SUPPORTING SIMULATION WITH BIM

# BUROHAPPOLD ENGINEERING

# Loughborough University

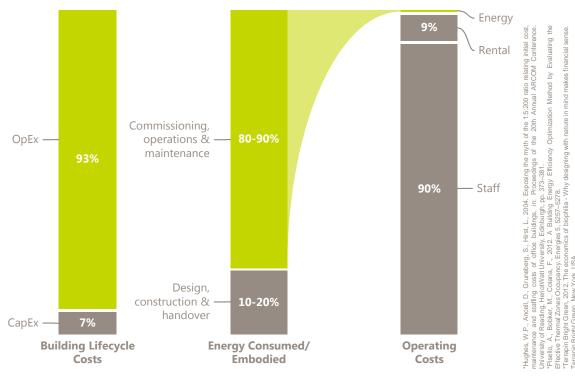
Thursday, 14 May 2015

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How can BIM be used to improve the design process, let alone improving operational performance?

## LOTS OF DATA ... LOTS AND LOTS OF DATA

- Data developed during design +
- Data generated throughout use
- Lots of data...but no real benefit
- What's more important;
  - ...the energy used by the building and its occupants?
  - ...the wellbeing of those occupants?
  - ...and who is this important to?



#### BIM AS A REFERENCE LIBRARY



Performance Monitoring

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## THE DATA DEVELOPMENT PROCESS

	Bid	Bid Concept Design		Schematic Detailed Desi		d Design	- /		Use	
delling		High-Level Design Influence	Mass Modelling	Baseline Performance Model	Ventilation & Fabric Exploration	Building Services Analysis	Regulation & Comfort Evaluation	Review of Contractors Proposals	Performance Model Handover	Post-Occupancy Evaluation
Energy Performance Modelling Activity		Experiences energy modelling specialist informs low-energy design decisions such as form, function, layout and location	Comparison of suggested designs using simple mass models taking into account building form, layout and expected occupancy	A design is chosen and the baseline model from which design decisions are based is defined (this is the fixed model around which further modelling is based)	Exploration and determination of various ventilation strategies and fabric compositions	Servicing capacities and optimal control strategies for later operations are defined	Regulatory compliance is determined using current configuration including internal climate criteria and energy consumption	Proposed changes are tested for viability and models updated to correspond with these	*This action rarely happens. Documentation handover is often limited to just operations & maintenance manuals	Occupant comfort and energy usage studies inform improved operational efficiency
ed	Proposed design requirements	Overall design advice	Theoretical performance	Baseline energy model	Energy performance analysis of options	Building services performance analysis	Evidential regulatory compliance	Proposed changes	Building energy performance model	Energy efficiency improvement advice
Stakeholder Supplied Information	Design requirements	Design requirements	Proposed design configurations		Occupancy levels & servicing requirements	Building services specifications	Performance calculation methodology		Operations schedules	Operations schedules
der S rmat					Finalised fabric specifications	Operations schedules	Full building services specifications		Operations & maintenance manuals	Maintenance schedules
Info										Energy usage data
Sta										Occupancy scedules
ed	Design requirements	Design requirements	Proposed designs	Baseline performance model	Proposed servicing specifications	Building services specifications	Full building services specifications	Proposed changes	Operations & maintenance manuals	Building operations data
Demanded		Overall design advice	Proposed designs		Occupancy & servicing requirements	Building services specifications	Evidential regulatory compliance	Full building services specifications	Building operation schedules	Energy efficiency improvement advice
Der					Energy performance analysis of options			Proposed changes		
	Architect	Client/Oc	ccupier EPM	Specialist	Engineer	Manufacture	Policy Ma	aker Con	tractor Fac	ilities Manager
									24	
						Decision Gates				

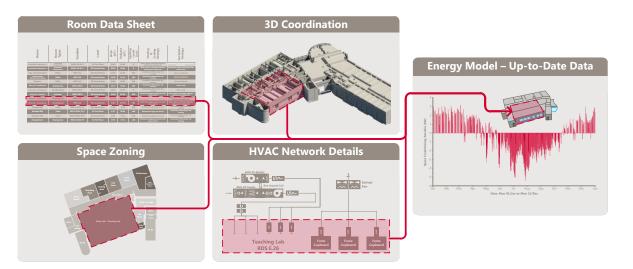
## THE DATA DEVELOPMENT PROCESS



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## CASE STUDY - YORK UNIVERSITY



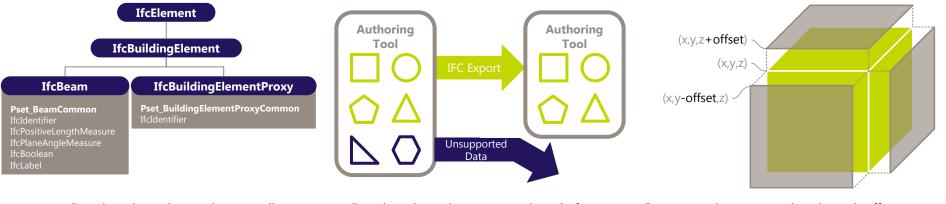
Data contributing towards the up to date energy performance model

Properties	×	
M2012_Heat LTHW Heatin	er-Cooler Battery ng Coil 8	
Mechanical Equipment (1	) 👻 📴 Edit Type	FRONT
Constraints	8.4	
Level	02 Second Floor	
Host	Level : 02 Second Floor	
Offset	0.0	
Text	*	
EQUIPMENT COMME	-	
Control Point Descripti	L2 M LTHW HC 8	·
Trend Logging	1/2H	
BMS Panel / Area	Main	
Change Control	N/A	
Electrical	*	
PHASE	1	
Hz	50.00 Hz	
Electrical Engineering	*	
VOLTAGE 230.00 V		
Electrical - Loads	*	
Panel	L2_M_LTHW	
Circuit Number	L2_M_LTHW	
Mechanical	\$	
WATER PRESSURE	10000.00 Pa	Other
ROOM DELTA T	35.00 °C	L L VA
LTHW SYS RETURN TE	50.00 °C	
LTHW SYS FLOW TEMP	70.00 °C	
ESTIMATED WATER C	4.674000	400.0 × 300
DESIGN HTG FLOW	0.14 L/s	
DELTA T	20.00 °C	
CORRECTION FACTOR	0.471330	300.0 × 300.0 🔍 👝 🖭
COIL LAT DB	19.00 °C	22. (2) 前前 mm
COIL EAT DB	0.00 °C	In Out
CALCULATED OUTPUT	243.21 W	

Extensible parameter attribution within Revit



#### PITFALLS AND OBSTACLES



Data loss through proprietary attribute storage methods

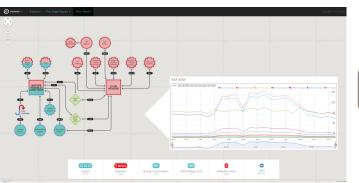
Data loss through export to other platforms

Geometry misrepresentation through offset coordinate assignment

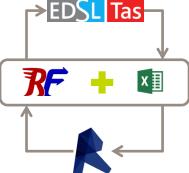


#### WHERE NEXT

Ad-hoc tools manipulating ad-hoc data



Clockwork FM



Systems and geometry export/import between tools

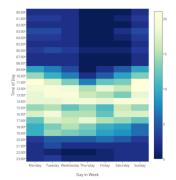
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Space usage and movement planning

Time-series dataset disparity



Data management and visualisation



#### CALL FOR PAPERS – SPECIAL ISSUE OF SCIENCE AND TECHNOLOGY FOR THE BUILT ENVIRONMENT

- "BIM Applications for HVAC&R Engineering and Operations"
- Manuscript submission June 12<sup>th</sup>
- Topics of interest:
  - HVAC&R performance modeling and simulation
  - Modeling of HVAC equipment
  - Fault detection and diagnosis
  - Building in-use management
  - BIM tools and performance simulation
  - BIM and energy system dynamics, controls and optimization
  - BIM applications for Facilities Management
- Contact <u>t.gerrish@lboro.ac.uk</u> for further details and the invitation containing instructions

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