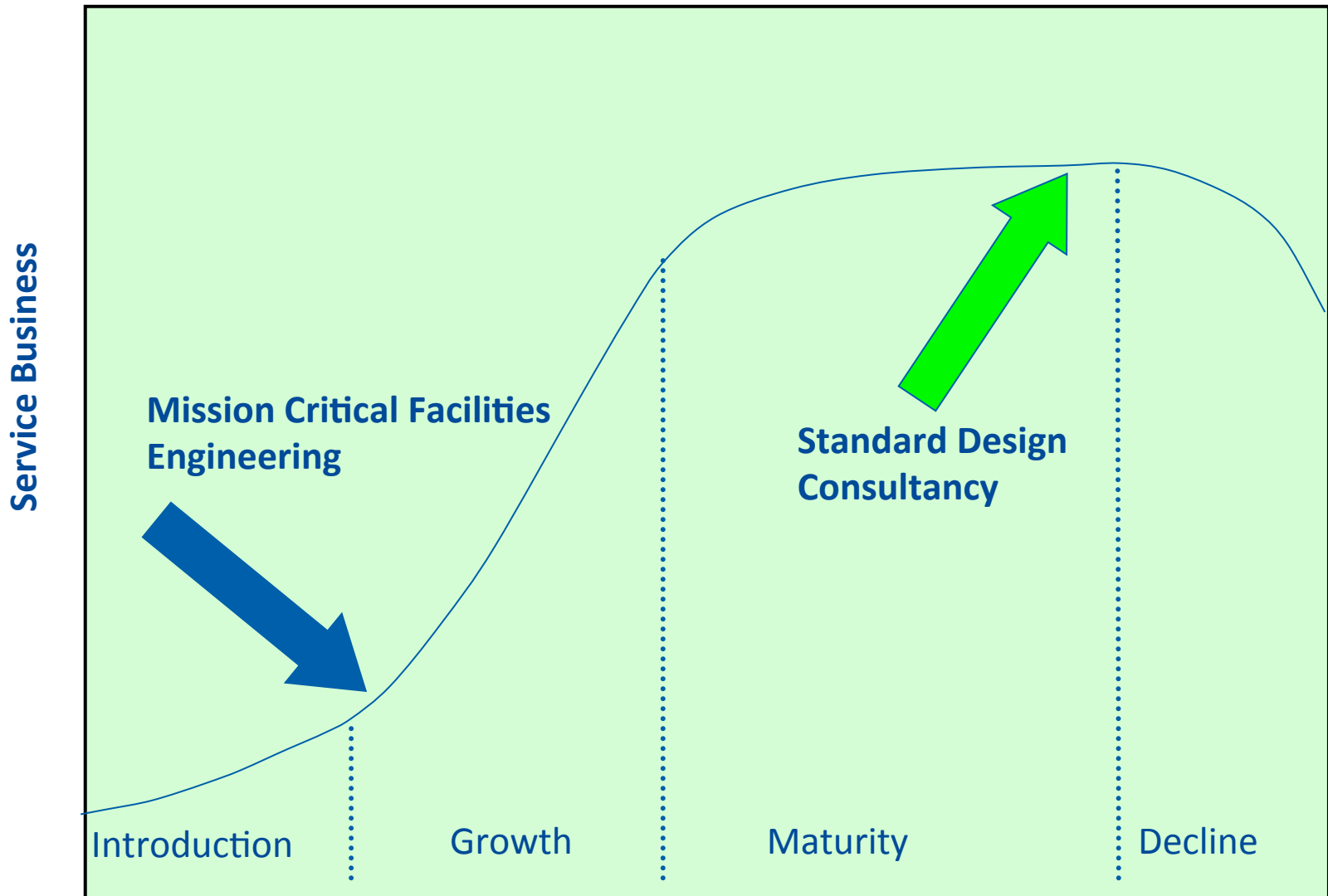


The Human Element in Data Centres

Sophia Flucker

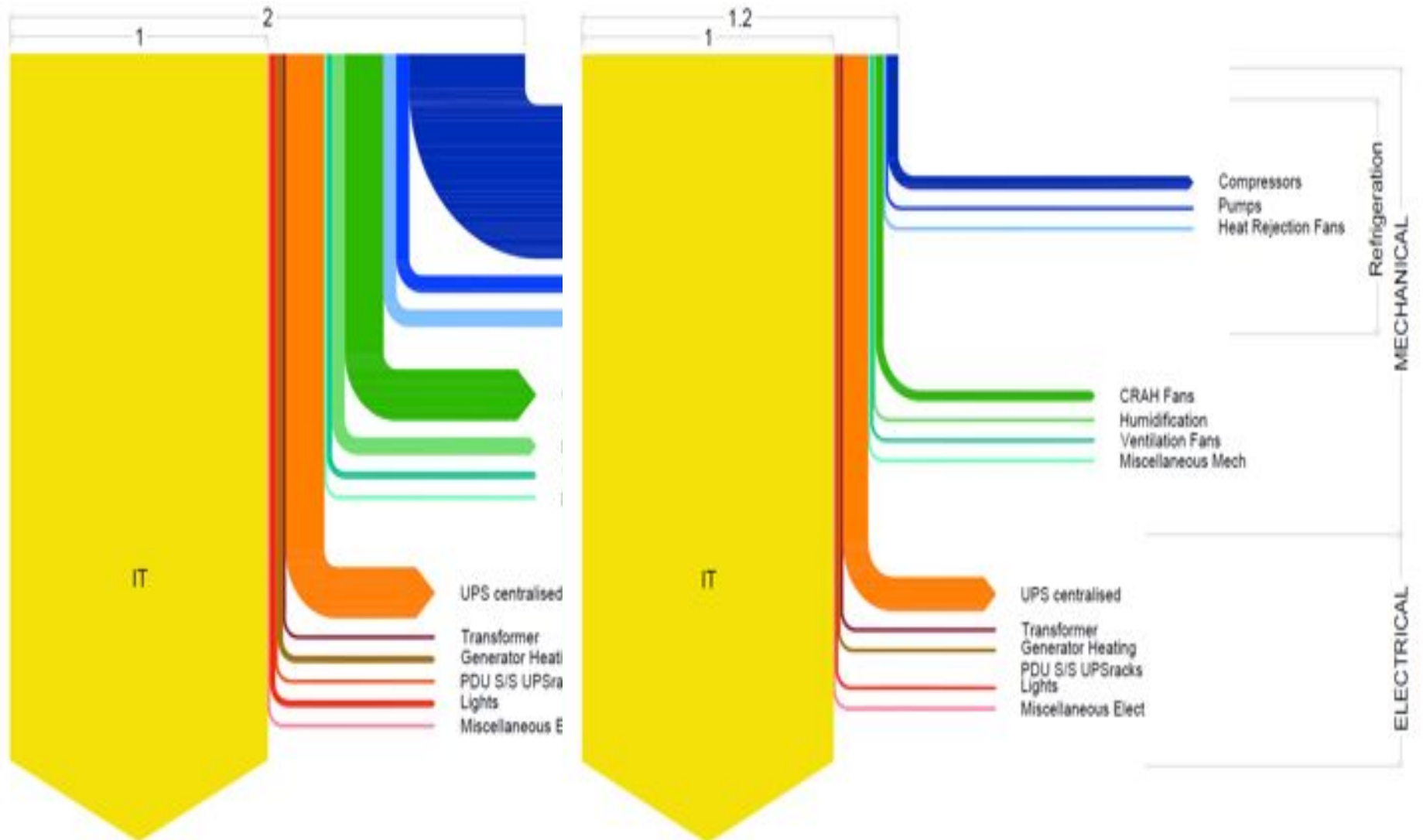
Robert Tozer

Industry maturity



Time

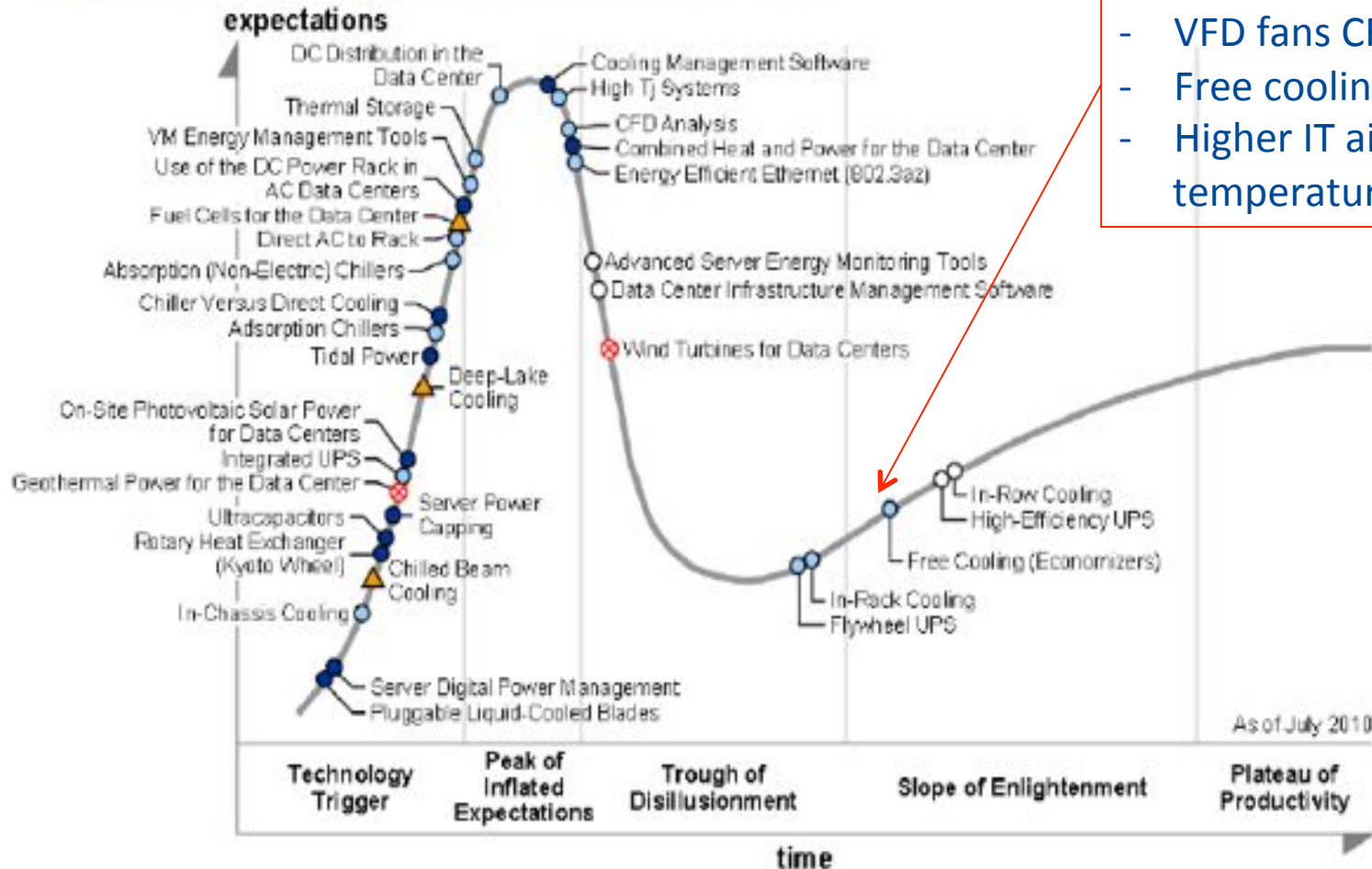
Data centre energy



Hype cycle

Figure 1. Hype Cycle for Data Center Power and Cooling Technologies, 2010

- Air containment
- VFD fans CRAHs
- Free cooling
- Higher IT air inlet temperatures (18-27C)



Years to mainstream adoption:

- less than 2 years
- 2 to 5 years
- 5 to 10 years
- ▲ more than 10 years
- ⊗ obsolete before plateau

Source: Gartner (July 2010)

Human error

- Found to cause 80% of failures in various industries, e.g.
 - Nuclear (Chernobyl)
 - Aeronautical (Concorde)
 - Space (Apollo / Shuttle)
 - Power (US grid 2003)



Duffey & Saull 2008 "Managing Risk: The human element"

- 75% reported in the Data Centre industry

The Uptime Institute

Failures are essential learning events

Apollo 1
O2 + spark
disaster

*"We became **complacent**...and **forgotten the hazards of O2**....**taken too many things for granted**...From now..... **accept responsibility and never stop learning**"*

Gene Kranz, flight director



Investigation:
Deep flaws in procedures
Quality control problems



Apollo 13
Near miss

Apollo 11
Man on Moon



Challenger
Mid air explosion,
O ring froze



*"Sheer
negligence"*

Columbia
Re-entry
disintegration



*"Acceptance of
deviations from
design criteria"*

1967

1969

1970

1986

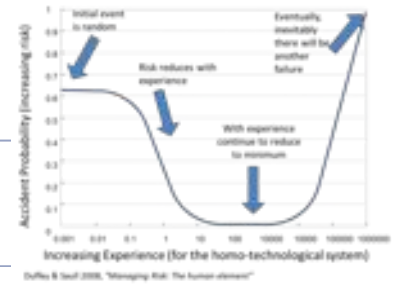
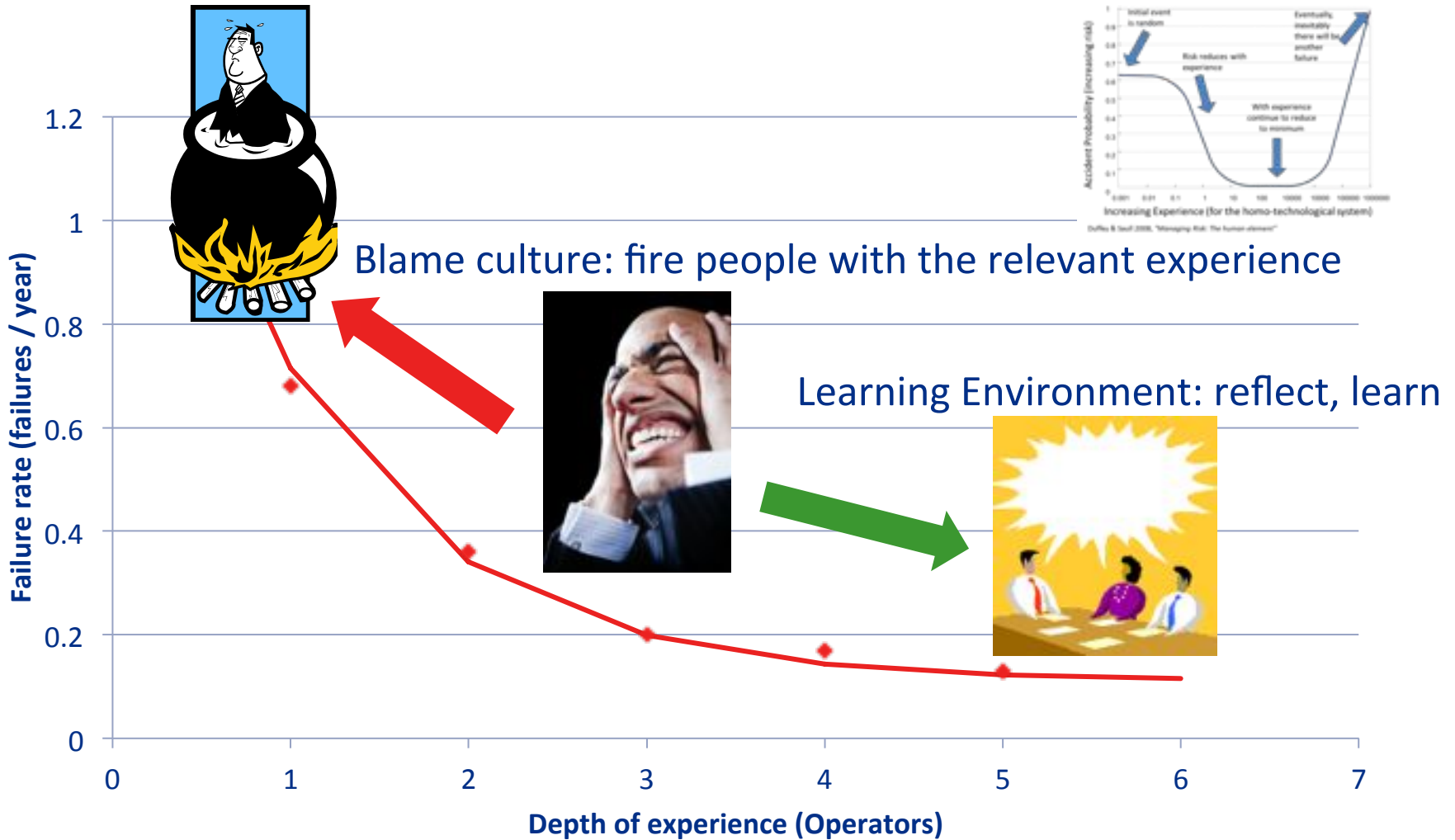
2003

19 years

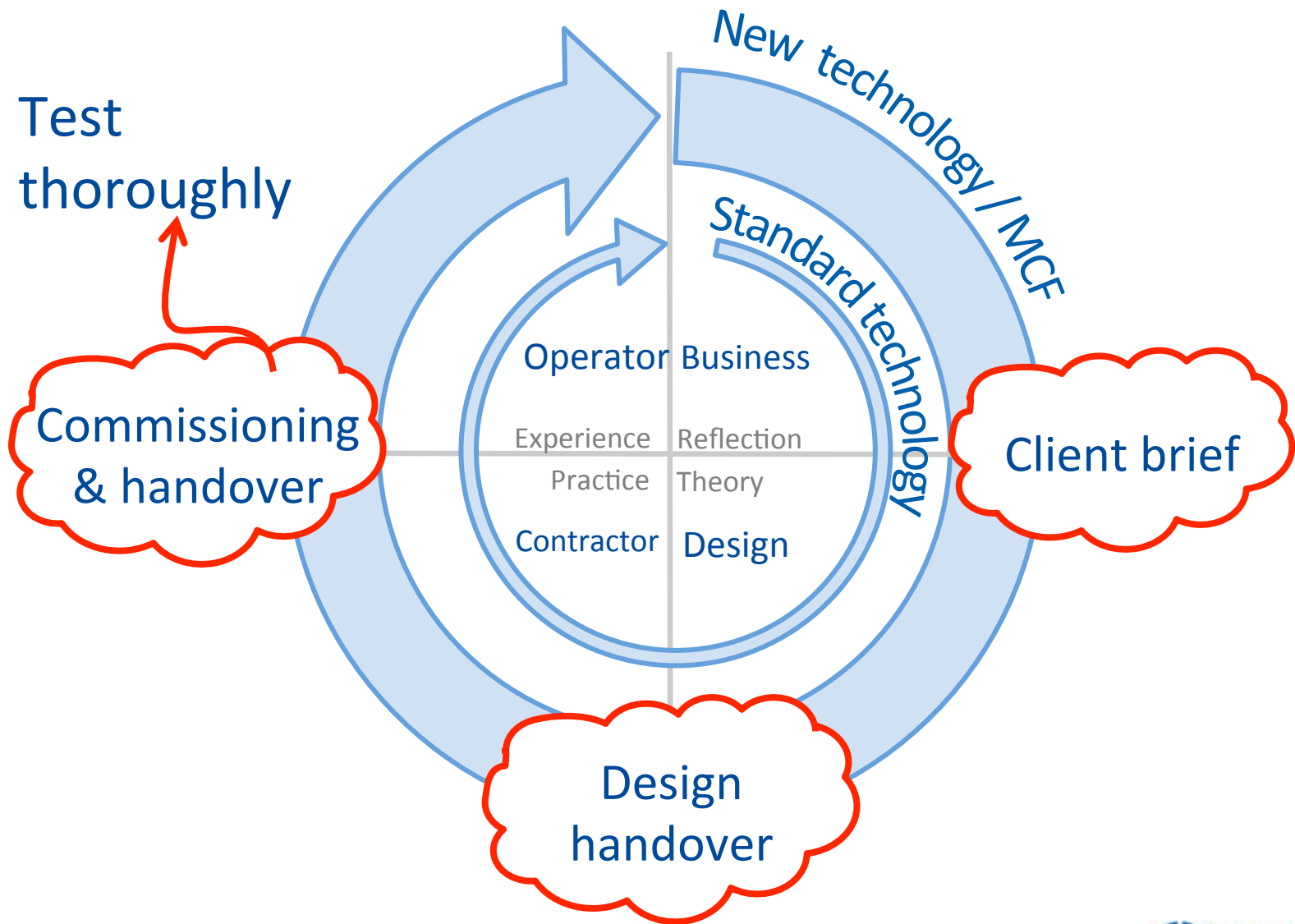
17 years

100,000 to 200,000 hrs = 12-24 yrs, or less?

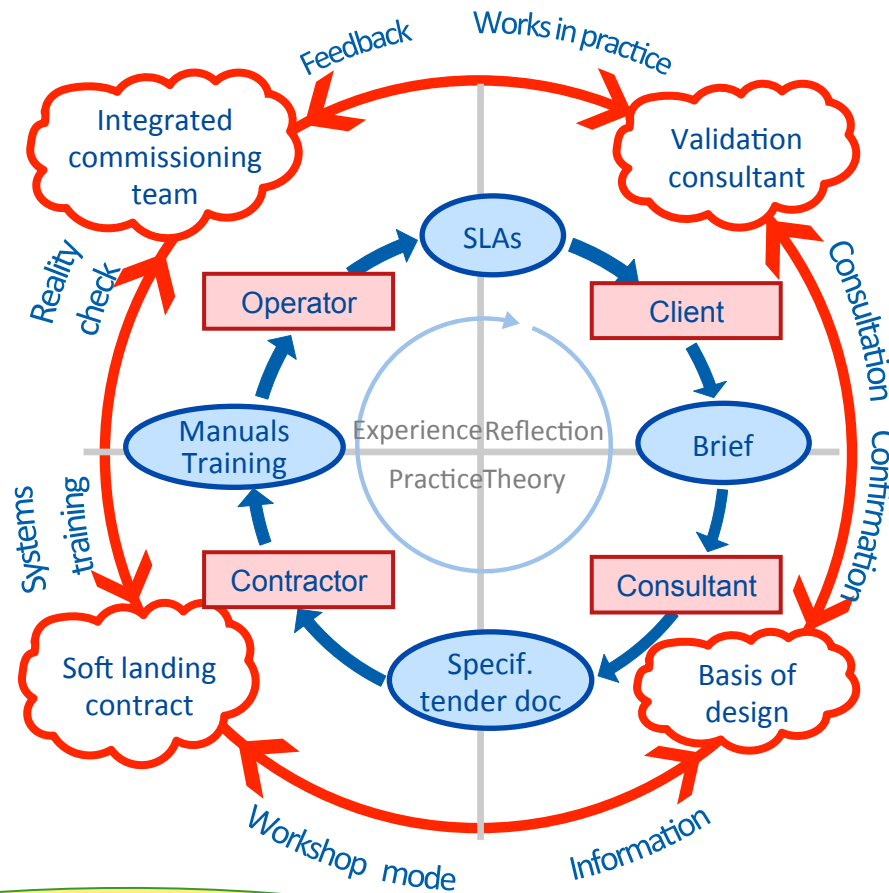
Response to failure



Commissioning / Learning



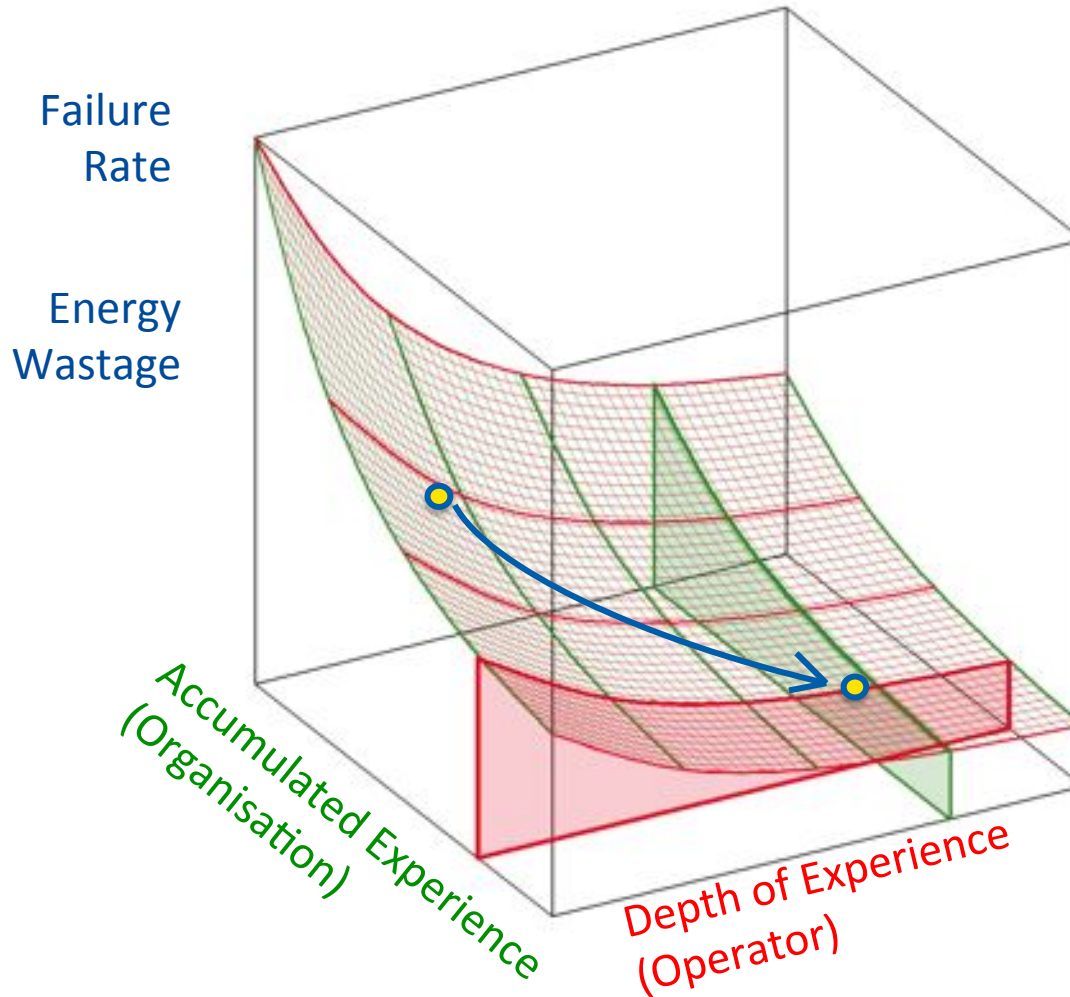
Contracts: the wider picture



What if I train my staff
and they leave?

What if I do not train
them and they stay!

Your learning curve



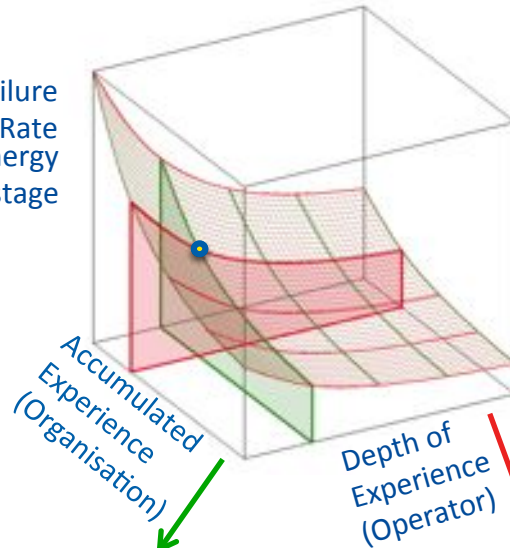
Data centre risk overview

80%

The Human Element

- Most failures are due to human error
- Most energy wastage is due to human unawareness

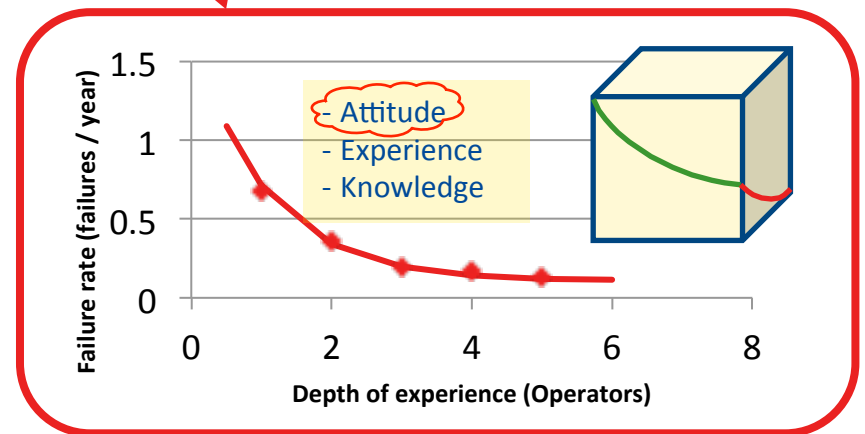
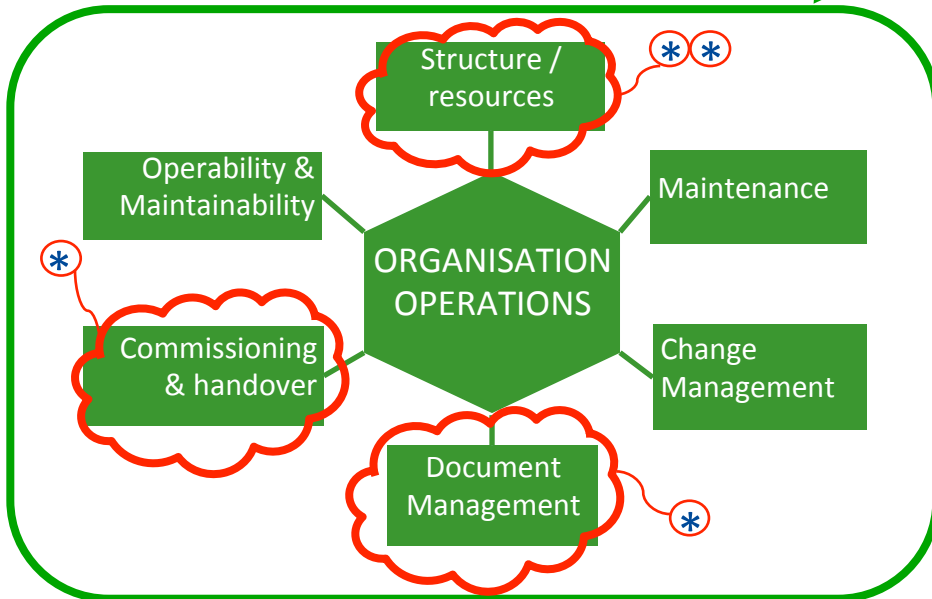
Failure Rate
Energy Wastage



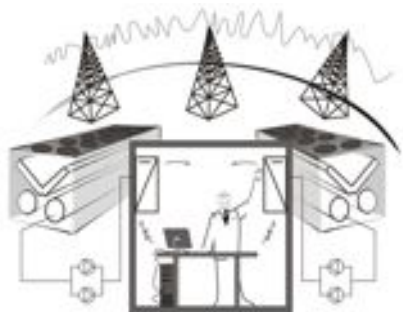
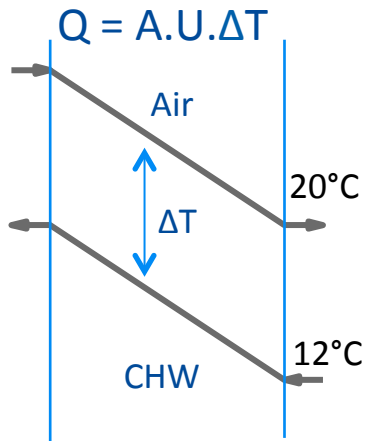
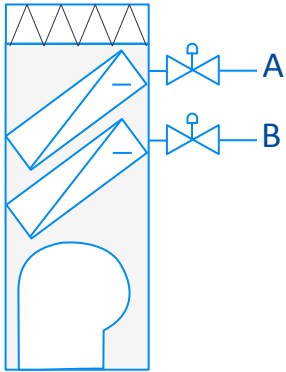
20%

Infrastructure Topology

- Tier level
- Design redundancy
- Single Points of Failure (SPOF)



Reliability & efficiency



Option 1: A or B

$$Q = A \cdot U \cdot \Delta T_1$$

Coil heat exchange area

Heat transfer coefficient

Temp diff between air & water

Option 2: A and B

$$Q = 2 A \cdot U \cdot \Delta T_2$$

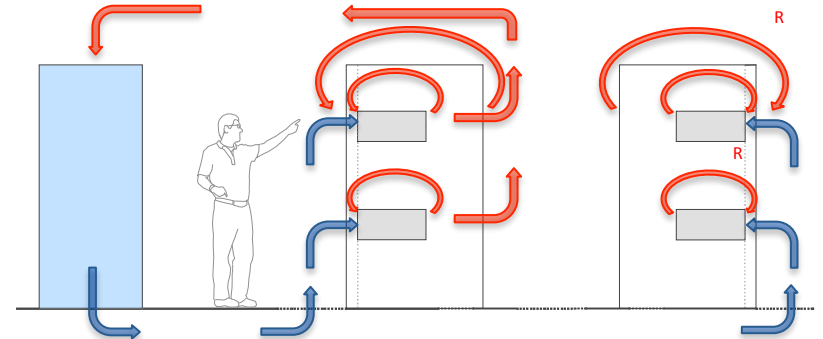
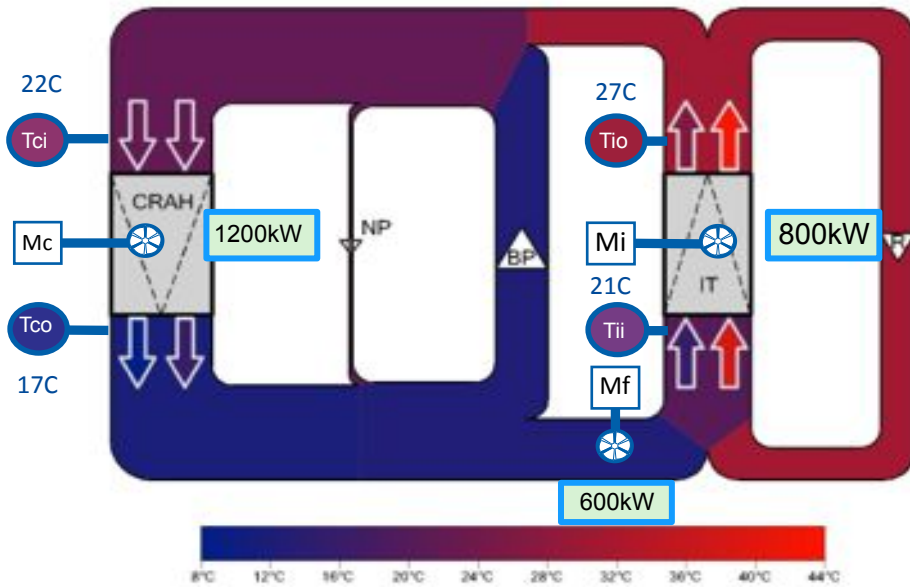
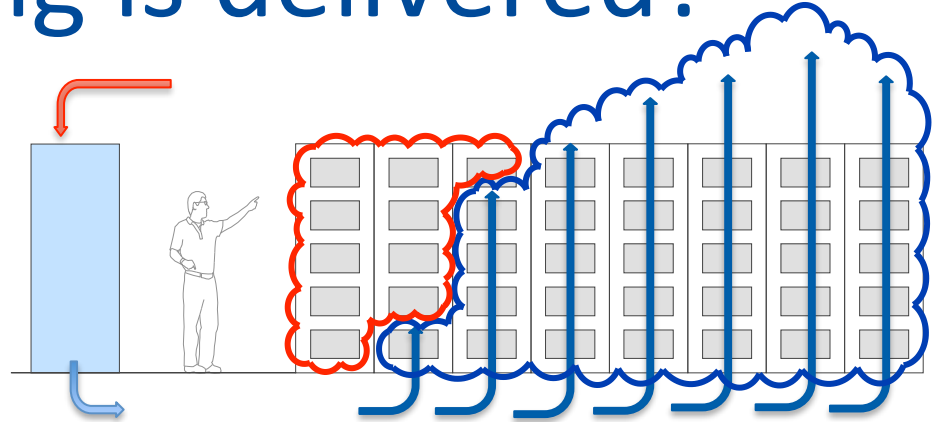
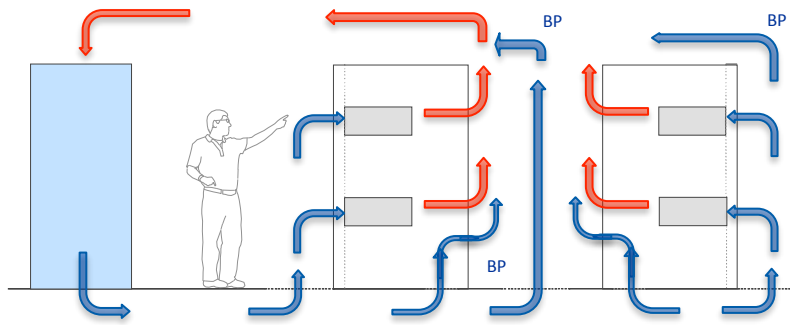
2 coils

$$\Delta T_2 = \Delta T_1 / 2$$

\therefore higher chw temp for same air temp, i.e. 4°C higher

\rightarrow >COP >FREE COOLING

How much cooling is delivered?



Air temperature server inlet

Recommended

Temperature 18-27 C

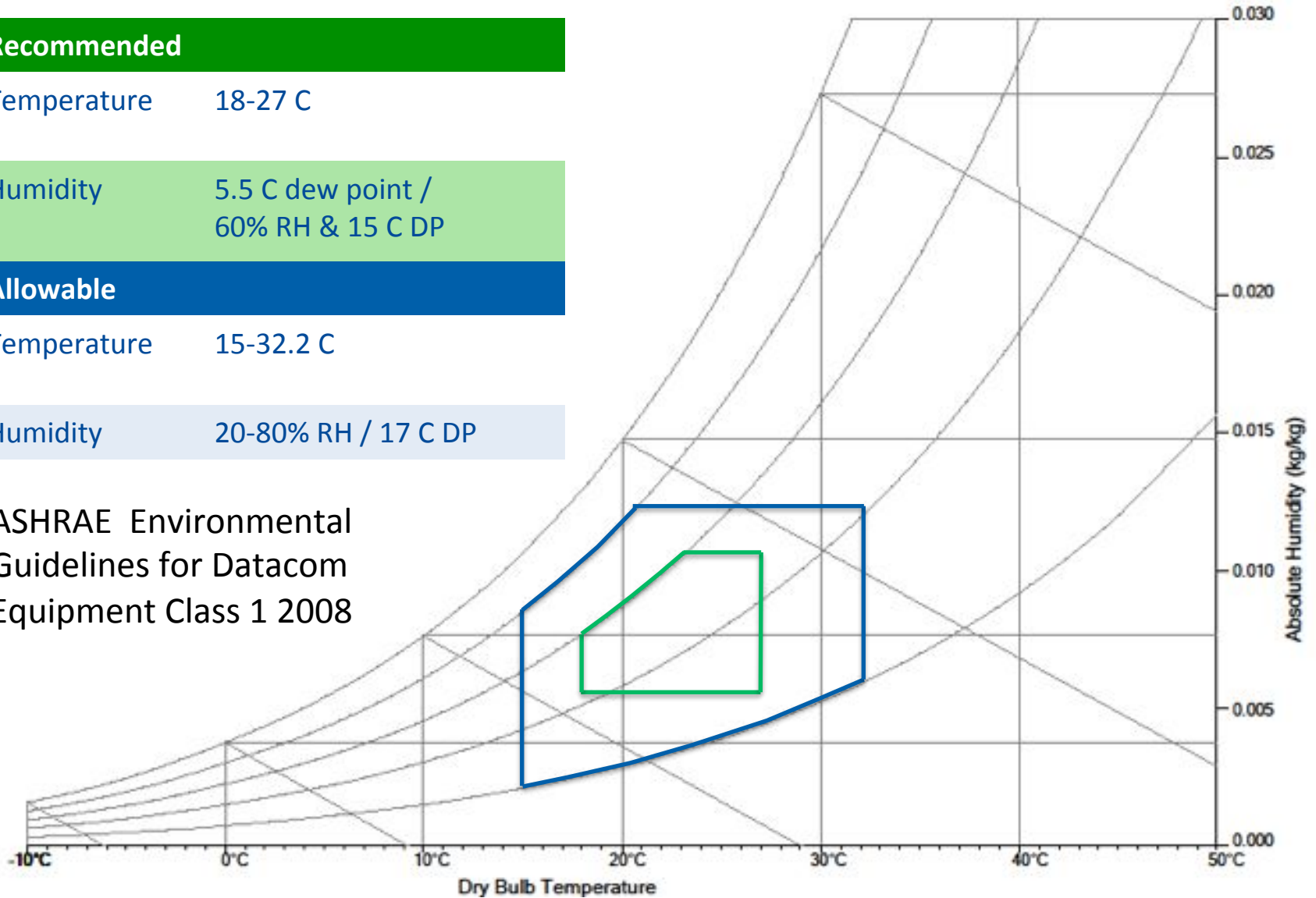
Humidity 5.5 C dew point /
60% RH & 15 C DP

Allowable

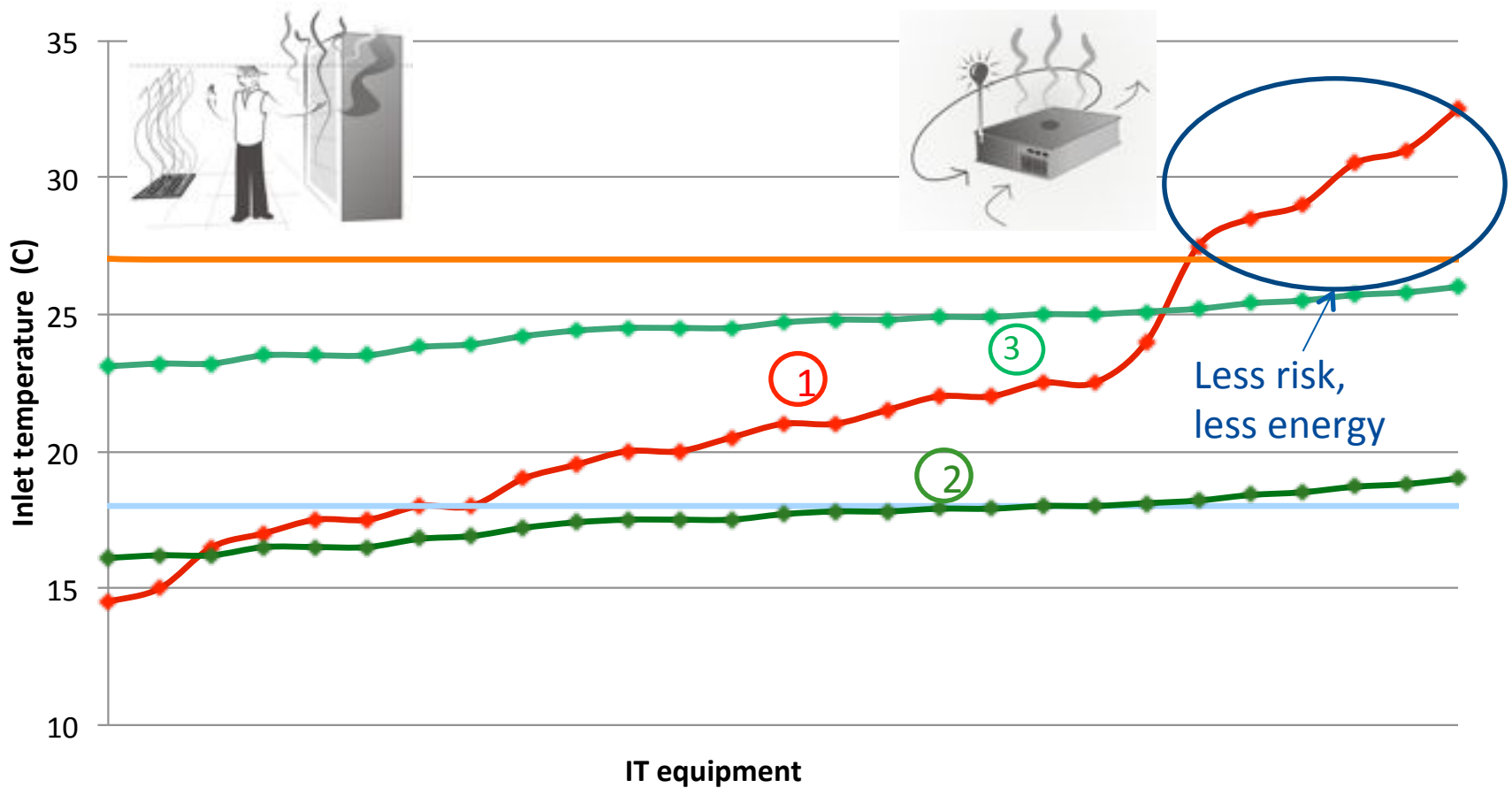
Temperature 15-32.2 C

Humidity 20-80% RH / 17 C DP

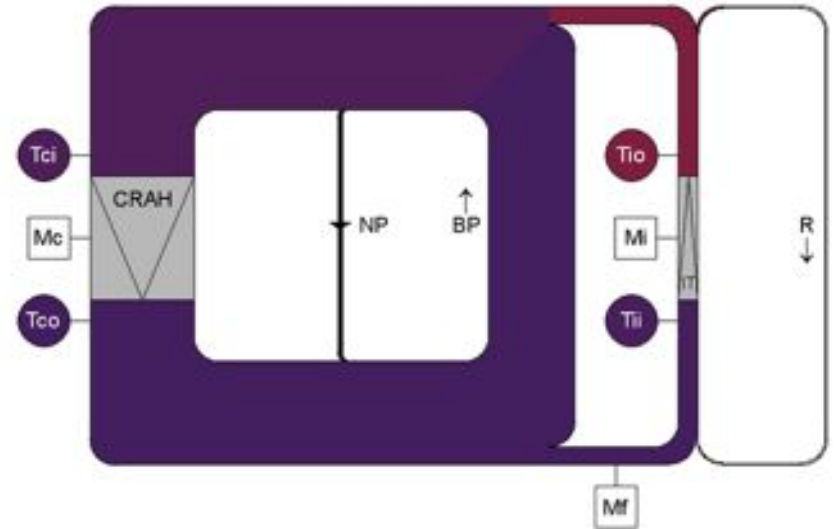
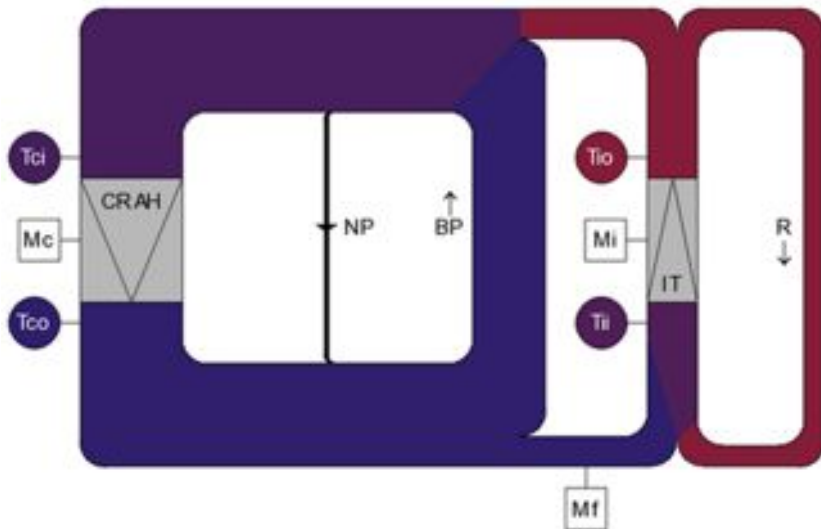
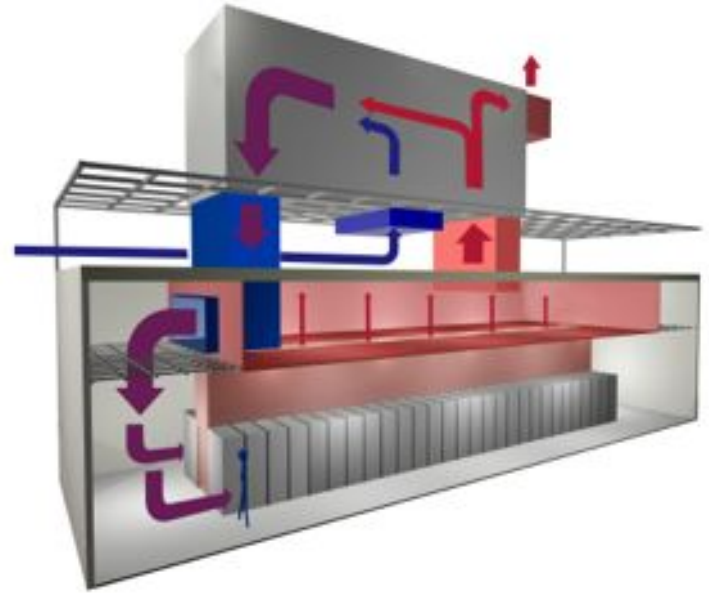
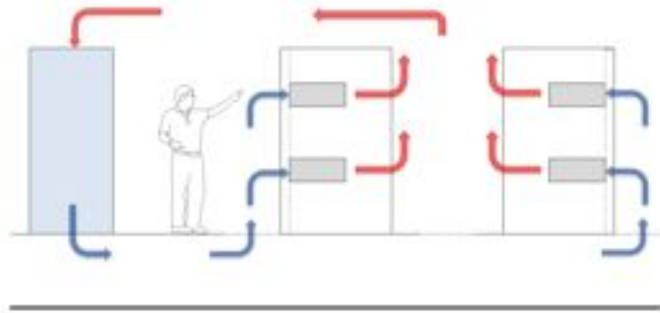
ASHRAE Environmental
Guidelines for Datacom
Equipment Class 1 2008



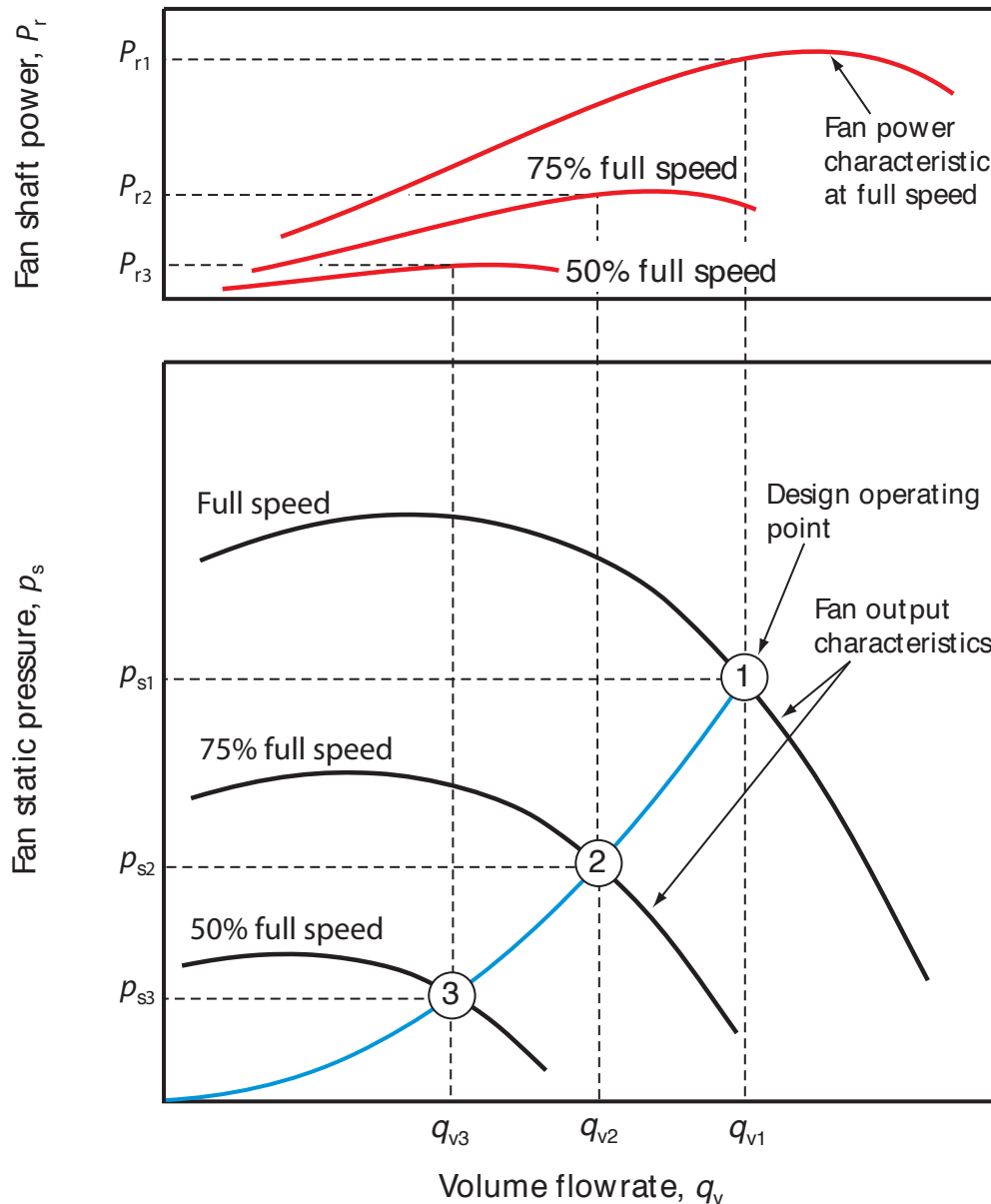
Inlet temperature to IT equipment



Air containment

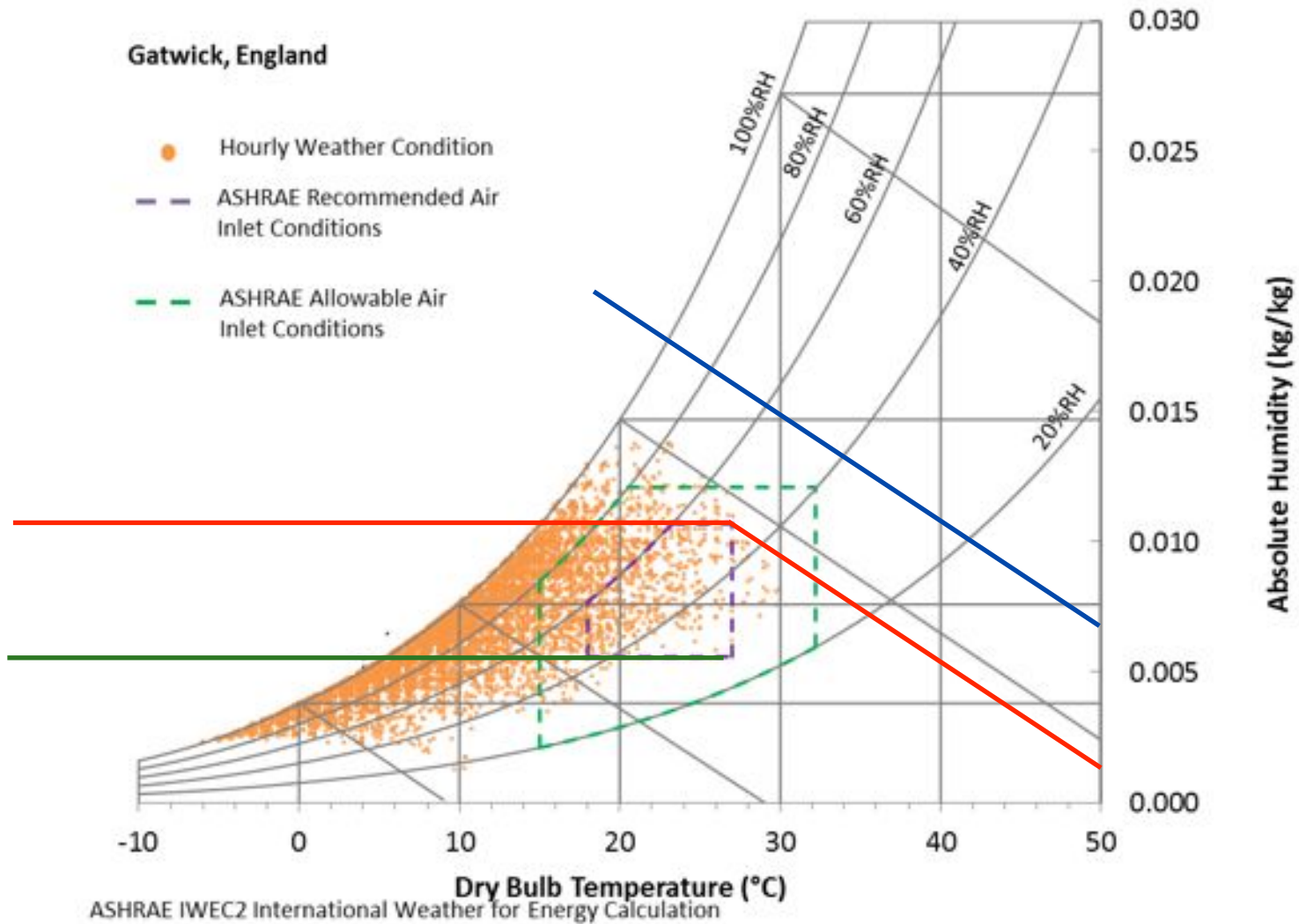


Fan speed, flow rate and power

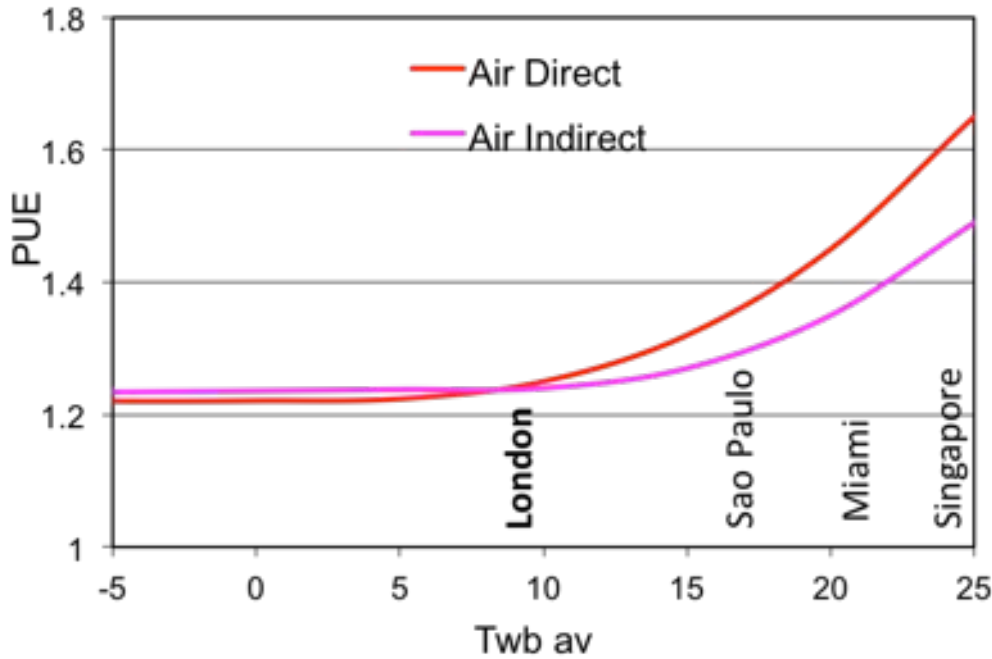


Fan Application Guide
CIBSE TM42: 2006

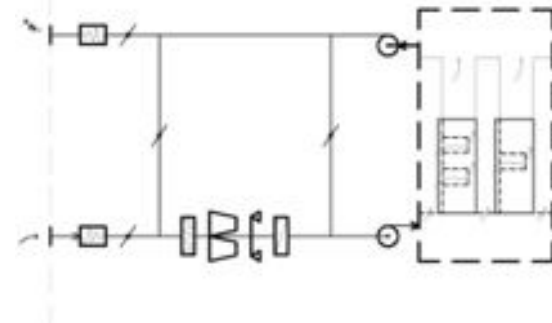
London 27C air supply



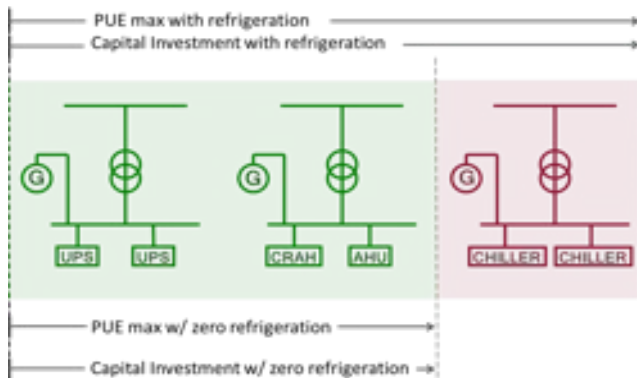
Indirect air free cooling underrated



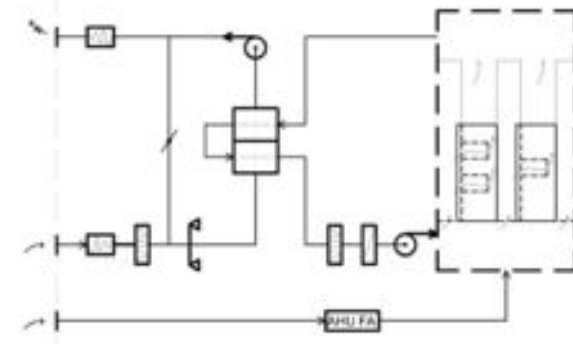
Direct air free cooling



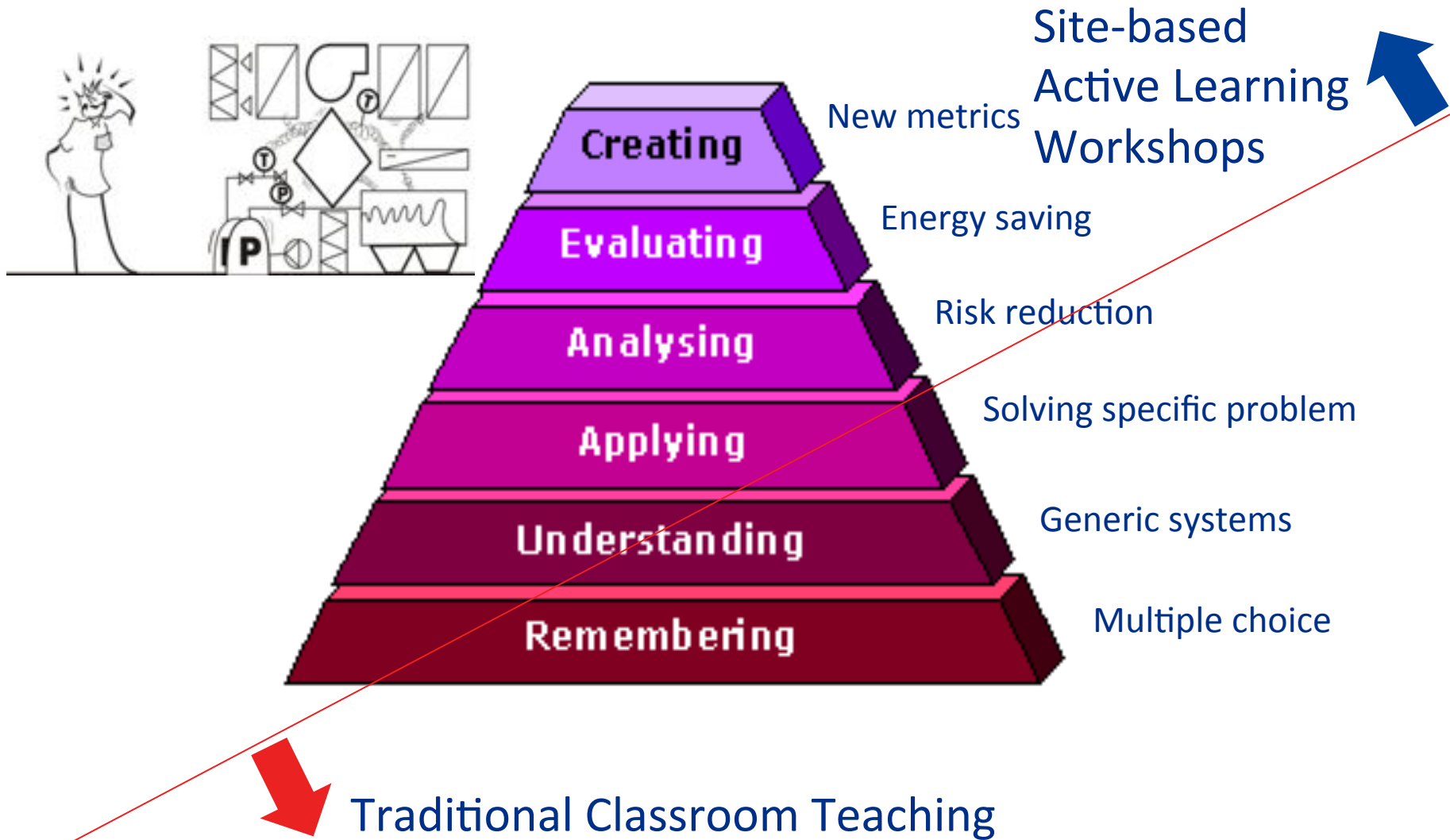
Zero refrigeration potential



Indirect air free cooling



Levels of Learning



Bloom's Taxonomy

Staff motivation

No satisfaction

Satisfaction

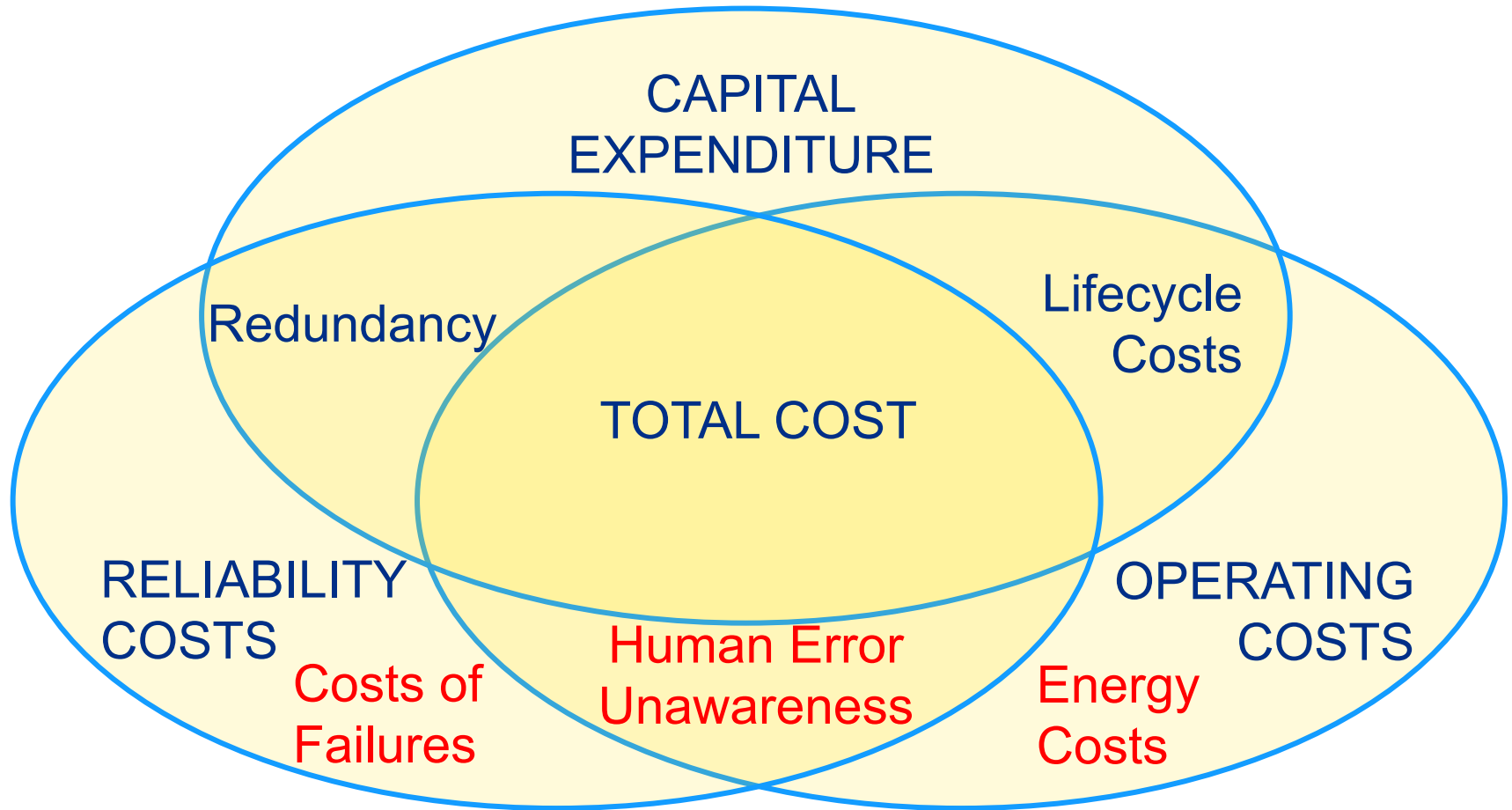
- Achievement
- Recognition
- The work itself
- Responsibility
- Advancement and growth

Dissatisfaction

No dissatisfaction

- Supervision
- Working conditions
- Interpersonal relationships
- Pay and job security
- Company policies

Summary: data centre operators impact on cost



\$1m/year from profit?

14% saving, ROI 3 months

Questions?



Optimising your data centre reliability & energy performance

Our programme has enabled an average energy reduction of **14%** with a ROI of **3 months** as of March 2013

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OI offer consultancy services and training in **RISK and ENERGY ASSESSMENTS** to help clients improve critical facility performance.



Our course is accredited by CIBSE and can contribute towards your CIBSE CPD requirement



News

11-12th April Sophia will be presenting at the CIBSE Symposium in Liverpool. [MORE INFO >>](#)

12th April Robert will be speaking at RAC's data centre question time in London. [MORE INFO >>](#)

25th April Robert will be presenting at DCD Buenos Aires. [MORE INFO >>](#)

Awards



Robert received the "outstanding contribution to industry" award for his extensive service to the data centre industry through publications, education, innovation and active involvement with data centre operations.

[MORE INFO >>](#)

Our Services



Data centre energy and risk have a significant impact on the operating cost. We work with data centre operators to identify opportunities for optimising total cost of ownership.

[MORE INFO >>](#)

Air Performance Tool



NEW! Air performance metrics use temperature data and mass flow balance equations to quantify air bypass and recirculation in the data hall.

[MORE INFO >>](#)

