JISC Final Report

Title Page

Low-carbon ICT project
Final Report,
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- All the presenters and people that helped with the two events: http://projects.oucs.ox.ac.uk/lowcarbonict/conferences/

Executive Summary

Please see: http://www.oucs.ox.ac.uk/greenit/index.xml.ID=desktop

Background

The idea for this project was submitted to JISC in 2007. JISC advised us that there would be a call for proposals in the area of ‘green’ computing which turned out to be the institutional exemplars programme, funded under the ‘institutional concern’ strand.

The original aim of the project was to help the centre for the environment act on its own research that shows how important it is to address the energy efficiency within computing. The original focus was on reducing greenhouse gas emissions, but over the last 18 months energy security and cost reduction have also become important business drivers.

Aims and Objectives

Objective at start of project	Outcome
Host two open invite conferences aimed at HE, FE and business communities	http://projects.oucs.ox.ac.uk/lowcarbonict/conferences/
Develop, test and roll out a production-grade wake on LAN service that can be used across the devolved infrastructure of the colleges and departments that form the University of Oxford University	http://www.oucs.ox.ac.uk/greenit/wol.xml
Develop a communications strategy	The communications strategy is based on supporting colleges and departments in continuously improving 'case studies' that describe their approach to low-carbon ICT: http://www.oucs.ox.ac.uk/greenit/desktop.xml
Develop training and classroom materials	The project team decided this approach was not appropriate and focus should be made to providing online support. At Oxford this includes a dedicated email address that feed into a support queues managed by several staff. Also the support documentation is continuously updated including a FAQ section. At Oxford we also provide hands on support to any IT officer than wants to install the gateway software.
Fully documented open source project	This project task is not complete yet because we're still finishing off the code for the monitoring service. We will approach the JISC Open Source Advisory service (OSSW) to get advice on how to distribute the code, and the best OS license to use. We expect to finish this by the end of September 2009. We have most of the documentation completed here: http://www.oucs.ox.ac.uk/wol/index.xml.ID=body.1_div.6
Monitor and report on the roll out of virtualisation at Oxford	We felt that the area of the benefits of virtualisation is amply covered by many other studies. For instance we are very much looking forward to the outcome of the BCS simulation tool: http://www.bcs.org/server.php?show=ConWebDoc.20535. We also commissioned support from the BCS which lead to re-design of a data centre that is being built in Oxford: http://www.oucs.ox.ac.uk/wol/oxford-central-machine-room-design.xml . The effort we planned here was instead put into the monitoring service which has been very helpful in supporting uptake.

Methodology

The general approach to developing the wake on LAN and monitoring service was to use the ideas from Agile Programming. In practice this meant working with a representative sample of early adopters (a museum, a college and three large departments) right from the start. We released new code frequently so that the early adopters could test the service and give their feedback. We had a strict rule that requirements for development never came from the project team, every requirement had to come from an early adopter. This ensured that we only spent time developing functionality that was requested by the 'customer'. For instance the following developments were requested:

1. Automatic scheduling to switch computers on each morning
2. Ability for multiple users to be able to switch a single computer on
3. Service to monitor how many computers were switched on throughout the day and keep records for a year.

(All feedback was logged in the project issue log: http://code.google.com/p/lowcarbonict/)

The last requirement for a monitoring service was a major change to the project plan. After talks with researchers at the Centre for the Environment we decided this change would be beneficial because it will add to the energy reporting already being undertaken. Importantly it was reporting that would apply specifically to desktop computing initiatives across the University. (1/2 hourly electricity meter readings report energy usage across many systems e.g. servers, lighting, printers etc.)

In terms of interoperability again we had to take an Agile and pragmatic approach to deliver the service. The integration points were developed according to the skills of the various developers involved, technical considerations relating to the systems that were communicating e.g. code they are written in, and finally the standards required to meet security guidelines e.g. signed certificates.

Implementation

We planned the implementation to get a system up and working as soon as possible. The reason being we wanted to get feedback from early-adopters right from the beginning. Once people were able to visualise the system we were creating they were better able to think how it would be used in their specific context. Early adopters were also valuable testers, where every comment was posted in the project issue log (http://code.google.com/p/lowcarbonict/).

The project had a number of resource dependencies mostly on the technical integration points e.g. with the University 'registration' web service that uses single sign-on (WebAuth) and the HFS Backup Service. The project got good support from these teams, both at the management and personal level with many staff putting in their own time to make things happen to schedule. Traditionally this is the most problematic area where project plans compete with the day to day commitments of people otherwise running production services. One reason this project may have got good levels of support is the high level of good will towards 'green' initiatives.

Outputs and Results

1. The project has developed a production-level wake on LAN (WOL) service that works within the institutional single sign-on system (WebAuth and LDAP). This service is fully documented, has been tested thoroughly by several departments, has an 'service level description' (http://www.oucs.ox.ac.uk/internal/sld/wol.xml) and ongoing support that has been communicated across all relevant teams within the computing service. The WOL service is also used by the institutional TSM HFS Backup service to switch computers on just before access is required. We also plan to develop integration between WOL and the Condor GRID computing service. The project outcomes are about to be pitched to the most senior committee in the University to help promote broader uptake.
2. The project has developed a prototype monitoring service (http://www.oucs.ox.ac.uk/greenit/wol.xml) that helps individuals see that their efforts are being reciprocated by others in their group.
3. Case studies (http://www.oucs.ox.ac.uk/greenit/casestudies.xml) that describe how each department and college implements methods to reduce costs and greenhouse gas emissions associated with desktop computers.
4. Two open invite conferences (http://projects.oucs.ox.ac.uk/lowcarbonict/conferences/index.htm). Audio recordings and PowerPoint slides are openly available.

Outcomes

We feel the project along with efforts in other Universities (e.g. Liverpool) can serve as exemplars and help others in the sector implement techniques to reduce IT-related energy consumption.

The project has helped to:

1. Explain to senior management what can be done to improve the way desktop computers are managed when considering the full life-cycle e.g. in-use and embodied energy costs
2. Highlight the options available to IT professional to reduce in-use electricity consumption e.g. improve desktop power management using wake on LAN and monitoring tools.

3. Show the importance that IT and Estates departments work closely on energy efficiency initiatives, and how to do this e.g. IT can provide tools that help Estates meet greenhouse gas emission and cost targets.
4. Show simple ways to estimate costs and greenhouse gas emissions and draw up policies based on these calculations
5. Show the importance of real time monitoring of performance against objectives for motivating people to 'do their little bit'

Conclusions

The project team has delivered an institutional wake on LAN service that can be used across the devolved infrastructure of the University of Oxford. By doing so we have demonstrated that the service can be deployed within any organisation. We also feel there is a case for the service to be offered more widely by drawing on the federated single sign-on initiatives e.g. using Shibboleth to provide authentication to a service that is hosted once for all UK organisations.

The project has found the real-time monitoring of power management is very important for motivating individuals to 'do their little bit', primarily because they can see their effort is being reciprocated by others in their group.

While it is essential to reduce in-use electricity consumption research shows that organisations can make significant contributions to the global effort to reduce greenhouse gas emissions by addressing procurement cycles. While Energy Star provide excellent guidelines on how to buy computers that have been manufactured in more sustainable manner and run more efficiently, increasing the useful lifecycle of a computer will normally be the best approach to make a real difference. This can be achieved by promoting greater sharing of equipment, only replacing equipment that is broken or not fit for purpose, offering equipment for re-use.

Improving desktop power management should be seen as an initiative to be undertaken by all organisations, and the sooner the better since the cumulative reduction in costs and greenhouse gas emissions will be increased. For organisations that have not already addressed this issue, 2009 is a good year to start because such a large body of experience and tools are now available.

The economic depression has reduced the cost of energy temporarily. When the economy picks up again, and existing power stations are decommissioned energy prices are likely to rise sharply, making green IT projects even more relevant. See this article for more information: http://www.economist.com/world/britain/displaystory.cfm?STORY_ID=14177328

Implications

The main implication of this work (and efforts taken by others in the field) is there is now a wealth of experience and tools to help most groups ensure that computers are switched reliably and safely to a low-power state when not in use.

If this broad objective were taken up by the FE and HE sector as a whole the contribution to public finances and the national greenhouse gas emission reduction commitments would be significant (http://www.oucs.ox.ac.uk/wol/index.xml.ID=body.1_div.3).

Aside from the direct savings we argue that focusing on desktop computers is the ideal project for 2009 since the effort involved is relatively small (compared to efficiencies in the data centre for example) and since desktop computers are so ubiquitous then they are a good tangible way to raise awareness of energy efficiency in general.

Recommendations (optional)

1. Desktop computing power management should be flagged as a priority to senior management committees across the FE and HE sector. The basic commitment would be for all organisations to publish how their computers are currently managed and to report regularly on IT-related energy consumption

2. More work needs to be done to make it easier for non-specialist to understand how their individual effort is contributing to a more sustainable planet. For instance there is considerable variation in the research around embodied energy (of manufacturing), the technical term carbon dioxide equivalent is difficult to understand, and comparisons with something an individual might do (switch off a computer) with other activities e.g. driving to work or the total production of a coal power station are difficult to come by. Without better tools/information in this area people are likely to become cynical with respect to taking action (in a similar fashion to the seemingly conflicting press releases about which foods are healthy). There are numerous tools in this area but perhaps they could benefit from people who've worked in learning and technology fields to enhance them.
3. Real-time reporting of measures taken from the environment will be a very powerful way for individuals to learn how the groups they are part of are behaving. The monitoring service created during this project is a simple example of a much larger class of similar tools.

References

http://www.oucs.ox.ac.uk/greenit/desktop.xml.ID=body.1_div.6

Budget

Directly Incurred Staff	TOTAL BUDGET £	Year 1 Oct 07-Mar 08 Actual Expenditure	Year 2 Mar 08 – Mar 09 (extended to May 09) Actual Expenditure	TOTAL EXPENDITURE £	TOTAL VARIANCE
[redacted] Grade 8)					
Total Directly Incurred Staff (A)	**£ 93,755**	**£ 30,822**	**£ 61,644**	**£ 92,466**	**£ 1,289**
Non-Staff					
Travel and expenses	£ 1,576	£ 86	£ 927	£ 1,013	£ 563
Hardware/software	£ 5,768	£ 635	£ 4,922	£ 5,557	£ 211
Conferences and Dissemination	£ 1,311	£ 0	£ 0	£ 0	£ 1,311
Event Organisation	£ 12,124	£ 460	£ 7,470	£ 7,930	£ 4,194
Other	£	£	£	£	£
Total Directly Incurred Non-Staff (B)	**£ 20,779**	**£ 1,181**	**£ 13,319**	**£ 14,500**	**£ 6,279**
Directly Incurred Total (A+B=C) (C)	**£114,534**	**£ 32,003**	**£ 74,963**	**£106,966**	**£ 7,568**
Directly Allocated					
Staff	£ 25,192	£ 7,914	£ 15,628	£ 23,542	£ 1,650

Estates	£ 32,702	£ 10,175	£ 19,999	£ 30,174	£ 2,528
Other	£	£	£	£	£
Directly Allocated Total (D)	**£ 57,894**	**£ 18,089**	**£ 35,627**	**£ 53,716**	**£ 4,178**
Indirect Costs (E)	**£114,642**	**£ 35,970**	**£ 72,873**	**£108,843**	**£ 5,799**
Total Project Cost (C+D+E)	**£287,070**	**£ 86,062**	**£183,463**	**£269,525**	**£ 17,545**
Funds Received from JISC	**£200,952**	**£ 60,243**	**£128,424**	**£188,667**	**£ 12,285**
Institutional Contributions	**£ 86,118**	**£ 25,819**	**£ 55,039**	**£ 80,858**	**£ 5,260**

Nature of Institutional Contributions

Directly Incurred Staff					

[redacted]

[redacted]

Directly Incurred Non Staff					
Travel and expenses	[redacted]				
Hardware/software					
Conferences and Dissemination					
Event Organisation					
Directly Allocated					
Staff	[redacted]				
Estates					
[redacted]	£	£	£	£	£
Indirect Costs (E)	£34,392	£10,791	£21,861	£32,653	£ 1,739
Total Institutional Contributions	**£86,118**	**£25,819**	**£55,039**	**£80,858**	**£ 5,260**