CASE STUDY REVIEW

ColdLogik

Cambridge University

West Cambridge Data Centre – 5 Years on

July 2019

UNIVERSITY OF CAMBRIDGE

"The West Cambridge Data Centre project will mark out the University as a clear early-adopter of the latest energy-efficient technology, showing what can be achieved and leading the way for other HE establishments to follow"

Ian Tasker, West Cambridge Data Centre manager

History

Cambridge University's 'West Cambridge' data center was completed in 2014 and officially opened by the University's Chancellor, Lord Sainsbury on Thursday 19 March 2015.

Rather than attempting to refurbish its existing diverse data storage infrastructures, the University and Cambridge Assessment formed a partnership to invest £20M in a bespoke world-class facility to support business operations, teaching, learning, and research communities for years to come.

By adopting a highly efficient 'chilled water' hybrid cooling technology that is unique amongst multi-user data centers within the University sector, the data center is expected to significantly reduce power consumption and deliver to the University a 10% reduction in carbon emissions compared against its 2013 levels.

The University of Cambridge is committed to reducing its environmental impact. Its Carbon Management Plan for 2010-2020 commits to reducing the University's energy-related emissions by 34% by 2020 compared to 2005/06 base levels, so when it came to commissioning the new data center, energy efficiency and carbon reduction was a prime motivator.

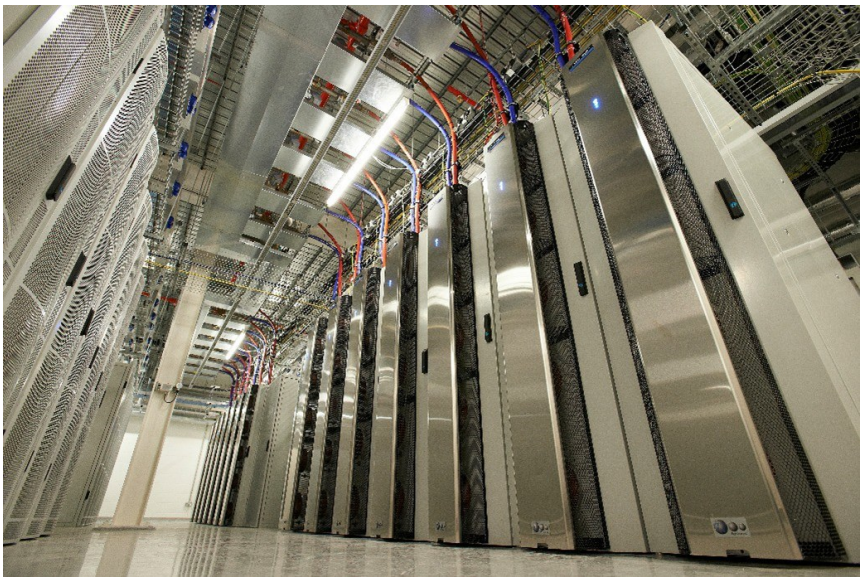
Initially, the West Cambridge Data Centre will serve the current and future needs of UIS and the institutions for whom it manages IT infrastructure, the High Performance Computing Service (HPCS) supporting the University's research activities, and the administrative needs of Cambridge Assessment, that manages the University's three examination boards. Cambridge University Press are also planning to share the Cambridge Assessment Data Hall.

The different activities of these three user groups generate varying amounts of IT load, ranging from low-densities of 3.5kW per cabinet to a high IT density of 30kW+ per cabinet for intensive research-based data processing.

Photo: AFS Holdings

The West Cambridge Data Centre (WCDC) won the Public Service Digital Delivery Award at Data center Dynamics's event for Europe, the Middle East and Africa (DCD EMEA).

The prestigious award is designed to recognize achievement in digital delivery models in Government and the public sector, which in many countries is the largest user of data center services. The winner excels in demonstrating the leadership required to bring together and co-ordinate the disparate groups and stakeholders required to deliver a successful project. According to DCD, "today's finalists will be tomorrow's winners"



[Ian Tasker, the Data Centre Manager, accepted the award on behalf of UIS and the broader University at the event at London's Royal Lancaster Hotel.]

"This is a fantastic achievement for the WCDC and recognizes the innovative approach taken for designing an energy-efficient facility capable of supporting differing workload demands from all parts of the University."
Ian Tasker, West Cambridge Data Centre manager

Determining the right approach

Traditional design approaches would advocate using three separate systems to support the three users' IT load types. After significant analysis, however, a 'one system' approach using the most appropriate new technology emerged as the best design solution.

The early design decision to supply air at the elevated ASHRAE A2 temperature range for all three user types unlocked the potential for creating our highly efficient design. The 'chilled water' solution pushes the industry towards a more flexible, yet still highly efficient system, delivering '100% free' cooling. This would not have been possible without the University's coming to trust that the benefits of using this novel 'chilled water' system would far outweigh the risks – a decision many data center clients would have shied away from.

Many approaches to cooling were explored, including all-air indirect evaporative systems. Power Utilization Effectiveness (PUE) and costing exercises were undertaken to assist with the tough decision-making. To meet the University's aspirations, however, it became obvious that the right solution for our data center would need to go beyond the capabilities of all-air evaporative cooling.

In preference, a 'chilled water' system was developed to deliver the same benefits of evaporative cooling, but without the use of chillers. This has allowed us to support both the low IT densities, which use hot-aisle containment and CRAH cooling, and the high IT density, which relies on rear-door cooling.

To support the high-density cabinets for High Performance Computing, a back-of-rack cooling solution was adopted following the success of the system in a trial environment. Working with local supplier, ColdLogik, the University has been able to experiment and determine the optimum system settings to deliver the highest efficiency levels.

The System

The center has two independently routed Point of Presence rooms providing the incoming communications to the University. All the data cabinets, CRAHs, back-of-rack coolers, and electrical equipment in the building have dual power feeds.

Main power is supplied via dual 11,000KV feeds from UK Power Networks (UKPN) via separate substations, and a single 3,150Kva transformer. The center has a 2,200Kva initial capacity from our provider, which can rise to 3,000Kva when this becomes available from UKPN. Backup power is guaranteed by three 1,100Kva generator sets configured to N+1 (only two of which are required to supply sufficient backup power), with enough fuel to run for 72 hours.

The three Hybrid Dry cooling towers are also designed for N+1 resilience, and only two of the three are required for normal operation. Three 1,000Kva modular UPSs – also configured to N+1 – each comprising five 200Kva modules with intelligent controls, deliver 98% power efficiency. Two UPS output panels deliver separate A and B feeds to each cabinet via an overhead track busbar system, chosen for its flexibility. Power distribution is controlled and metered by intelligent cabinet power strips.

The System, cont.

The new two storey 2,200m2 steel & block facility houses four data halls designed for the different IT density requirements of its key stakeholders. The design allowed for 180 racks across three halls: Hall 1 accommodates the HPCS's high density IT load of up to 900KW; Hall 2 provides 201KW for Cambridge Assessment's needs, and Hall 3, 240KW for UIS' servers.

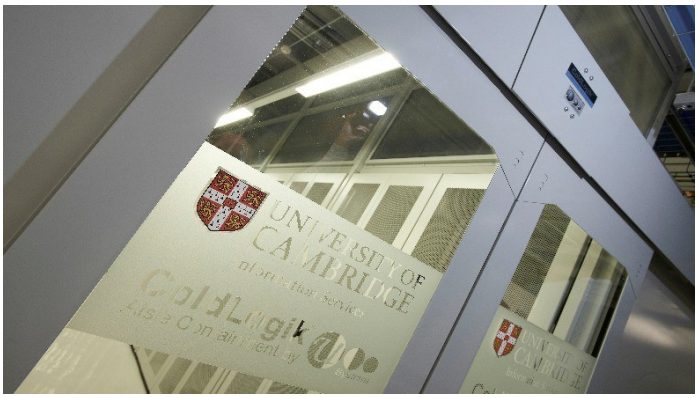
Hall 4 remains deliberately empty and has not been fully fitted out. This forward-thinking decision allows us to install another 40-50 racks as future demand increases, leaving us with the maximum flexibility to incorporate the latest technologies as they emerge. The purpose- built unit has a dedicated build room, an operations room, security office and meeting room space.

Power usage effectiveness (PUE) is a measure of the ratio of power used by the data center to the power consumed by the actual IT equipment; a perfect PUE would be 1. In January 2013, the European average was still more than 2.5. Once fully operational, the West Cambridge Data Centre aims to deliver an overall PUE of 1.2, which is not far off that of large global players like Google (1.11 average for Q2 2014) and Facebook (1.06 and 1.08 averages for its two data centers, May 2013) who have made significant investments in their green data centers.

Operational Lessons—5 years on

The chilled water (warm really) cooling system was originally commissioned at 18°C supply water (design) but this was quickly raised to 21°C as the building cooling performance showed the design specifications to be 'over' cautious. This did cause some function issues with the AHU in the low-density halls, but this was quickly overcome.

It has also been observed that with three 600kW (N+1) Hybrid coolers (building IT duty 1.2MW) and running all three during high ambient/wet bulb conditions, the 5°C (9°F) quoted approach temperature (water supply temperature above wet bulb) can be reduced to around 2°C (3.6°F) – three hybrids running at 68% duty – thus delivering under 25°C water supply in UK with 34°C ambient and 23°C wet bulb.



Over the past 5 years the IT load within the building has steadily increased until its now nearing max capacity. Over these years the PUE for the DC has steadily improved as the IT load has increased: -

Early years, 30-40% IT load = PUE 1.3-1.35

Growing 50-65% IT load = PUE 1.2-1.25

More recent 70-90% IT load = PUE 1.14-1.17

The main data hall (HPC DC) which was laid out assuming perimeter CRAC units, contained 60 racks plus expansion space for 12 additions. That hall will now accommodate 120 racks with 109 installed to date.

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MIDDLE EAST

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