to what it does. The red light for setting 1 is on the far left of its button, hinting that there be more than one stage for each setting. Is the off button for system off, or does it apply to each of the four stages in turn? Does the vertical button to the right raise or lower the lighting generally, or on each setting? In the absence of clear annotation, the user is forced to experiment.

Usability criteria	Ranking (controller as supplied) Poor … Excellent
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Labelling and annotation	▬
Ease of use	▬▬
Indication of system response	●
Degree of fine control	▬

This controller is clearly a control device for ventilation. The knob at the lower left appears to offer control over a setpoint (presumably for temperature), against an arbitrary scale of plus or minus. In the absence of controller feedback, the user would need to learn the settings by experimentation. The function of the knob on the right is clearer, with three fan speed-settings, but is it for room ventilation or a fan in a heating/cooling unit? Probably the latter, as experience has forced the facilities manager to append a label telling users not to switch off the fan.

"we sell dreams and install nightmares"
– CONTROLS SUPPLIER

SOURCE: www.usablebuildings.co.uk/Pages/Publications/UBPubsControlsForEndUsers.html and BSRIA

RECAP
PROBE findings 1995-2002

- They often perform worse than predicted, notably for energy and occupant satisfaction.
- Unmanageable complication is the enemy of good performance.
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- Buildings are seldom tuned-up properly. Controls are often difficult to understand.
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and now, in the 2010s
what people still find in recent buildings

- They often perform much less well than anticipated, *especially for energy (notably electricity) use, carbon, and occupant satisfaction*.
- Unmanageable complication is the enemy of good performance. *So why are we making buildings more complicated and difficult to manage in the name of sustainability? Prevention is better than cure.*
- Design intent is seldom communicated well to users and managers. *Designers and builders tend to go away at handover.*
- Buildings are seldom tuned-up properly, and controls are a mess. *So now we have more things to do, what chance do we have?*
- Good environmental performance + occupant satisfaction can go hand in hand, *but only where good, committed people have made it happen.*
- Modern procurement systems can make it difficult to do things properly, with enough attention to detail. *Need a new professionalism that engages routinely with outcomes, e.g. using* ***Soft Landings****.*

"it's déjà vu all over again" … YOGI BERRA

"it's déjà vu all over again, yet again" … BILL BORDASS

and yet again: *Conclusions from report on IUK Building Performance Evaluation programme 2010-15*

Significant problems with integrating new technologies, especially configuring and optimising BMSs. Insufficient thought given to how occupants will use them.

"Controls are something of a minefield." Tendency to make control of heating, lighting and renewable energy systems over-complicated. The one air source heat pump had operational issues in cold weather.

Problems with automatic window controls.

Multiple systems fighting each other e.g. cooling vs heating, different heating systems jockeying for control.

Maintenance, control & metering problems, especially with biomass boilers, PVs and solar heating.

SOURCE: J Palmer & P Armitage, BPE Programme, Early findings from non-domestic projects, Innovate UK (Nov 2014)

3
WHAT CAN WE DO ABOUT IT?

If you wanted to improve building performance in use, *what would you do …*

A. Focus on building performance in use?

OR

B. Do lots of other things and hope that performance will improve …?

Why have we been barking up the wrong tree?

Why is actual performance not the proper target?

Why do people kick Case Studies into the long grass, *saying they are anecdotal?*

THEY AREN'T !

FIVE MISUNDERSTANDINGS *(after Flyvbjerg)*

1. *General knowledge is better than context-specific knowledge.*
2. *You can't begin to generalise from a single case.*
3. *They might help you make hypotheses, but other methods are better for hypothesis-testing and theory-building.*
4. *They have a bias to confirming the investigator's bias.*
5. *It is often difficult to extract general propositions and theories.*

RUBBISH ! *Why do people so often ignore the advance warning signals, instead of listening to the canary in the coal mine?*

SEEKING MORE DATA IS OFTEN JUST A DELAYING TACTIC.

REFERENCE: B Flyvbjerg, *Five misunderstandings about case study research,* Association for the Conservation of Energy, London,

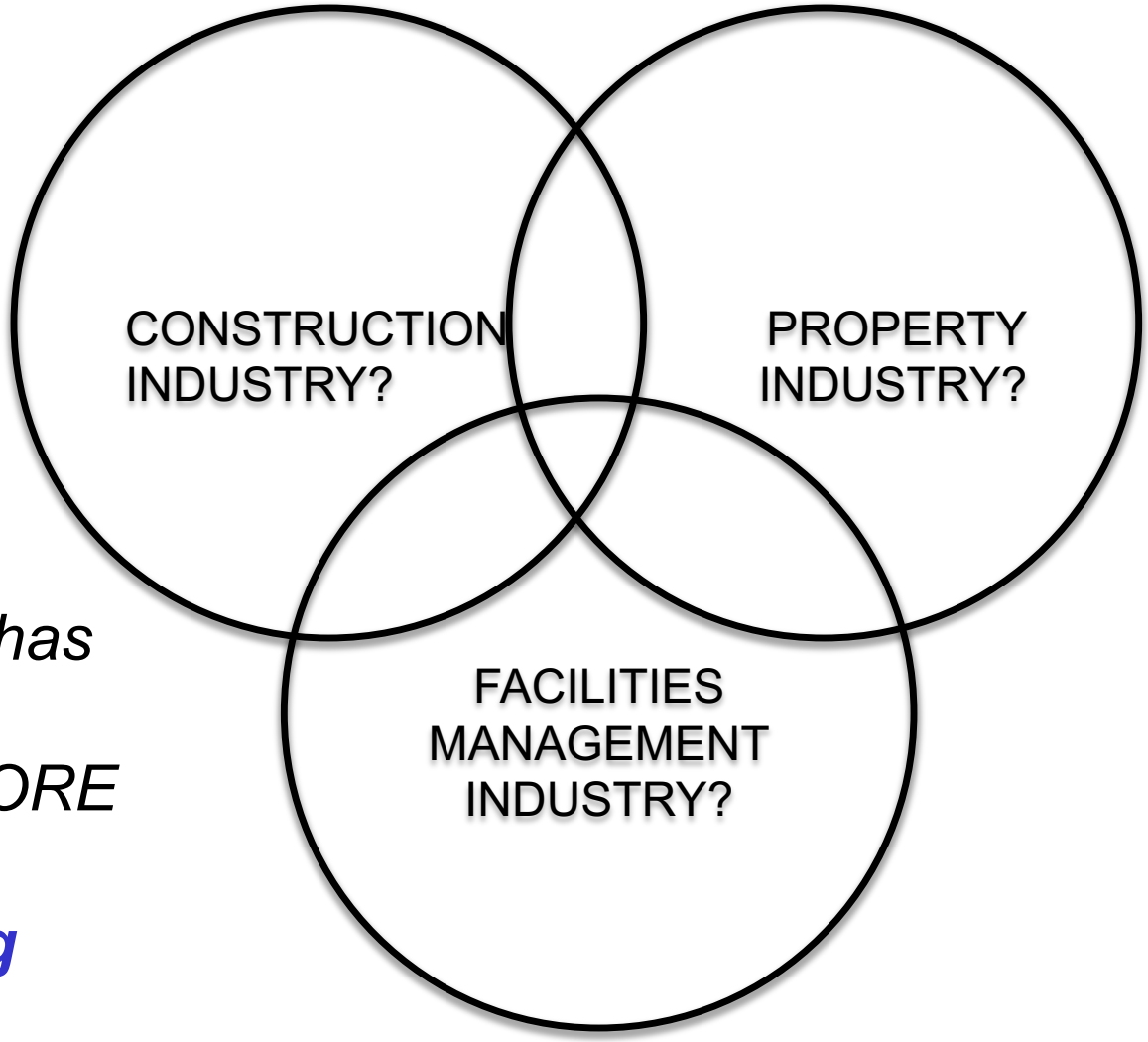
Which industry and market is really responsible for building performance?

None of these:
it's much more
complicated
than that.

The lack of traction
is not market failure,
but category error!

"The social contract has been fractured by outsourcing" – AL GORE

We need something more …



UBT's proposed sticky interventions:

seeding things with potential to snowball over time

Cultural adaptations, not just technical "solutions".

To create virtuous circles of continuous improvement.

MAKE IN-USE PERFORMANCE CLEARLY VISIBLE

In a way that motivates people to strive to improve it.

This needs a well-informed technical infrastructure to help the plethora of different systems to converge, particularly for energy and carbon.

CONSOLIDATE THE KNOWLEDGE DOMAIN OF BUILDINGS IN USE

Develop building performance as an independent knowledge domain, to gain the evidence and authority to inform practice and policymaking.

REVIEW PROFESSIONAL ETHICS AND PRACTICES

A shared vision for building-related professionals to work in the public interest and engage properly with outcomes: *NEW PROFESSIONALISM*

SEE ALSO: Bill Bordass, George Henderson Memorial Lecture, University College London (12 June 2013).

Changing the way we do things

- Many construction-related institutions require their members to understand and practice sustainable development.
- *How can members do this unless they understand the consequences of their actions?* The real outcomes.
- If they don't, they are working outside their region of competence …
- **in other words, not acting in a fit manner to be a professional !**

SO HOW ABOUT?

- Changing attitudes to the nature of the job.
- Re-defining perceptions of the professional's role, to follow-through properly and to engage with outcomes.
- Closing the feedback loop – rapidly and efficiently.
- Making much more immediate, direct and effective links between research, practice and policymaking.

Making things simpler and doing them better

- Can we trust the procurement system?
- Can we trust the fabric?
- Can we trust the services?
- Can we trust the controls?
- Can we trust the operations?
- Have we tuned the building up?
- Have we shared our experiences?
- Can we predict performance well enough?
- Are we still *Optimising the Irrelevant?*

Thank you
QUESTIONS … *or appendices?*

"Complexity is profitable, [it] makes people believe you understand it."
JON DANIELSSON

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