White Paper

How technology is Building Schools for the Future

Putting ICT at the heart of education in 2009: From datacentres to desktops

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Executive summary

This White Paper will examine the progress of the Building Schools for the Future programme with particular focus on the ICT component.

The nature of that ICT element will also be explored as well as the various benefits of particular types of technology: principally focussing on the delivery of applications to the desktop; the enablement of flexible and remote ICT use and the role of the datacentre in maximising performance, creating economies of scale and positioning schools around future-proof and sustainable infrastructure.

Introduction to Building Schools for the Future

Building Schools for the Future is a central government initiative to renovate and modernise a number of existing schools as well as build new schools and academies across 300 Local Education Authorities in England. In total the programme will improve or create 3,500 schools.

The overarching aim of the initiative is to ensure every child is learning in a 21st century environment by 2020, replacing outdated school buildings with facilities capable of supporting modern ICT-enabled learning and accommodating larger numbers of pupils aged 11 to 19.

Funding of the projects is split between central government budgets and Public Finance Initiatives. A budget of £45bn has been allocated for the programme; 90 per cent of which is for building work, with 10 per cent for ICT.

At launch, in 2004, then Prime Minister Tony Blair said: “Over time this investment will see the entire secondary school building stock upgraded and refurbished in the greatest school renewal programme in British history.”

Partnerships for Schools, a new public body, was created by the Department for Education and Skills (now the Department for Children, Schools and Families) in 2004 to manage the programme; including selecting consortia to build the schools and install and manage the ICT infrastructure.

The order in which work is being undertaken is based on the extent of need, such as the condition of current schools and infrastructure. The first wave of BSF projects which launched in 2004 included 189 schools across the following LEAs:

Bradford; Bristol; Gateshead and South Tyneside; Greenwich; Knowsley; Lancashire; Lewisham; Leeds; Leicester; Manchester; Newcastle-upon-Tyne; Newham; Sheffield; Solihull; Southwark; Stoke-on-Trent; Sunderland and Waltham Forest.

Bristol opened the first BSF school in September 2007.

Six distinct waves of investment and development are now under way, incorporating at least 856 secondary schools and academies across 72 LEAs. These range from 23 LEAs where building work is already completed or underway to those currently in the process of selecting bidders to carry out the work.

"The opportunity to design and build a new school…has been an incredibly exciting experience. It's allowed us as a community to think creatively and innovatively about the type of teaching and learning we want to develop…to inspire our students."

Karen Bastick-Styles, headteacher of Sedgehill School, Lewisham.
On 20th January 2009 Sedgehill became the 50th new school to open as part of the Building Schools for the Future programme.

Where are we now?

On 20th January, PricewaterhouseCoopers published its second independent evaluation of the Building Schools for the Future programme. The report compiled the feedback of both pupils and headteachers in order to assess the ongoing successes and challenges for Building Schools for the Future partners.

Key findings from a technology perspective include:

- 84 per cent of pupils enjoy using computers
- 78 per cent believe using computers can help them learn
- 73 per cent rate their ICT equipment as either 'good' or 'very good'
- 65 per cent agree the equipment in their classrooms is good
- 56 per cent feel they have enough computers in their school
- 47 per cent believe their schoolwork has improved through using computer
- 30 per cent can use computers at home linked to their school
- 6 per cent find it difficult to use computers

The above findings all relate to pupils at schools in waves 1 – 3 of Building Schools for the Future. The below findings all relate to headteachers at schools in waves 1 – 3 of Building Schools for the Future.

- 44 per cent of headteachers rate their ICT equipment as good or very good
- 54 per cent believe pupils have access to ICT equipment whenever needed
- 42 per cent believe ICT is fully integrated throughout the school
- 66 per cent believe ICT is used creatively through the school to deliver the curriculum

While some of those statistics show clear room for improvement, Steve Moss, strategic director of ICT at Partnerships for Schools, says the phased structure of the Building Schools for the Future programme means subsequent waves are able to learn from the experience and best practice of previous waves. Similarly, ICT providers don't walk away on the opening day for each school. These are ongoing projects where any problems can be addressed.

LEAs already engaged at any stage with a live Building Schools for the Future project:
Barking and Dagenham; Barnsley; Bedfordshire; Birmingham; Blackburn; Blackpool; Bournemouth & Poole; Bradford; Bristol; Cambridgeshire; Camden; Coventry; Darwen (with Blackburn); Derby City; Derbyshire; Doncaster; Durham; Ealing; Essex; Gateshead and South Tyneside; Greenwich; Hackney; Halton; Hammersmith & Fulham; Haringey; Hartlepool; Hertfordshire; Hillingdon; Hull; Islington; Kensington & Chelsea; Kent; Kirklees; Knowsley; Lambeth; Lancashire; Lewisham; Leeds; Leicester; Liverpool; Luton; Manchester; Middlesbrough; Newcastle-upon-Tyne; Newham; North Lincolnshire; North-East; Lincolnshire; Nottingham; Nottinghamshire; Oldham; Portsmouth; Redcar & Cleveland; Rochdale; Salford; Sandwell; Sheffield; Southwark; Solihull; Somerset; Southwark; St Helens; Stockton-on-Tees; Stoke-on-Trent; Suffolk; Sunderland; Tameside; Telford & Wrekin; Tower Hamlets; Waltham Forest; Wandsworth; Wolverhampton; Westminster.

Understanding what pupils and teachers want and need

The remit of schools and the nature of modern learning are far from restricted within tight perimeters.

While physical security must be paramount and sensitive student data locked down, digital flexibility is key to successful 21st century learning. Pupils must be able to seamlessly switch location, from home to classroom, classroom to library and library to home without compromising their access to important learning tools or the performance of those tools.

In terms of what those tools are, the range of ICT services and equipment used in schools is hugely diverse, from basic desktop publishing and productivity tools such as Microsoft Word to sophisticated computer aided design packages and imaging and video editing suites. Rich media web resources, from collaborative tools to virtual worlds such as Second Life must also be supported. Also, presentation technologies, such as interactive white boards must integrate fully with online and on-premise resources.

In order to benefit fully from the range of technology available, its implementation must be all the more democratic and inclusive. Such rich learning tools in just a limited number of hands would only serve to widen the UK's digital divide, therefore an ICT architecture must be found that is not just right for every school but also for every student. It must also be device- and geography-agnostic at its core and provide fast access to applications in order to encourage the greatest possible level of engagement, according to Steve Ash, government business manager at Citrix.

With this in mind, building solutions based on internet access appears to be a viable answer to many of the most pressing questions.

Ensuring the experience of both teachers and students is consistent with their prior use of computers is also essential, so new technology cannot present an insurmountable level of culture shock to either party and the choice of hardware, software and desktop experience must, where possible, be sympathetic to the expectations of both students and staff.

However, there is no one right answer. Where high-end laptops may prove costly or inefficient in the long-term, so a model based on thin-client devices running applications from a datacentre may be found wanting for the most power-hungry processes such as video editing.

But this must not mean pupils or teachers are put in a position where they need to develop a different skills set for every classroom in which they use a computer.

Steve Moss said: “One of the key messages we need to get across is that the local authority must ensure the schools are fully involved in the consultation.”

Technology which is forced upon people, or which comes with added layers of complexity, inevitably sees lower levels of use and the statistics from PricewaterhouseCoopers suggest students are currently more engaged than staff with the possibilities of the ICT component within Building Schools for the Future. Headteachers showed less positive responses to questioning around technology, with 73 per cent of students, compared to 44 per cent of headteachers, rating their ICT as ‘good’ or ‘very good’.

Moss said teacher engagement is vital and he is already seeing “improved confidence and willingness on the part of teachers to use ICT”.

Certainly getting teachers on board is crucial to the success of Building Schools for the Future. This emphasises the fact the ICT provider’s work only really begins once everything is installed, they must also manage training and ongoing support as well as developing an agile strategy based on teacher feedback.

Teachers have a twin role of educator and ambassador for the wider adoption of technology by schools and students and responsibility for getting teachers engaged with the process must also be shared by headteachers, governors and the LEA. Where that doesn’t happen, cracks can start to show.

“There have been teething problems but typically they are a result of inadequate training of staff in advance,” said Moss. “That often results in help desks being inundated with enquiries when the technology actually works as it should.”

Implementation of ICT within Building Schools for the Future projects

The successful bidder for each BSF project includes both the building partner and ICT provider working together as a consortium. It is incumbent upon those bidders to propose a solution to Partnerships for Schools which delivers to the specific needs of each and every school.

The consortium adjudged to represent the best combination of builder and ICT provider is then selected to begin work.

As building work accounts for 90 per cent of the budget some critics suggest a more effective ICT proposal could be overlooked in the event its building partner presented a less compelling case to Partnerships for Schools. That lowers the likelihood of the best builder AND best ICT provider being selected and given the comparative weighting in budget allocation, the builder will invariably hold the balance of power in decision-makers minds.

However, Steve Moss, strategic director of ICT at Partnerships for Schools, believes those concerns have proved ill-founded in reality as the benefits of the builder and ICT provider working hand-in-hand have outweighed any potential negatives.

“As of the end of December 2008 we had 21 authorities up and running. Already we have seen enhanced reliability and greater responsiveness to school needs.”

The consortium approach certainly reflects the elevated role ICT now plays in education. ICT must be a consideration in everything, from the provision of air conditioning to the nature of power supply. This shows schools have moved on from the days of putting six computers into a room and calling it a computer lab. ICT must now be integrated throughout the school, in every classroom and accessible to every pupil.

Students in 2009 don’t just learn technology; they use technology to learn.

The use of computers, software and online resources is common across all subjects and essential to effective learning, from research to the production of written work and multimedia projects.

Moss believes flexibility and, where possible, starting with a blank canvas are key to gaining the greatest benefit from the consortium approach.

In total, as many as 900 new schools will be built by 2016 as part of the Building Schools for the Future programme. Building from the ground up, rather than attempting to integrate ICT infrastructure within existing buildings, presents the greatest flexibility to deliver the best ICT possible.

“There are no technology specifications, there are only output specifications,” said Moss, emphasising the fact bidders are charged with delivering a complete, bespoke solution, rather than competing merely on price to replicate an inflexible infrastructure dictated to them.

Bidders have had to address those output specifications with an approach that showed an awareness of the needs of “all schools and each school”. This means balancing a fine line between exploiting economies of scale and delivering against the unique needs of each and every school.

The right tech for the job: From datacentre to desktop

A budget of £4.5bn to spend on technology alone – equivalent to £1,675 per pupil – and strict service level agreements placed upon ICT providers would suggest schools stand to benefit from the very best technology has to offer. But split across 300 LEAs economies of scale must be sought.

The infrastructure must also map to the great need for flexibility and show how it fits into consideration about future planning.

An example of one such SLA is that service providers must fix a problem on a desktop computer within 15 minutes or incur a penalty. With as many as 1,200 computers per school, that creates a logistical headache, which, while designed to keep service providers strict on performance, could ultimately affect schools and learning if computer downtime isn't dealt with swiftly and becomes common.

Fortunately, evolution within the IT world is creating solutions to the very problems it creates. A great deal of IT is moving towards a utility or service model, delivered through the ubiquity of the internet rather than installed locally. That means management can be centralised, generally within a datacentre environment.

The logistics of troubleshooting on one machine in the datacentre versus thousands of machines in the field also present a compelling argument for centralising as much of the computing power as possible and running applications as a service from within a managed datacentre. Updates and patches are also far easier to apply quickly when pushed out from a central location.

Such a model also reduces the need for high performance computers on every desktop, and creates a strong case for thin-client terminals with a lower total cost of ownership and lower inherent value. Value of the end point is a consideration when assessing risk of theft and also when budgeting for the cost of replacements.

The quality and availability of internet connections used to be a dividing factor within society but those issues are now one of the most consistent factors when assessing methods for the delivery of applications and IT services to dispersed and often mobile end points.

In 2008 the Department for Children, Schools and Families announced a £300m initiative to get all school children online at home. It recognised at the time that as many as one million children may not have home internet access. This initiative would greatly complement ubiquitous internet access throughout schools and allow a joined-up approach to classroom-based learning and homework. The PricewaterhouseCoopers figures show 30 per cent of pupils currently enjoy seamless computing between home and school. That number must still increase.

Proponents of the datacentre-based model claim it is able to serve almost any computing need, however, there is still no automatic argument for an IT estate consisting purely of thin-client devices as the only route to processing power. Even some experts who favour a thin-client approach say such devices may only account for 60 per cent of an effective ICT estate.

“There really is no one magic device that suits everybody,” said Dave Hornsey, principal solutions architect at RM, a leading provider of ICT solutions to the UK Higher Education sector. “A mixture of Apple Macs, desktops, net books and even devices such as the Sony PSP can have a role to play on top of a fully flexible infrastructure.”

Hornsey added there is still inequality in terms of bandwidth in and out of schools – a provision not covered by Building Schools for the Future – and as such putting total faith in thin client could be limiting.

The greatest demand for processing power may still be best served by high-spec laptops or desktops, added Hornsey. Being able to be fully mobile with that processing power, for example when taking a laptop to a teacher’s desk, or from classroom to classroom, also supports a case for having choice within the IT estate.

However, the datacentre is key and smarter procurement and use of datacentre space and infrastructure can certainly deliver performance, economies of scale and all-important environmental benefits.

Furthermore, pooling of datacentre resource is possible, such as that proposed for Croydon and Kingston – increasing further those economies of scale.

Why the Citrix proposition works

The end-to-end virtualisation that sits at the heart of the Citrix Delivery Centre proposition enables school ICT providers to more effectively manage the applications (XenApp) and desktop environment (XenDesktop), while maximising the economies of scale which exist through the use of optimised servers within the datacentre (XenServer).

This provides greater flexibility and scalability across ICT as well as enabling a more joined-up use of technology between school and home. End-to-end virtualisation enables providers to securely deliver both specific and broad ICT on a micro and macro level, fitting with Partnerships for Schools' requirement for ICT that caters to each school and every school. For example, XenDesktop will deliver a student or teacher's personalised desktop environment to any computer in the school or at home, but it will also deliver the same basic desktop environment to a wide array of computers for all users. Similarly, applications can be delivered virtually with XenApp. And XenServer enables datacentres to image individual machines for every school within one or even two LEAs on far less datacentre real estate than a non-virtualised solution. The number of servers required can be reduced by up to 80 per cent.

Energy consumption can also be reduced through this kind of rationalisation as servers which are only 10 per cent utilised still consume around 75 per cent of the energy of a server working to its full potential, according to IT analyst house Quocirca.

Return on investment is realised through cost, utility and labour savings. This approach also enables school ICT providers to choose and effectively manage devices such as thin-client desktops, which have a recognised lower total cost of ownership compared to high-end laptops.

The case of Thomas Deacon Academy:
Novus, a key part of the consortium delivering ICT to the Thomas Deacon Academy in Cambridgeshire, which also included Pinacl Solutions, decided upon using thin client devices with applications delivered from a central source by Citrix XenApp.

The benefits of this approach included session portability, enabling students to end and pick up sessions seamlessly from lesson to lesson or when working at home. Applications could be delivered direct to a web browser, increasing portability, flexibility and scalability and centralising the management overheads. That centralisation also meant time to set up was dramatically reduced over solutions where installation and configuration are required on each individual machine.

According to Novus, the use of Citrix XenApp also overcame an issue with Apple Macs which previously have been used in specific design activities but not fully utilised across the full range of in-school ICT. Standardisation of web browsers meant Macs can be integrated into the thin-client infrastructure, making fuller use of an otherwise highly specialist and costly but ultimately underused resource.

How ‘future-proof’ are our schools for the future?

A criticism raised around Building Schools for the Future has been of its procurement model built predominantly on large upfront capital expenditure because while that clearly fits closely with the way building projects are developed and structured within the consortium it is less relevant to the way IT service provision is going in both the public and private sector.

Upfront expenditure on in-house hardware and software licences is becoming less common and the focus is instead shifting towards subscription and utility models in ‘the cloud’. By 2012, IT analyst house Gartner predicts 80 per cent of Fortune 1000 companies will be using cloud computing services and given schools are preparing students for their futures it is therefore essential schools’ IT use reflects trends in the ascendancy in the private sector, rather than those on the wane universally.

It appears, however, this may be an inherent disconnect between public sector funding and private sector expectations. Even the largest vendors to the public and private sector are changing their approach based on this shift. Microsoft points towards its Live and Azure strategy as an indication that it too is counting on a transition away from revenue models built solely on upfront capital expenditure.

Critics of Building Schools for the Future suggest that during such a period of major change within the IT world buying into long-term IT contracts could prove an expensive investment in in-built obsolescence. As such questions about funding will likely persist until promises of the programme being ‘future-proof’ are satisfied.

Obsolescence and IT have always been inextricably linked. But implementations are not normally beholden to the timeframe of building projects an in that regard a further concern arises.

The time lag from agreeing a new-build BSF project to the school actually opening can be between two to six years, which means the technology element agreed up front must be fully flexible or it will be dated before the ribbon-cutting ceremony even takes place.

According to Steve Moss, projects are revisited for a “baseline re-specification” six months prior to the school opening, which means all ICT provision agreed at the outset is revisited and its relevance checked against subsequent emergent innovations and market trends. This could mean a change in anything from the installation of higher-spec PCs to the use of a different wireless internet access protocol.

This in turn raises further questions about how effectively the proposed ICT element can be assessed at the outset, though this issue is mitigated by Partnerships for Schools’ insistence upon output specifications rather than technology specifications.

The datacentre model ensures replacement cycles, patching and updates are part of a more streamlined approach to application and asset management. Likewise, greater power in the datacentre can potentially mean less in-built obsolescence on the desktop, which has green benefits.

In essence, the most future-proof component of the desktop device is the port to accommodate the RJ45 – or Ethernet – cable.

The role of sustainability

"Sustainability is an integral piece of the puzzle and something which must be considered alongside all functionality and future-proofing of Building Schools for the Future. Our schools have a perfect opportunity to get on board this movement now."

Steve Ash, Citrix

Schools don't just need to be future-proof regarding the capabilities of their technology; they must also be sustainable with regards the introduction of ever-stricter environmental regulations.

Under the Children's Plan, there is a target for all new school buildings to be carbon neutral by 2016 and the Government established the Zero Carbon Task Force for Schools in June 2008 in order to drive the education sector towards hitting this target.

According to independent watchdog The Sustainable Development Commission the carbon footprint of UK schools currently stands at 9.4 million tonnes. That shows there is some way to go as Partnerships for Schools and the Department for Children, Schools and Families look for ways to reduce that footprint to as close to zero as possible.

IT has a major part to play as it will be the 'moving parts' of a building that come under the greatest scrutiny. Steve Moss, strategic director of ICT at Partnerships for Schools, said: "A lot of architects will say you can build a carbon neutral building, but the challenge comes when you start to put the technology in."

As such, Building Schools for the Future projects being undertaken now must keep a keen eye on the procurement of more energy efficient technologies and this is one example of where builder and ICT provider working together from day one can prove invaluable.

To emphasise the amount of regulation in this area, schools aspiring for BREEAM (BRE Environmental Assessment Method) certification must strictly limit the use of air-conditioning to only three rooms. Therefore machines that require less cooling can be used in more classrooms with less impact on the local and global environment.

Steve Ash at Citrix said: “Virtualisation enables schools to use devices such as thin-client machines which give off far less heat. That is a major consideration when looking at power consumption and related issues such as the need for air conditioning.”

Stuart Brown, director at Novus, added: “Thin client is the only way forward. People are talking about green PCs and laptops but the simple fact is they will never get anywhere near thin client in terms of energy consumption.”

Research published by Novus (Enrich White Paper, October 2008) shows 1,000 thin-client devices create, on average, 14.6 tonnes of CO2 which compares to an average of 82.6 tonnes created by 1,000 PCs – a difference of nearly six times the amount of CO_2.

There is also a clear cost saving associated with this reduction in energy consumption equivalent to a saving of £39,800 per 1,000 devices per year for those choosing thin client over PCs.

In terms of meeting regulations, the reliance upon a datacentre also moves a considerable carbon footprint off-site, thereby helping the school meet the criteria of its building being carbon neutral – even if it is in effect outsourcing a still-considerable carbon footprint. Simon Perry, principal sustainability analyst at Quocirca, said suppliers to schools must find the most environmentally efficient relationship between hardware, need and processing power. Inevitably that must mean reducing the carbon footprint of the desktop while making the most of economies of scale within the datacentre. With regard the latter, server virtualisation will prove a key technology.

“In the Wintel environment, server workload utilisation is pitiful compared to the capability of the hardware,” said Perry. “Typically most single OS Wintel servers are idling along at sub-30 per cent utilisation. But there is also actually relatively little difference between the base electricity requirement of a lightly loaded server compared to a server that is being thrashed.

“So all those servers are using a lot of electricity and doing little work for it. That problem is amplified though because all those servers also require lots of supporting infrastructure to keep them happy, such as air conditioning.”

But by employing a server virtualisation strategy, much of this can be overcome.

“In the simplest terms you're using up all that spare capacity you were paying for anyway, therefore you're getting more processing for the same amount of electricity. This is a basic efficiency story.”

Stuart Brown at Novus agreed: “The useful life of a PC in a school is probably three years; thin-client devices offer twice that life cycle.”

"Thin client is the only way forward. People are talking about green PCs and laptops but the simple fact is they will never get anywhere near thin-client in terms of energy consumption."

Stuart Brown, Novus

Steve Ash at Citrix said: "Sustainability is an integral piece of the puzzle and something which must be considered alongside all functionality and future-proofing with the ICT element of Building Schools for the Future.

"The industry and end users are moving towards a future where applications are delivered as a service from highly efficient datacentres. Our schools have a perfect opportunity to get on board this movement now and stand to benefit from the fact the most sustainable approach is the most future-proof and arguably the most effective."

Conclusions:

Much of the success of the Building Schools for the Future programme rests on its ability to deliver the ‘Future’ component of that stated goal and all that entails.

Technology permeates the lives of almost all citizens in England and is increasingly important within the workplace. For that reason engagement among students with technology must be total if they are to be effectively equipped for their own individual futures.

That also means getting teachers on-side to be ambassadors for technology which in turn means that technology must be easy to use, it must work and it must work quickly – it has to assist, not slow down the learning process and remove not add layers of complexity.

Learning must also reflect the greater mobility technology affords and must not stop at the school gates. Therefore technology must help education branch out into the home, embracing the benefits of broadband internet access. It must be as fluid as possible which means the use of virtual desktops and application delivery to web browsers, rather than installation on local machines.

Given public sector budgets are subject to great scrutiny – especially around IT spend which has had a chequered track record of successes and high profile failures – the solutions delivered must be the most cost effective. That means embracing the economies of scale to be found in the datacentre.

By so doing schools can also reduce both their on-premise and total carbon footprint and such sound planning around sustainability will be a key part of public sector IT procurement over the coming years due to stricter legislation.

It is too early to gauge the likely success of such an ambitious project as Building Schools for the Future, however, if it can enable students to use technology more smartly to learn and improve both their present and their future, then it will have taken the current educational provision within England to an altogether more beneficial level.

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