BUILDINGS THAT WORK

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BUILDING USE STUDIES

ESSENTIAL FEATURES ARE OFTEN ABSENT

ENVELOPE PERFORMANCE
Poor air infiltration, insulation, shading, window control.
BUILDING SERVICES
Gismos applied to systems not intrinsically efficient.
SYSTEM COMMISSIONING
Frequently incomplete. Need for "sea trials"
CONTROL SYSTEMS
Dysfunctional, intrusive, unusable, poor feedback.
UNMANAGEABLE COMPLEXITY
Not designed or documented to suit occupier priorities.
CUSTOMER SUPPORT AFTER HANDOVER
Not planned for ... so frustration and little feedback.

WHAT ARE CONTROLS FOR?

PERFORMANCE

Meets design intentions.

ECONOMY

Matches supply to demand. Avoids waste.

SAFETY

Avoids catastrophic and chronic problems.

COMFORT

To suit the users.

RESPONSIVENESS

To meet needs of activities and individuals.

FEEDBACK

For fault detection and continuous improvement.

OBTAINING PERFORMANCE

Purpose and Strategy
+
Building shells
+
Technical systems
+
Controls
+
Fitouts
+
People
+
Management
+
Monitoring and Feedback

CLEAR OBJECTIVES, ATTENTION TO DETAIL, NO BEGGED QUESTIONS, BUILT AS INTENDED, RAPID RESPONSE

STATUS OF CONTROLS TODAY

What have we got?

Manual, automatic and intelligent

How well are they doing?

In straightforward and in innovative buildings.

How could we do better?

Strategy

Procurement

Technology

Usability

HOW ARE THEY DOING?

MEETS DESIGN INTENT? *Is intent realistic?*

AVOIDS WASTE? *Frequently not.*

SAFE OPERATION? *Can eclipse other objectives.*

COMFORT? *Often significant shortcomings*

RESPONSIVENESS? *Often major shortcomings*

FEEDBACK? *Poor to management and users*

Need to improve function and usability

CONTROLS: COMMON PROBLEMS

POOR STRATEGIES

Importance of good control not well recognised.
Inappropriate assumptions made about occupants and management.

FAULTY PROCUREMENT

Difficult to specify well: what adds value isn't valued.
Fragmented supply chain.
Poor communications in a cut-throat market.

POOR USABILITY

Design intent not obvious.
Changes difficult or impossible. Little suitable feedback.

UNINTENDED OUTCOMES

Dysfunction, waste, conflicting strategies, user alienation.

GENERIC FAULTS

Insufficient connection between supply and demand sides of the industry.

Difficult to devote the time necessary to innovate, test, and attend to details.

Requirements+technologies changing faster than knowledge in application.

Essential features aren't valued.

Poor controls and usability.

Inadequate benchmarks. Difficult to get what you want.

Revenge effects.

Non-existent or outsourced feedback loops

Life's too short!

ASPECTS OF PERFORMANCE

STRATEGY	*What you want*
PROCESS	*How to get it*
PRODUCT	*What you get*
SERVICE	*What it does*
FUNCTION	*How it works*
VIGILANCE	*What it needs*
RESPONSE	*If doesn't suit*
REVENGE	*If doesn't work*

OWNERSHIP OF PROBLEMS

"if you aren't part of the solution you're part of the problem"

FIT AND FORGET

- Adaptable buildings
- Passive measures
- Intrinsic efficiency

FIT AND MANAGE

- Design for manageability
- Effective management
- Good feedback
- Rapid response

IMPLEMENT/INTERNALISE

- Make what you want either habitual or intuitively obvious
  ("knowledge in the world" - D NORMAN)
- Try to with the grain.
- If not, major support may be necessary.

RISK AND FREEDOM

- Seek self-managing adaptation
- Meet safety requirements efficiently
- Seek appropriate default states.

BUILDINGS SHOULD BE SAFE, COMFORTABLE, CONVENIENT AND HEALTHY

People will soon notice if they are not ...
or if what they want to do is thwarted, e.g. by poorly-functioning technology.

The best can be the enemy of the good.
Don't make things too complicated: "good enough", not necessarily "just right".

People must be able to get out of trouble:
If things are not "good enough", people need opportunities to correct things in their favour.
(e.g. the "crisis of discomfort" ... D HAIGH)

Hence balance between provision of appropriate conditions (acceptable most of the time) and scope for interventions (timely and effective).

Too much need for intervention is irritating.
Not enough is annoying. Inappropriate automated interventions are exasperating!

Trading-off is important, *but often neglected.*

BUILDING USERS NORMALLY PREFER

1 Predictable, normal, **background "default" states,** which habitually form the background to what they are doing.

2 **Opportunities to make interventions** or corrections if requirements or conditions alter.

3 **Clarity:** the ability to act clearly, quickly and effectively ... and to know immediately that an appropriate response has been obtained.
Simplicity and convenience is paramount.

USABILITY IS THE SATISFACTORY COMBINATION OF ALL THREE

(defaults, interventions, clarity)

Usually with most emphasis on CLARITY:
People tend to concentrate more on the functionality of the thing, and less on the background context in which it finds itself.

SCOPE FOR INTELLIGENCE:

1. Establishing *(and especially restoring!)* safe, comfortable, convenient and efficient default states.

2. Providing opportunities for intervention.

3. Providing information.

4. Not taking over, or getting in the way!

RECOGNITION OF CONTEXT

People are adept at recognising their own context, but poor at communicating it to others. *(viz: computer software problems).*

Most tools and technologies are developed to be used
in well-defined contexts *(e.g. bread knives on breadboards in kitchens),* but may afford other opportunities *(chairs can be stood on).*

KNOWLEDGE IN THE WORLD: it is clear what objects are for *(knobs for turning, etc.),* but reinforced by cultural norms and common use.

KNOWLEDGE IN THE HEAD:
you need to be told. *Preferably only once!*

DESIGNERS CAN USE knowledge of requirements, contexts, constraints, analogues and affordances to improve usability.

WHAT OFTEN GOES WRONG

UNREALISTIC ASSUMPTIONS
Frequently poor recognition of context, oversimplifying occupant requirements and activity and use patterns.

SUPPLY-SIDE CULTURE
Providing without enabling.

CONFLICTING STRATEGIES
Creating clashes and restricting trade-offs.

IGNORE UNUSUAL REQUIREMENTS
Look at averages, not ranges and rare events *(what if ... ?).* Do not recognise differences between circumstances and individuals.

WASTEFUL DEFAULT STATES
Particularly now in the age of flexible working.

UNDERESTIMATED ABILITY OF MORE COMPLEXITY to increase burdens on everybody: *difficult to define requirements and get fulfilled; unintended behaviour; baffled occupants; stressed managers.*

FRUSTRATIONS FOR OCCUPANTS

Unable to change physical settings from an undesirable existing state to a preferred new one *(e.g. interlocked furniture in workstations).*

Arbitrary changes in conditions which they can perceive but are not able to over-ride.

Working in non-standard situations, for example outside normal hours. *Can the default states and the facilities for intervention cope?*

Poor support in stressful situations either personally, or in an imposed emergency.

Unable to achieve speedy and effective response from their own actions, control systems or other people *(typically FM).*

Little influence over **adverse effects,** *(e.g. draughts from grilles or distant windows; glare via a manager's glass partition; occupancy-sensed lights in peripheral vision; banging doors; circulation routes).*

Deprivation of choice between the lesser of two evils
(e.g. between ventilation and noise).

USABLE END-USER CONTROL DEVICES

Easy to identify *what they are and do.*

Easy to understand,
and preferably intuitively obvious (at least after some simple instruction).

Easy to use
(or people will ignore, or take a more convenient route).

Operate and be effective as near to the point of need as possible *(this and the required device may differ with time and user).*

Work effectively, *with sufficient fine control to give the required level of adjustment (and inhibiting use of excessively coarse control).*

Immediate tangible feedback *that the device has operated.*

People may need reminding about basic actions, especially if these are not obvious and the device or feature is used only occasionally
(e.g. telephone call diversion).

DON'T LET FEATURES TRIUMPH OVER CLARITY & FUNCTIONALITY

SOME IMPLICATIONS

LOOK AT WHOLE SITUATIONS
Not just people-machine interactions.

PUT PEOPLE IN THE CONTROL LOOPS
(but only where this makes good sense!).

CONSIDER THE FULL RANGE OF USERS AND CONTEXTS. Don't focus on an average subset.

TAKE DEFAULT STATES SERIOUSLY
Will this be what you want? ... *or what is least trouble, but is neither comfortable nor efficient.*

PROVIDE GOOD FACILITIES FOR INTERVENTION. *People who can get themselves out of trouble tend to be happier, more productive ... and less of a headache for management.*

IF YOU REMOVE OPPORTUNITIES FOR INDIVIDUAL ADJUSTMENT ... How will you replace what you take away? *This may require more money, design and management than you think!*

AND FINALLY ...

Designers are not users, though they often think they are ... J NEILSEN

THE KILLER VARIABLES

A killer variable has a critical influence on the overall behaviour of a system

1. STRATEGY
2. CONTEXT
3. RESPONSE
4. USABILITY
5. INTEGRITY
6. REVENGE

1. STRATEGY
ENDS BEFORE MEANS:

"Who needs to ask questions, we've got all the answers!"

TECHNICAL STRATEGY
MANAGEMENT STRATEGY
CONTROLS STRATEGY
USABILITY STRATEGY

THE (false?) PROMISES OF TECHNOLOGY

"We sell dreams and install nightmares"... BMS supplier

What is it for?

Will it be usable?

Avoid the downsides

Maximise occupant tolerance and forgiveness

THE TECHNOLOGICAL LIFE CYCLE?

1 RESEARCH
2 INVENTION
3 REFINEMENT & PRODUCTION
4 MARKETING
5 WIDE DISTRIBUTION
6 INTEGRATION INTO HUMAN LIFE
7 PEOPLE FINALLY FIGURE OUT WHAT IT DOES

Source: D Burke & J Lotus, GET A LIFE, Bloomsbury (1998)

2. CONTEXT

Appropriate solutions change with context, which may vary with specific type of user and alter with time

CULTURAL+TECHNICAL FLUX
PERCEPTION OF RISK
PHYSICAL CONTEXT
OPERATIONAL CONTEXT
USER CONTEXT

Who might be inconvenienced?

SPATIAL CONTEXTS for USER CONTROL

1 Owned
2 Shared
3 Temporarily owned
4 Occasionally visited
5 Unowned
6 Managed

FROM BRE INFORMATION PAPER 6/96:
PEOPLE AND LIGHTING CONTROLS

3. RESPONSE

Comfort-provision may not be enough:
what happens if people become uncomfortable?

ADAPTIVE OPPORTUNITY
user reacts and intervenes
QUICK SYSTEM RESPONSE
user closes the physical loop
MANAGEMENT RESPONSE
can be a good surrogate

Seek forgiveness: unwanted triggers
and responses may cause outrage.

SEEK SAFE, ECONOMICAL DEFAULT STATES

4. USABILITY

Can the intended user behaviour be achieved in practice?

EASY TO UNDERSTAND
preferably intuitively obvious:if not, can you make it so?

EASY TO USE
otherwise people will take the more convenient route.

AT THE POINT OF NEED
may vary with time & user

WORKS EFFECTIVELY *with sufficient fine control*

IMMEDIATELY CLEAR WHAT HAS HAPPENED.

IMPROVING USABILITY

Get it in the brief
Establish design principles
How do you specify?
Product development
Applications engineering
How do you evaluate proposals?
Preparation for occupancy
Ownership of problems
Post-occupancy feedback

USABILITY REVIEWS and AUDITS

5. INTEGRITY

Strategic integration can help to avoid troublesome interdependencies

CAN THE CONCEPTS BE MADE REAL?

SEEK SAFE TERRITORY + ROBUSTNESS

PROBLEM OWNERSHIP *who, what, where?*

CONFLICT AVOIDANCE

REALITY CHECKS + USABILITY AUDITS

REALITY CHECKS

FIT AND FORGET

- Is the brief realistic?
- Are standards appropriate?
- Does the building minimise loads?
- Are the systems intrinsically efficient?

IMPLEMENT and MANAGE

- Are systems designed to be manageable?
- Are default states economic?
- Is there good feedback?
- What can go wrong

IMPLEMENT and INTERNALISE

- Review the needs of all types of user
- Culture should identify and reinforce desired habits
- Design+provision should make the desired actions intuitively obvious

RISK and FREEDOM

- Is adaptive opportunity high?
- Can people interact with systems in sensible and effective ways?
- Will exceptional circumstances upset the apple cart?
- Will the systems warn you of unintended operation?

Will management be able to cope with the residual requirements?

6. REVENGE

What often happens if things don't go to plan.
Rogue emergent properties!

STRATEGY:
Poor strategies, management over-dependence.
CONTEXT:
Not understood, or systems can't adapt to changes.
RESPONSE:
Slow, unexpected or unwanted.
USABILITY REVIEW:
Designers are not users, but they often think they are!
INTEGRATION: *e.g, Mixed Mode, or mixed up?*
Keep things simple, and do them well. Follow through.

Never let the supply of common sense run low W. MULES

ENERGY: FAILURE MODES

- *Unrealistic expectations.*
- *Poor understanding of users.*
- *Poor user interfaces.*
- *Underestimated parasitic losses.*
- *Antagonistic operation.*
- *Embedded system failure.*
- *Hidden interlocks and overrides.*
- *Default to ON.*
- *Thoughtless safety overprovision*
- *Poor at coping with exceptions, e.g: late working.*
- *Service before economy.*
- *Just in case.....*
- *Management information absent or inappropriate.*
- *Tail-wags-the-dog.*
- *Likely failure paths not reviewed or trapped.*

RISK ESTIMATION CONSIDERATIONS

1. *How do technological systems function as a whole? are there unanticipated interdependencies and failure paths?*

2. *How do human behaviour and errors affect technological systems and safety measures?*

3.*Do we rely too much upon current scientific knowledge ?*

4. *Are chronic, cumulative effects being overlooked?*

UNMANAGEABLE (or unmanaged) COMPLEXITY TENDS TO BE THE BIGGEST UNDERLYING PROBLEM

RECAP:
THE KILLER VARIABLES

1 STRATEGY

2 CONTEXT

3 RESPONSE

4 USABILITY

5 INTEGRITY

6 REVENGE

http://www.usablebuildings.co.uk

WINDOW DESIGN
A CRITICAL INTEGRATOR

MAIN FUNCTIONS: *Ventilation, daylight, view, sun.*

COMFORT REVENGES
Draughts, overheating, radiation, glare, winter air quality, noise, fumes, insects, security, privacy.

TECHNICAL CONFLICTS: *You name it!*

ENERGY REVENGES
Blinds down lights on, heat fighting cool, leakage

USABILITY REVENGES
Wrong context! Too few elements, poor fine control, difficult to reach; blow papers about, long distance effects; default inertia; unsuitable, mindless, coarse-zoned automation.

STOP

MIXED MODE SYSTEMS

Combine mechanical ventilation and cooling systems with openable windows

MAIN DESIGN STRATEGIES:

CONTINGENCY

Readily altered and upgraded.

ZONED

Servicing varies with location and requirement.

COMPLEMENTARY

Natural and mechanical systems are present together.

MM OPERATION: GENERIC CONTROL STRATEGIES

1. CONCURRENT
Systems operate together.

2. CHANGEOVER
Modes regularly switch

3. ALTERNATE
Modes change very occasionally.

PURPOSES OF VENTILATION

SELECT THE MOST APPROPRIATE MIXES

1. Background air quality

MANUAL NV, AUTO NV, MV?

2. Cooling during occupancy

MANUAL NV, AUTO NV, MV?

3. Cooling outside occupancy

MANUAL NV, AUTO NV, MV?

4. Local exhaustion: heat and pollution

WINDOWS, STACKS, LOCAL MV EXTRACT, BALANCED OR CENTRAL SYSTEMS?

5. Carrier medium for mechanical conditioning (cool, heat, filter, RH)

WHAT KIND OF COOLING SYSTEMS BEST SUIT THE NEEDS? HOW SHOULD THEY BE MOST EFFECTIVELY OPERATED?

TYPICAL ENGINEERING APPROACHES

Traditional systems like those in sealed buildings: *CAC Central air-conditioning.*
DAC Distributed air-conditioning.
MV High-volume mech. vent.

Integrated systems:
BV Background ventilation.
BV/MV Ditto, with high speed option.
MNV Mechanical night ventilation.
TC Trickle charged.
WW "Whole works" - elaborate strategies.

Opportunist systems:
Contingency designs with minimum background provision but latent upgrade potential.

WHAT NEEDS ATTENTION?

Avoiding wasteful energy performance.

Minimising downside risk, such as defaults to ON.

Window design and control (for all functions).

Better understanding of management and occupants.

More concentration on operation.

Control and management strategies, to improve simplicity, effectiveness and acceptability.

More effort on design, handover, review and attention to detail. "Sea-trials" and continuous commissioning.

Self-monitoring systems with exception reporting.

OTHER PROBLEMS

Inappropriate or over-complex control strategies (abetted by modelling?).

Critical details overlooked, ignored or "not affordable"
Insufficient understanding of occupants + management.

Over-reliance on automation.

Over-sized, inefficient, over-used, possibly unnecessary services, particularly ventilation.

Wasteful and inefficient operation, sometimes with inappropriate management arrangements.

Lack of guidance and exemplars.

Concentration on providing and optimising, not facilitating and risk-minimising.

A NEW AGENDA?

Briefing: ends not means
strategies not fantasies, understand the context

Robustness & forgiveness
balance upsides and downsides

Design for manageability
to suit available management

Avoid false promises
reality checks, usability audits, standards benchmarks

From features to functions
spec, QA, handover, sea trials

Running it sweetly
high performance, tickover or benign neglect?

Continuous improvement
Commitment, training, monitoring, rapid response. Seize opportunities

Don't outsource your feedback loops!

CONSIDERATIONS FOR NEW DESIGNS

Context definition: *what is the likely situation?*

Discomfort alleviation: *not just comfort provision*

Usability: *at all levels.*

Group dynamics: *who has the control?*

Design for manageability: *reduce failure pathways*

Robust simplicity *or engineered precision?*

Safe territory *or innovation?*

Getting what you wanted: specification, review, sea trials.

STRATEGY CHECK: 1

BRIEFING

BRIEF	*Realistic?*
ASSUMPTIONS	*Explicit?*
BENCHMARKS	*Set? Reviewed?*
STANDARDS	*Appropriate?*

STRATEGY

DEMAND	*Minimised?*
SUPPLY	*Efficient*?
FUELS	*Appropriate?*
USAGE	*Metered?*
CONTROL	*Matched?*
OCCUPANTS	*Understood?*
OPERATION	*Responsive?*
MANAGEMENT	*Minimised?*
USABILITY	*Maximised?*

STRATEGY CHECK: 2

DESIGN

APPROACH	Balanced?
ASSUMPTIONS	*Robust?*
INTEGRATION	*Realistic?*
COMPLICATION	*Minimised?*
INTERFACES	*Detailed?*
CLASHES	*Avoided?*

REALISATION

SPECIFICATION	Appropriate?
OBJECTIVES	Explained?
BENCHMARKS	Explicit?
DETAILS	Appreciated?
QUALITY	Checked?
COMMISSIONING	Undertaken?
STAFFING	Familiar?

STRATEGY CHECK: 3

COSTING *Imaginative?*

INTO USE

ACCEPTANCE	*Tested?*
HANDOVER	*Ownership transfer?*
OPERATION	*Managed?*
MANAGEMENT	*Responsive?*
MAINTENANCE	*Specified?*
PERFORMANCE	*Monitored?*
FEEDBACK	*Sought?*
SEA TRIALS	*Planned?*

Virtuous or vicious circles?

ON COURSE?

Deploy client resource
Manage the brief
Review objectives
Reality checks
Usability audits
Clear explanations
Critical details
Acceptance procedures
Sea trials.

SIMPLE GUIDELINES

PROCESS before PRODUCT
PRODUCT and back to PROCESS
PASSIVE before ACTIVE
SIMPLE before COMPLICATED
BETTER before MORE
80 before 20
ROBUST before FRAGILE
SELF MANAGING before MANAGED
EFFICIENT before ELABORATE
TRICKLE before BOOST
INTELLIGIBLE before INTELLIGENT
USABLE before ALIENATING
FORGIVING before DEMANDING
ASSETS before NUISANCES
RESPONSE before PROVISION
OFF before ON
CELLULAR before OPEN?
EXPERIENCE before HOPE
THOUGHT before ACTION
HORSES before CARTS

"Much energy consumption comes from the compounding of unnecessary loads" A LOVINS