CSCS
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

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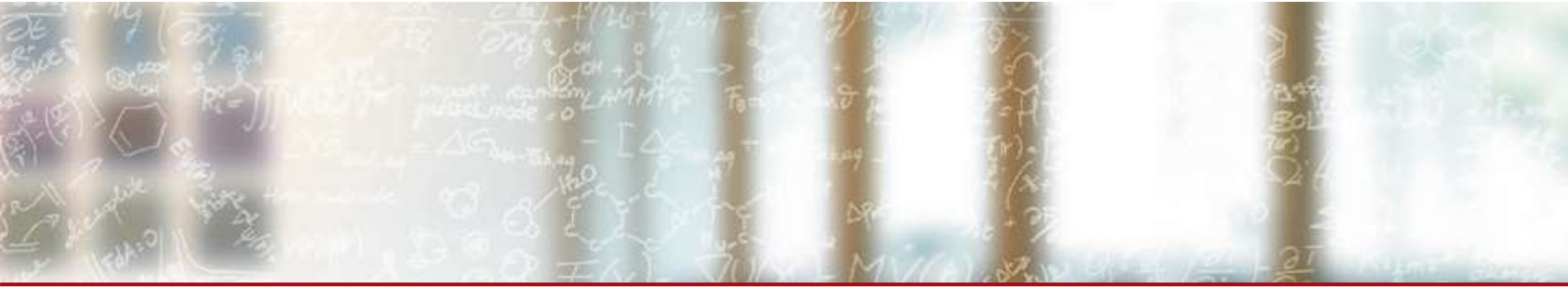

Master thesis: Data centre design standards and best practices for public research HPC centres

Seventh Annual Workshop for the Energy Efficiency HPC Working Group

Ladina Gilly, CSCS

November 13, 2016

Agenda

- Motivation
- Research questions
- Interviewees
- Findings

Motivation and goals

- Motivation stems from personal experience of challenges when planning new CSCS data centre
  - HPC requirements v. design standards
  - Life cycles of buildings and IT
  - Fast changing technology developments
  - Optimising CAPEX and OPEX
- Goals:
  - Provide overview of relevant design standards
  - Examine the drivers that different requirements
  - Provide future managers of HPC data centre construction projects with a useful starting point.

Research questions

- To what extent are existing data centre design standards known and applied within public research HPC data centre?
- Which design issues, common to public research HPC data centres, do the standards not cover?
- How do public research HPC data centres define design criteria where there requirements are not covered by existing standards?
- What approaches to future-proofing do public research HPC data centres apply?
- Is there sufficient similarity in the applied approaches to allow the definition of a standard for the design of public research HPC data centres?

Interviewees

Argonne NATIONAL LABORATORY

NERSC

BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

IT4Innovations national supercomputing center

Lawrence Livermore National Laboratory

Pacific Northwest NATIONAL LABORATORY

cea

Leibniz-Rechenzentrum der Bayerischen Akademie der Wissenschaften

Los Alamos NATIONAL LABORATORY EST. 1943

Sandia National Laboratories

PSNC

INES Centre Informatique National de l'Enseignement Supérieur

SURF SARA

OAK RIDGE National Laboratory

NREL NATIONAL RENEWABLE ENERGY LABORATORY

cnrs dépasser les frontières

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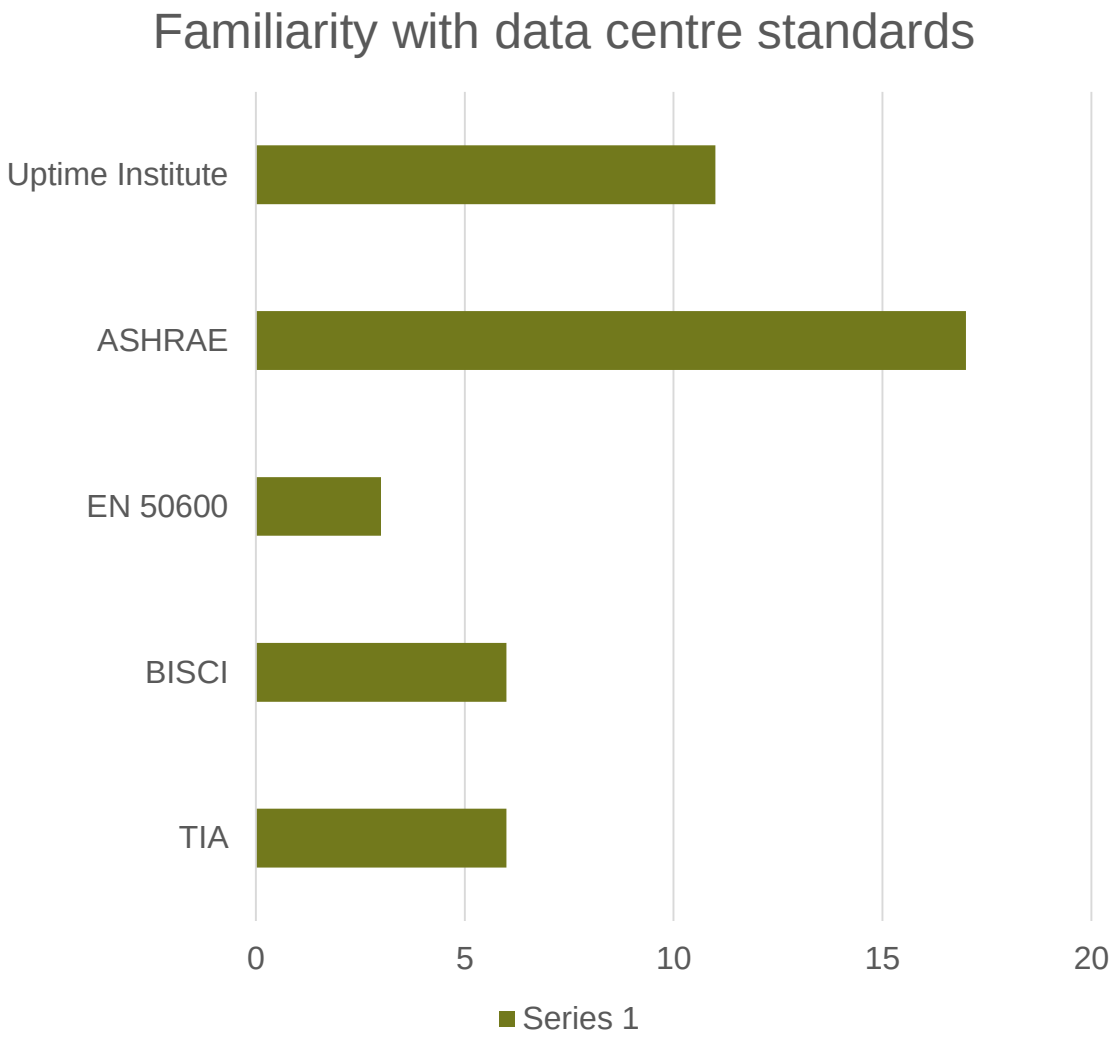
RIKEN

Familiarity with and application of data centre design standards

- Standards surveyed
  - Uptime Institute Data Center Tier Classification and Performance Standard
  - ANSI/TIA-942 Telecommunications Infrastructure Standard for Data Centers
  - ANSI/BICSI 002-2014, Data Center Design & Implementation Best Practices
  - EN 50600 Information Technology – Data centre facilities and infrastructures
  - The American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Datacom Series



Where standards do not cover HPC requirements

Attribute	Data centre industry	Public research HPC sites in sample	
Load per cabinet	1 – 15kW	Min. 20 kW	Max. 100 kW
Raised floor height	Up to 1.1 m	Min. 0.4 m	Max. 6 m
Raised floor rating	Up to 1220 kg/m^2	Min. 980 kg/m^2	Max. 3410 kg/m^2
Equipment on UPS	All	13 sites: critical equipment only 6 sites: all equipment 1 site: no equipment	
Cooling technology	Air	16 sites: liquid 16 sites: hybrid 14 sites: air	
Time to build	Up to 30 months	Min. 24 months	Max. 180 months

- Caparison of HPC site attributes and those observed by the Uptime Institute in the enterprise data centre industry show that these are the areas where the two differ markedly:
  - Load per cabinet
  - Raised floor height
  - Raised floor rating
  - Equipment on UPS
  - Cooling technologies in use
  - Time to build

Criteria not covered by standards and challenging to define– rep. 10

Future-proofing challenges and strategies

- Design infrastructure to accommodate growth
- Building envelope – big vs. modular
- Plan for the future – know your business plan, your assets and your technology
- Diversity of cooling technologies - different technologies and temperatures
- Invest in a raised floor with high specifications

Scope for definition of a design standard for HPC data centres?

Definition of a standard:
British Standards Institution: *"…. An agreed way of doing something.... Standards are distilled wisdom of people with expertise in their subject matter and who know the needs of the organizations they represent ... The point of a standard is to provide a reliable basis for people to share the same expectations about a product or service."*
ISO: *" ... a document that provides requirements, specifications, guidelines or characteristics that can be used to ensure that materials, products, processes and services are fit for their purpose."*

Vs.

Mission of HPC sites:
- accelerate scientific discovery
- tackle issues of societal and scientific importance
- push the boundaries of discovery and engineering
- ensure the competitivity of a nation

Standards are established based on experience.

First of a kind supercomputers
Leading edge technology
HPC sites are frequently the first to gain experience with new systems

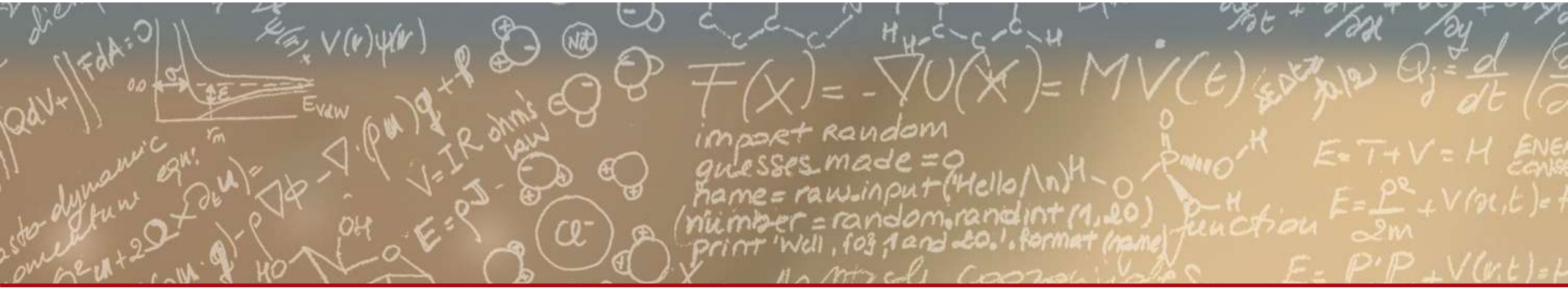
Best practices – key topics

- Management topics
- Tendering processes
- Building envelope
- Raised floor
- Electrical infrastructure
- Cooling
- Fire protection
- Measuring and monitoring
- Once in operation

Conclusion

- Although standards do not cover all requirements of HPC they are nonetheless useful as a starting and reference point.
- Due to the nature of HPC, the definition of a standard is not possible.
- A collection of best practices applied in the peer community can however provide a good knowledge base for the community to work with and exchange and build on. The collection compiled during this work is by no means exhaustive.

Defining the design criteria for an HPC data centre is a complex task that requires a combination of engineering expertise, great curiosity and educated guesses about future IT developments to allow the derivation of a clear design requirement for the A&E partner whilst maintaining maximum flexibility to adapt to future changes.



Thank you for your attention and thanks again to all interviewees for contributing their time, experience and knowledge.

Want to know more? You can download the thesis at the following link: http://www.cscs.ch/publications/technical_reports/index.html

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