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# Evidence Based Evaluation Research in Engineering

Kevin Kelly

Dublin Institute of Technology, [kevin.kelly@dit.ie](mailto:kevin.kelly@dit.ie)

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# Presentation to CIBSE Conference Dublin - March 9<sup>th</sup> 2010

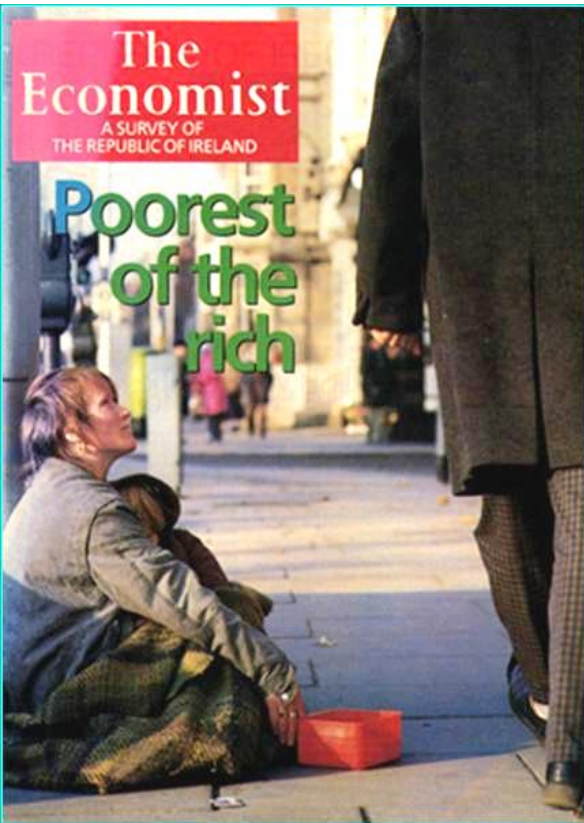
## *Evidence based Evaluation* (RESEARCH) in Building Services Engineering

Dr Kevin Kelly  
School of Electrical Engineering  
DIT

[kevin.kelly@dit.ie](mailto:kevin.kelly@dit.ie)  
<http://eleceng.dit.ie/kkelly/>

# The Irish Economy 1988 - 2004

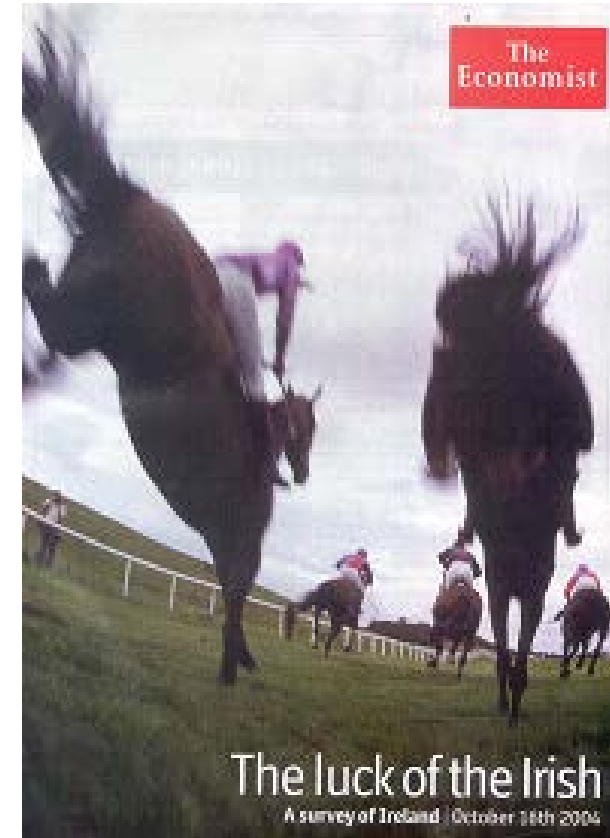
1988



1997



2004

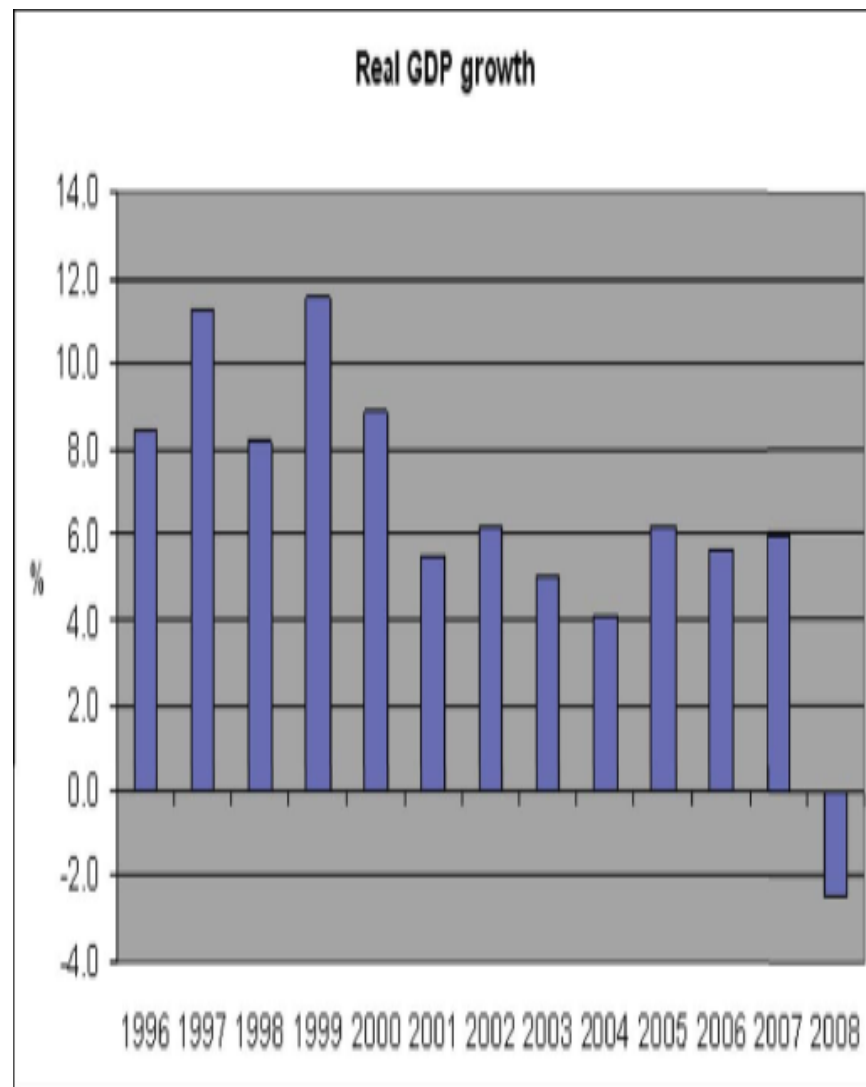


# The Celtic Tiger Roared Ahead



# Boom to Gloom overnight

- Crisis management
- Survival?
- Scaling Down
- Unemployment
- Trying to Identify New Opportunities
- Trying to Identify New Ways of Doing Things



# Where to Now?

- A **Learning Organisation** responds quickly to a changing environment. For this to happen effectively, change has to occur from all parts of the organisation in a flatter structure and communication has to be excellent. Decisions are based on an **analysis of evidence** and the Learning Organisation is ever evolving....

Senge (1991)

Also Schon – *The Reflective Practitioner*

# Analysis of Evidence

Evidence/data from:

- External Environment
- Internal Environment
  - Processes
  - Projects
  - Innovations.....

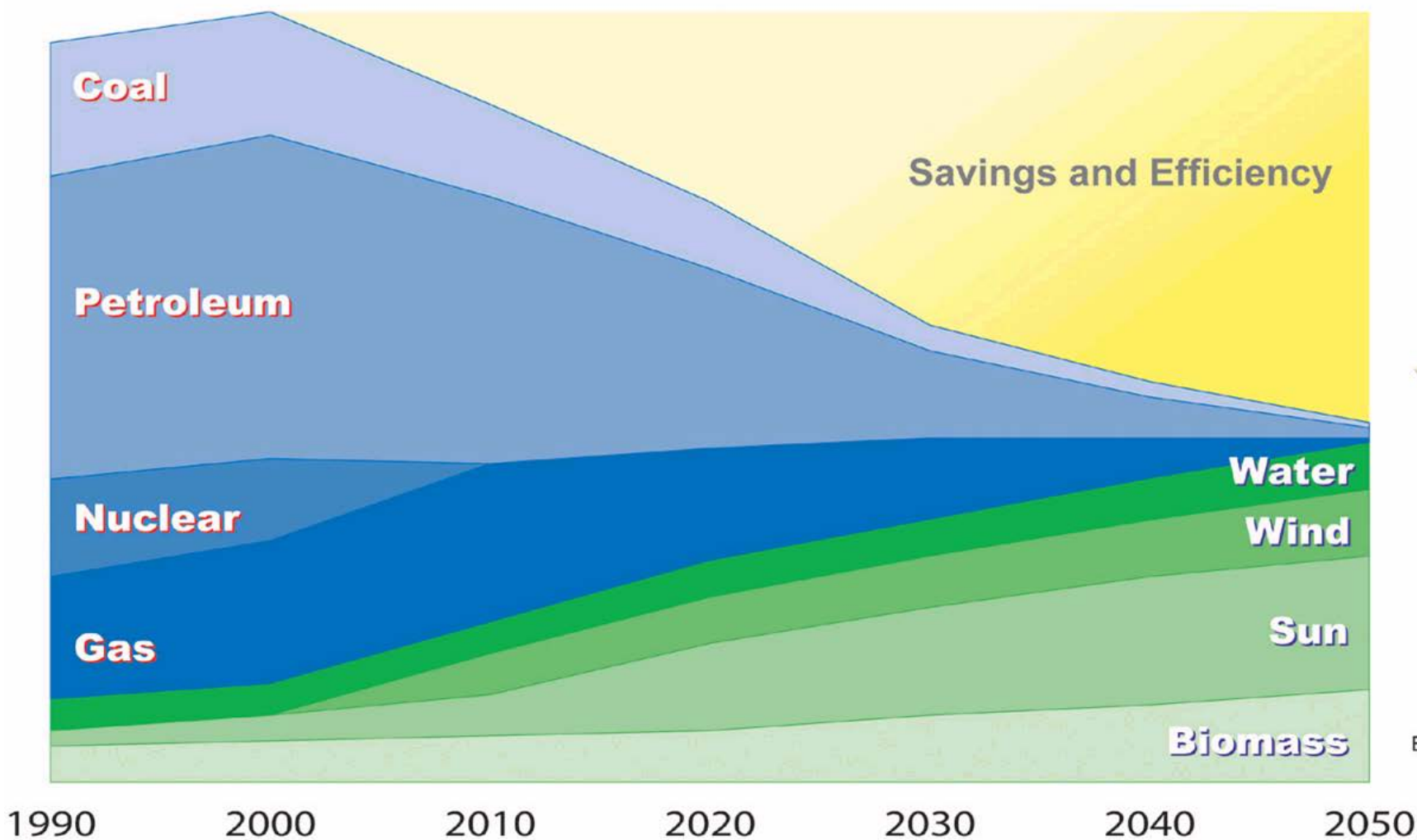
# Evaluation – Is this Research?

Yes, it can be if you are examining real value through a **critical analysis of data (evidence)...**

Let us now look at opportunities and how Evaluation Research applies to projects and innovations



# Opportunities with the Sustainability of Buildings



Source:  
H. Lehmann  
Wuppertal  
Institute for  
Clima,  
Environment,  
Energy

# Existing Buildings

## Opportunities:

- Energy Reduction
- Increased Use of LZC technologies

# Convincing the Client?

Two possibilities perhaps:

- **Ideologically?**

**OR**

- **Evidence Based Evaluation** of Economic and other benefits to the client

**Which do you think is best?**

# Evidence Based Evaluation?

- This is Rigorous Research
  - Critical analysis of evidence and more...

# What it is Not

- Selective sampling of successful innovations or selective use of some data that suits an argument from a particular project
  - This might be seen by some as just propaganda & sales talk, if so will a discerning client looking for value not see through it?

# Over Promising & Under Delivering

Payback to Client:

- Micro-Generation
  - PV?
  - Wind?
  - GSHP?

How is this evaluated?



# Where are best returns with retro fits?

- Insulation?
- Infiltration?
- Lighting?
- CHP?

How do you find out?

# From Wyatt (CIBSE

## Service Sector Buildings

Fig.16

SUBSECTOR	END USES	Catering	Computing	Cooling & Ventilation	Space Heating	Hot Water Heating	Lighting	'Other'	TOTALS
	<u>Annual Carbon Emissions</u>								
Commercial Offices	%	4	12	4	51	5	23	1	10
	M t C	0.09	0.28	0.09	1.17	0.12	0.53	0.02	2.3
Communication & Transport	%	5	3	6	19	3	62	4	3
	M t C	0.03	0.02	0.04	0.13	0.02	0.43	0.02	0.69
Education	%	9	3	3	53	7	23	2	12
	M t C	0.25	0.08	0.08	1.46	0.2	0.63	0.06	2.76
Government	%	8	13	2	60	6	10	1	7
	M t C	0.13	0.21	0.03	0.97	0.09	0.16	0.02	1.61
Health	%	6	2	1	54	11	25	1	8
	M t C	0.11	0.04	0.02	1.00	0.2	0.45	0.02	1.84
Hotel & Catering	%	28	1	4	37	17	12	1	15
	M t C	0.97	0.03	0.14	1.28	0.59	0.41	0.03	3.45
Retail	%	16	3	7	31	3	38	2	18
	M t C	0.67	0.12	0.29	1.28	0.12	1.58	0.08	4.14
Sports & Entertainment	%	10	2	7	41	12	25	3	4
	M t C	0.09	0.02	0.06	0.38	0.11	0.23	0.03	0.92
Warehousing	%	2	5	20	32	3	35	3	6
	M t C	0.03	0.07	0.28	0.44	0.04	0.48	0.04	1.38
Others	%	3	4	2	54	11	22	4	17
	M t C	0.12	0.16	0.08	2.1	0.43	0.86	0.16	3.91
TOTALS	%	12	5	5	46	9	22	1	100
	M t C	2.76	1.15	1.15	10.58	2.07	5.06	0.23	23MtC



# Research

Rigorous analysis of data & evidence

- Examine what others have found out
- Identify questions to be answered
- Gather data required to answer
- Analyse the data critically
- Draw conclusions – including what has not been adequately answered and identify future research questions



# Is Evaluation research happening widely in our industry in Ireland?

The anecdotal evidence I have gathered operating two research events for CIBSE suggests not...:

- *We can't do research because we don't have a lab...*
- *We don't have time for that...*
- *We can't tell you what went wrong because we would look bad.... but we know*
- *If only we could afford it...*
- *Our company does not have research skills*

# Panic Situation

*Post Graduate Student:*

- *My thesis/research is blown, they have disconnected and discarded the daylight controls because they were causing too many problems – this is the third building where this has happened.*

*My Reaction:*

*Wow what a great research question:*

*Why has this happened three times?*



# Methodology for this RQ

- If you want to find out what people think, then ASK them...Interview data is referred to in research as *Qualitative Data*...This is often viewed with suspicion but it applies well when exploring what is happening...
- It often helps define tighter research questions which can then be answered with Quantitative Data...It is with quantitative data that traditional scientists and engineers are often most comfortable
- Perhaps conclusions are best drawn from Quantitative data? But Qualitative data can be very informative – you may be gathering many years of experience and knowledge –
- Qualitative Data is much underused in Engineering but it can be very insightful – when properly applied and with academic rigour.



# C.Eng requirements ..

- **Historically the academic requirement was an honours degree**
  - Where successful graduates regurgitated the information provided by *Expert* Lecturers
  - Experience in recent years based on working in a high demand environment (lots of work available)

**BUT TIMES ARE CHANGING FAST**

# Masters participants (mature) ME & MSc programmes

- **Master Degree studies normally require individuals perform at least one piece of research for their dissertation**
- **My experience with some mature masters students:**
  - **Very knowledgeable & experienced in engineering**
  - **Presentations and reports are usually written well –**

**BUT Conclusions are often drawn which may extrapolate outside what was found and sometimes they lack adequate evidence or rigour, particularly wrt critical analysis. Perhaps they are more used to using data to propagate a view or argument rather than to find out something and add to knowledge?**

  - **Research is about adding to knowledge, you need an open mind....**
  - **Then – the findings can be used to support a commercial argument but not the other way around, at least not in my view**

# The Bottom Line is Everything?

**I am told this a lot at present and perhaps it is true but let me present something for you to ponder...**

**Is this not a short term view in an economy where at least some clients may be increasingly looking for improved value not just the cheapest installation?**

**If so then Evidence Based Evaluation will help**



# Collaboration with Higher Education

- FWBL
- Research Groups
- Post Graduate Courses
- But with Evaluation Research data is not adequately collected in a laboratory, data is needed from real buildings – research groups in HE need you and you need HE to provide support to you
- We must all be more collaborative  
– and then everybody can win





# Post Occupancy Evaluation

- *Probe series*
- *Important to Identify RQs that can be answered and how this will be done. Careful planning of the Methodology must ensure methods are fit for purpose*
- Rigorous critical analysis – Warts & All  
*(My project did not work out....)*

# Conclusion

- My experience suggests to me that rigorous engineering research is commonplace in many other countries.
- In Ireland this is not my experience in our industry, our problems to some extent may be a lack of critical mass or a lack of history in our industry at post graduate level or the lack of response of HE to industry's needs
- With the open market you and your companies will become increasingly exposed to competition from international companies where research is part of their everyday work. Ireland is now a front edge economy and a Learning Society. We must adapt change & quickly.
- We need to get moving with increased research and evidence based evaluation is where it can start for your company and for you as an individual.

# CIBSE (ROI)

- **Sustainable Design Competition**
  - Sponsored by *John Sisk & Son*
- **SLL/ILE Irish Lighter Competition & Young Lighter - *Sponsored by Enlighten***



# Young Lighters

2004 to 2009:

- Art Gallery Lighting - Winters
- Bio Rhythms - Brennan
- Photosynthesis – Crowley

Amongst others

# There is good Evaluation Research out there – (*Enlighten Irish Lighter*)

## Blackwell Wins Inaugural Irish Lighter Award

Oliver Blackwell of Low Energy Designs Ltd has won the inaugural Irish Lighter competition for the LED street and flood lighting project he designed for The Square in Tralee, Co Kerry. Unfortunately, Oliver could not attend the final presentation of papers, or the awards ceremony, as his wife gave birth to a son on the same day. However, John Murphy, his business development partner, delivered the paper on his behalf, and also collected the premier award on his behalf later that evening.

The judges for the awards were:—

- Gerard Keating (Chairman), partner in Homan O'Brien & Associates and outgoing Chairman of CIBSE (ROI);
- Liz Peck, Secretary of the Society of Light and Lighting;
- Jim Patton, Light and Lighting and SLL representative NI;
- Allan Howard, WSP Group and ILE council member;





And there is other types of research  
and sometimes IT IS Rocket Science



# Sustainable Design Awards More Good Evaluation Research (Sponsored by John Sisk & Son)



# CPD Engineers Ireland

## ***Writing that journal article –***

Module 5 is intended to be an ongoing support module for participants who complete module 4 and wish to write a journal article or conduct a small piece of research. The tutor would offer support in a practical way of ongoing feedback and proof reading of drafts and acting as a critical adviser.





# Irish Research in Building Services New Journal?????

Perhaps a collaboration b/w CIBSE, SEI  
& HE??? – Sponsors needed

This would allow you see what good  
research looks like

AND my forecast is that you will say:  
*YES we can do that.*

# Finally

There are many types of research but in this presentation I am emphasising *Evidence Based Evaluation* to you. If you would like to discuss this further

...

[kevin.kelly@dit.ie](mailto:kevin.kelly@dit.ie)



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