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SUMMARY

Contact/activity to date
The consultants have visited the Museum on 5 separate occasions, 2 prior to award of contract and 3 since:

To understand the background to the brief and for initial viewing of the site prior to submission of proposal;

To discuss the submitted proposal in greater detail with Learning Centre Project Manager, Head of IT and representative of Web Team;

To meet with Learning Centre Project Manager, and Director of Learning & Interpretation (briefly) and acquire information on wider background and additional detail, in combination with full site visit.

To meet with the architects, and Head of IT (briefly); for Synetrix to carry out a preliminary wireless survey of the Henry Cole Wing floors 00 and 01; and to compile initial specification of IT requirements. Synetrix’s wireless survey and associated costing is included as an appendix; their fixed network survey is appended as a separate document.

To meet with the Project Manager, Head of IT and Synetrix to discuss fixed network options.

From discussion to date has emerged the following:

That booked groups with a focus will be the main emphasis of the new Learning Centre. An important secondary focus will be drop-in activities.

That the IT systems for the Learning Centre would ideally function as a separate network (VLAN), firewalled beyond the museum’s main network.

That low maintenance, robust IT solutions will be the ideal with respect to likely levels of technical support.

That wireless coverage will significantly assist the Centre’s aims and objectives.

That both as an older building and as a refurbishment/new build, the Henry Cole Wing may present some problems for wireless implementation. An initial mapping survey has been carried out.

That via a consultation exercise with 3 schools, potential users of the Centre recommended several useful approaches which have been noted.

Next steps
Further expansion and then refinement of the specification will be necessary.
RECOMMENDATIONS

On the basis of site visits and discussions so far, recommendations are as follows:

1. As a general principle, the Centre should concentrate on installing services to maximum feasible extent as prior requirement for applications and devices, which can then be introduced and replaced as upgrading requires.

2. A phased approach should be taken to implementing systems for the Centre, to enable testing, stabilisation and optimisation of facilities. This could extend to 3 phases to assist transitions. The report addresses a first phase up to 2008.

3. Wherever feasible, technology for the Centre should be maximally supportive of human activity while remaining minimally intrusive on the appearance of the building spaces.

4. In line with above, wireless connectivity should be made available wherever it is possible and cost effective to do so. A follow up survey will be required once the building has been refurbished. It is also advisable to conduct a monitoring survey after installation to test for typical performance under load, that is, with significant numbers of people using it simultaneously.

5. A percentage of the wired network bandwidth throughout the Learning Centre should be upgraded to 1Gb if costs and agreements with Imperial College permit.

6. That configuration of network access arrangements for Centre resources operate as 2 subnets:
   
   one open, for access to specified services only via assigned and time limited registration details for visitors with their own equipment;

   one secure by password & login, for specified IP addresses of V&A owned equipment.

7. That the Centre keep an open balance between proprietorial software and Open Source software in line with wider Museum policies and intentions.

8. That if judged appropriate, a leasing arrangement for equipment be considered for the first year to trial various solutions and to enable adjustments to be made. A leasing arrangement should also include technical support with clear Service Level Agreements (SLA), which would supply assistance when required and ease resource costs when not required.

9. That if a solution involving external technical support is not chosen, that the highest possible priority be given to sufficient adequately qualified and experienced technical personnel to enable excellent levels of support.

10. That in time at a later stage, a section, element or dimension of the Digital Studio be allocated as an experimental technology area/facility.
3. An example of this would be siting of wireless access points behind false ceilings and of ample supply of power and data from within floor or other cavities. Where neither is possible every effort should be made to arrive at a solution that blends supply with surroundings. There may be some scope to achieve this through commissioning of solutions from specialist designers. Worksurfaces and seating in principal rooms should aim to incorporate data and power cabling in their design wherever possible. Other solutions are given below in the main sections of the report.

4. This will enable maximum flexibility and rearrangement of spaces and allow the flow of creative thought and social communication uninterrupted by human movement within the Centre. As the initial wireless survey can only relate to the present structure, a follow up survey will be required once the building has been refurbished.

5. This would significantly future-proof capacity for the next 3 years. 25% of the fixed network at 1Gb/sec could be a starting point.

7. The adoption of Open Source (non-proprietary) software would save significantly on licensing costs, but may be more problematic to support.

8. That if judged appropriate, a leasing arrangement for equipment be considered for the first year to trial various solutions and to enable adjustments to be made. A leasing arrangement should also include technical support with clear Service Level Agreements (SLA), which would supply assistance when required and ease resource costs when not required. However such an arrangement would require careful consideration because of the particular security requirements within the museum, both on and off the network, and of other factors such as working overtime during unsocial hours and clearance for contact with children.

9. This is particularly critical for the Digital Studio and for principal spaces such as the Auditorium and Seminar Room 1 if they are intended to generate income.

10. This could be part of a later phase and could enable the Centre to offer to interested parties a prototype test facility for emerging technologies in partnership with designated students and a range of users. This could constitute a potential revenue stream for the Centre or a basis for a “quid pro quo” approach for sponsorship.
INTRODUCTION

Profile of new Learning Centre
The V&A’s new Learning Centre is intended as a flagship element of the museum:
both as an independent arts centre in its own right, and as a gateway to exploration
of the wider museum.

Intended to emphasise the V&A’s position as the national museum of art and design,
the Centre aims to engage a diverse range of visitors in new ways. Within this range
are categories of particular interest, but the overall emphasis is firmly on an
inclusive, participative approach.

These new ways offer the opportunity to leverage the use of digital technologies to
enable visitors to experience and be inspired by the complex web of the museum’s
collections, building, spaces, people and online presence.

The elegance and clarity of the new building design should be complemented by
minimal visual intrusion of technology apparatus. It should be apparent that
technology is pervasive, but as a supportive, and maybe later, an intelligent and
responsive partner to the Centre building and its visitors. It should be the focus of
attention for display of creative outputs and information rather than as massed
hardware.

Digital technologies let visitors completely redefine the museum visiting experience.
Museums have now moved into a world where permanent connectivity and pervasive
interactivity offer both new challenges and opportunities for looking at and engaging
with static objects and displays, both in proximity and remotely. These facilities also
offer opportunities and challenges for enhancing practical activities.

The purpose of this report is to set out how the Learning Centre could best make use
of digital communication and information technologies in ways that enable human
expertise and enthusiasm to take and hold centre stage, supported by robust
technology solutions.

The original brief for this consultancy was to
1. Analyse and recommend suitable solutions
   1.1 Users and spaces
   It might be tempting to define the Centre primarily as a series of spaces; but in reality
   it might be better characterised as a wide range of users. Although ICT equipment
   will be located in distinct spaces with different functional profiles, which will in turn
   influence how people use technology, people, not spaces, will be the users. These
   users will be visitors and staff, both technical and non-technical.

   Because the prime use of the Centre is anticipated to be mainly, but not exclusively
   booked groups, the main scope and focus of this report is on users situated in the
   physical spaces of the Learning Centre. In time, once the ICT systems of the
   Learning Centre are tested and optimised, then there will be the opportunity to link
   with gallery and web spaces.

   The initial technology focus is on a timescale of 2 - 3 years, up to May 2008. Beyond
   this it is better to anticipate developments generally rather than specifically.
   An outline of selected technology developments/horizons is given below.

   The spectrum of intended users is very wide, given the emphasis on inclusive
   participation. The Centre is not only intended to function as a focus of museum
based learning, but outside museum opening hours also as an independent arts
centre. This means that the ICT provision must be accessible by all ages and levels
of digital literacy and across a wide cultural span. Good ergonomic and interface
design will be important. Issues of accessibility and DDA must be integral to the
solution wherever possible. Clear instructions on network access and connection
procedures should be easily accessible to visitors. Adequate technical support – via
frontline technology “buddies” if appropriate – should always be available when
people are in the Centre.

Intended visitors are (from Learning Centre final project brief, p2):

- adults attending daytime courses or evening lectures
- FE/HE students, 6th form students or adults attending study days, events,
  workshops or conferences
- students, teachers, lecturers carrying out their own research
- teachers/lecturers preparing visits or attending INSET courses
- professionals in the creative industries
- people from different minority ethnic and social backgrounds who may be
  visiting independently or in groups
- new, first-time visitors of all ages and backgrounds
- families participating in weekend or holiday events or visiting independently
- children in school groups – ages ranging from pre-school to 18
- young people attending workshops or evening events
- private or corporate groups who have booked a talk
- virtual visitors accessing information or activities

One specific group of interest is the 18 – 25 age range at whom the Friday Late and
similar events are aimed. They are also likely to constitute a significant percentage
of students from the participating institutions in the HEFCE funded CETLAD
programme, and to partially represent creative industries participation in other
projects. IT solutions for the Centre should reflect the strategic significance of this
market sector/cohort, but without compromising accessibility for other groups.

1.2 Access modes
Given that virtual visitors to the website outnumber physical visitors to the museum,
access to resources over the network would best be achieved via a web browser
environment. This would fit with the V&A common data model of a web services layer
as front end to a range of information resources and XML compliant data structures.

This would assist integration of physical with virtual visitors, for example if virtual
visitors to the website wish to see activities from rooms via webcast or webcams,
alongside information sources that a physical visitor is accessing in real time.
It would also enable seamless access to a range of resources across platforms.

2. Design an IT system for the Learning Centre as a whole

From initial discussions the following factors are significant in defining an approach to
recommendations for an IT system.

2.1 Network connectivity
People now expect to be able to roam freely through space while connected.
They appreciate the freedom and flexibility that wireless connectivity and mobile
networks offer.
However, wireless and mobile networks differ significantly in their behaviour from fixed networks. They are more fluid, present more challenges for solving problems of handover from one state to another and need robust protocols to deal with traffic and signal interference. Security considerations are paramount as radio frequencies are inherently less secure than fixed infrastructure.

As an older building, it is likely that the Henry Cole Wing may present some difficulties for optimisation of wireless networks. Nevertheless, it would be wise to anticipate that wherever required and appropriate, wireless should enable connectivity to whatever people are doing and whatever they are using.

Fixed network infrastructure should complement wireless provision as baseline technology for intensive applications, and as fallback position should wireless provision be unavailable. For this reason data points with POE (power over ethernet) to access the fixed network should be adjacent to every power socket designated for IT use.

By 2007 it is very likely that any major public facility or institution not providing wireless access will be the exception, not the norm.

2.2 Network security and access:
For reasons of security, the IT system for the Learning Centre should function separately from the main museum network. This means it should operate as a VLAN (Virtual Local Area Network) with a firewall positioned between it and the main museum network. Policies of control for visitor access will need careful consideration.

It is suggested that this VLAN be configured as two subnets and access arrangements operate as follows:

one open network, for visitors with their own equipment for access to specified services only, using time limited and dynamically generated registration details supplied by the Centre;

one secure network, accessed by password & login for specified IP addresses of V&A owned equipment.
(see Recommendations above).

Visitor expectations of easy and seamless access to resources will need careful balancing with demands on technical support. Because extra staffing for the Centre may well be no more than the bare minimum, provision and configuration should be as robust as possible. Security considerations will be especially important for the wireless network.

2.3 Network design and servicing
The networks for the Centre would need two comms rooms, one on each floor. These would ideally be situated in the centrally placed storage spaces on levels 0 and 1. The siting of the comms rooms here on each floor would locate them centrally, within optimum reach of technical staff configuring equipment in adjacent rooms and spaces beyond.

By contrast, the servers for the Learning Centre would best be sited in the main server room for the museum. There is no perceived advantage in locating Learning Centre servers within the Centre itself.
A central tenet of providing connectivity has been to supply power and data wherever requirement might reasonably be anticipated to occur. As a first phase, this could start with ample fixed wiring and network data points, and then wireless coverage of the most important spaces:

### 2.4 Prioritisation of areas for wireless coverage

**Level 0:**
- The Digital Studio (Studio 2 L0 3.2)
- The adjacent Lunch/Activities space (L0 2.3)
- The long run of brick bays designated for lunch/activities (L0 2.1 and 2.2)
- Studio 1 (“messy” art studio L0 3.1)

Entrance 1 and Reception 1 & 2 area coverage would be highly desirable but may have to be prioritised second. Obviously the ideal would be ubiquitous coverage but this may be subject to costs.

**Level 1**
- The Auditorium and adjacent Seminar 2 room (L1 7.3)
- Seminar 1 (L1 7.2)
- Studios 3 and 4 (L1 8.1, 8.2)

If constraints apply, the lobby areas 1,2,3 could be omitted; however, since these interconnect with the key spaces, ubiquitous coverage would be ideal.

It is important to note that while wireless coverage tends to be defined by spatial parameters, from users’ points of view they need to stay connected while moving between areas, spaces and levels. For example, a speaker sitting in the Green Room or Seminar 2 room about to enter the Auditorium may not want to drop connection while relocating.

Ubiquitous coverage throughout would be ideal but would depend on cost. It should be noted that the cost of a wireless access point is relatively inexpensive (c. £400) balanced against the benefits of provision of access.

### 3. Set up the Digital Studio

#### 3.1 Function

The Digital Studio could be seen as the engine room of the Centre, where new and pioneering modes of visitor engagement and learning can be piloted. For the immediate future, the focus is on maintaining flexible layouts and levels of equipment, where a wide range of visitors can work comfortably on creative tasks using a range of digital technologies.

As the Centre develops, there may be the opportunity to equip the Digital Studio as an intelligent space and trial more immersive environments. The maximum incorporation of false ceilings, floors and walls would significantly assist this.

Consideration could be given to the use of the glass screens that separate the Digital Studio from the reception area as conductivity surfaces. This would enable them to carry digitally programmed artworks on their surfaces, perhaps in combination with other treatments such as etching or embedded fibre optic pathways. These conducting pathways could track both the flows of visitors through the physical museum, and clusters of virtual visitors to web pages. Both could be overlaid with each other to demonstrate for example activity round an exhibition. This could
combine a screening function with a more overt statement on the profile and “reach” of the room.

In time it might be possible to view the Digital Studio as a revenue earner for Level 0, as the Auditorium and Seminar 1 are for Level 1. Appendix B outlines the possibilities for the Digital Studio in more depth.

3.2 Infrastructure and platforms
Provision of fixed and wireless networks should enable a range of applications and devices to connect. Supply points for data and power have been liberally but unobtrusively incorporated. Together with adequate floor/wall/ceiling cavities, this should enable a reasonable degree of future-proofing for updating of connectivity for present and future devices. Because the Digital Studio is anticipated to use mostly applications for still and moving image and audio capture/manipulation/editing, specification of flexible combinations of equipment is largely based on Apple and Mac o/s. PCs can be included if required. DDA assistive software should be provided on machines where people need it.

4. Provide specifications and advice for the procurement of IT equipment

4.1 Specialist requirements
Because of the cost implications, it is strongly recommended to place specification of requirements for network design and of audio visual equipment installation with specialist contractors. These elements are specialist activities and are best undertaken by companies who have extensive knowledge and expertise in these areas.

4.2 Leasing as an option
Leasing of equipment is an option that could be explored, particularly for the first year to see how equipment levels match actual use and projected demand. Any adjustments required prior to decision to purchase the Centre’s own equipment (or not) could then be made. Participation in educational purchasing consortiums, if not already in force, could bring additional savings.

The main attraction of leasing would be renewal of the hardware and associated software at a rate that would keep pace with the cutting edge. An accompanying technical support arrangement (essential) might also save on some HR related costs.

It might also prove attractive to a sponsor to meet the costs of a leasing arrangement. Sponsorship of equipment in kind might be an alternative solution provided it was matched with a technical support package. However, over similar time scales leasing could prove more expensive in comparison to upgrade of equipment by purchasing at intervals. The ending of any leasing arrangement in adverse economic conditions without sufficient resource to replace would be a significant risk.

5. Advise on issues of maintenance and running costs, software, licences

5.1 Costing disclaimer
It should be noted that specifications and costings supplied are based on current prices and are indicative of the market at the time of writing. Prices and technical
specification will inevitably have changed by the time the Centre opens. It is recommended that these elements are revisited and rechecked closer to opening.

5.2 Cost considerations
Obviously the intention in this area should be to keep costs down as far as possible, but without compromising the overall aim of the Centre to demonstrate leading edge practice. The V&A has educational status for software licensing and this should be exploited to the full as currently.

Wherever possible and appropriate, bundling of hardware and software should be the preferred option. An example is the range of music and image/video editing tools that come bundled with Apple equipment such as the Option 6 mobile classrooms.

A major consideration would be cost differences between proprietorial and non-proprietorial software. In this respect it would help to note the longer term wish of the Information Systems Department to move away from proprietorial desktop systems to Open Source solutions if possible. However, technical support is a consideration for those adopting non-proprietorial software. It would be wise for ISSD to trial any Open Source solutions ahead of adoption by the Learning Centre. A watching brief should be maintained on market trends. Open Source Academy centres have already been established to evaluate Open Source applications for the business sector and might be able to advise on longer term viabilities.

Specialist software for DDA requirements (customisable magnification, text to speech readers) should be included in the costs of software and licences.

6. Comments on the original brief for IT system: main criteria
(numbering in this subsection from original brief; responding comments in italics)

6.5 AV/ IT system to allow the following:
• a presentation / music in one room to be seen/heard all around the adjoining spaces
  would need balancing against requirements for soundproofing and carry additional equipment specification requirements.

• flexibility to reorganise spaces and bring in extra IT and AV as required.
  this would significantly be assisted by wireless access, by ample supply of power and fixed data points and by moveable portable equipment

• networking, including wireless, in all spaces
  this has been anticipated as specified (see caveat on need for wireless survey after refurbishment)

• provision for video conferencing and web casting throughout
  videoconferencing is envisaged for identified rooms with webcasting achievable via dedicated media server. Specialist videoconferencing companies would need to advise on particular combinations/solutions as videoconferencing carries particular requirements..

• projection screens in most rooms, ideally set into the floor or ceiling mounted
  ceiling mounted would be preferable in the Auditorium; in other areas such as Studio 1 main art studio, rear projection has been specified where appropriate eg.
rear projecting smartboards – this increases flexibility of room space, respects room architecture and ambience and enables mobility of smartboards between rooms (so enabling cost savings if appropriate).

- induction loops throughout (designed so as not to interfere with one another)

It is anticipated that this element will be dealt with by specialist access consultants.

Facilities for digital media are essential to the museum’s communication with its users and will be integrated into the design throughout. We are fairly clear about the activities we would like to run for a range of audiences. Activities include:

- Courses and workshops on digital art and design using computer-aided packages, digital photography and video.
- Digital network projects in partnership with other organisations using internet links, video conferencing and other means of creating networks.
- Taster sessions for on-line courses.
- Access to web and other core systems, databases and resources in the V&A.
- Live feeds to show artists in residence at work and other events in progress around the Centre and elsewhere in the museum.

All the above will be supported by fixed and wireless connectivity throughout together with appropriate equipment specifications and both proprietorial and freeware/shareware software packages.

Repositionable wireless equipment such as wireless cctv cameras and projectors should enable relay of activities to a range of display outputs. Use of a web browser environment for access to data resources will enable considerable flexibility of access to information and deployment of equipment.

7. Learning Centre: IT requirements

7.1 Overall throughout Centre:
Network capacity in the Learning Centre would need to be at least 1Gb in 25% of overall extent to future-proof foreseeable demand for the next 4 years.

Network access arrangements for Centre resources would best operate as 2 subnets:

- one open, for access to specified services only via assigned and time limited registration details for visitors with their own equipment;

- one secure by password & login, for specified IP addresses of V&A owned equipment.

There should be dedicated comms spaces for each floor and these should be located centrally:
On Level 0 this should be adjacent to L0-3.3
On Level 1 integral with the control room L1-7.3 of Seminar Room 1

Fixed network via cabling should be installed in each room with power over ethernet to every datapoint. Every datapoint should have a minimum of one power point adjacent.
All power outlets required by higher power devices to have data points located adjacent.

All data points to have power over ethernet (used by lower power devices).

Wireless access points should cover all main rooms and circulation spaces where feasible.

For every wireless access point there should be one datapoint (with power over ethernet) and one power socket.

Wireless access points should be installed behind false ceilings where these are fitted. Where original, not false, ceilings feature in rooms, access points should be positioned optimally for frequency transmission but also to minimise visual intrusion.

All main worksurface furniture in principal rooms should be capable of having power and data built in via cabling conduits (to relay from floor connection to end unit)

All main worksurface furniture in principal rooms should also be height adjustable for DDA compliancy.

Projection is rear projection wherever feasible in order to save space and costs by redeploying equipment wherever it is needed.

7.2 Equipment requirements by room:

NB Specifications will need revisiting closer to procurement to update functions and configurations. For present exercise take as placeholder solution to underlying user need/activity eg., quick information check, absorbed browsing, collaborative group working.

See costing list for number of data and power points assigned to each room, both for specified equipment and for “spare use”.

7.2.1 Level 0

L0 1.1 Entrance 1:
This is now the main entrance for the public from Exhibition Road, leading into the Learning Centre reception 1.

Because these areas are at the entrance of the new Learning Centre, any IT provision should be compatible with assisting, not blocking traffic flows.

L0 1.2 Reception 1

IT equipment in this area is provided for brief checking purposes such as teachers fine tuning visit details, or for quick reference to resources.

3 datapoints, 3 power points

2 x desktop machine and flat screen monitor; PCs running thin client + web browser for limited access to email, web, V&A resources.

Printer eliminated and print output to be repositioned behind reception desk, but with notice adjacent to machines to direct public users to collect from desk.

Seating optional, to discourage extended use of machines. If no seating DDA aspect would need thought.
Large 66" plasma screen or updated equivalent for display to set tone/ambience and emphasise entrance to Learning Centre (display not interactive which would impede traffic flow.) Could link to nearby object displays.

**L0 1.3 Reception 2 & desk**
1 wireless access point in seating area 1 datapoint 1 power point
(additional data and power points optional, depending on views on use of seating area)(NB staff pc and printer behind desk to come from ISSD budget)

**L0 2.1 Lunch/activities bays**
*This is intended to be a flexible space for a range of groups and activities. Wireless projectors above bay ends can relay images from workshops in other rooms or from other inputs as required.*

5 wireless access points, 1 per bay
4 wireless projectors (2 essential, 2 desirable) associated to wireless access points, for projection onto lunchroom walls (powered from sockets)

data and power points at each bay end (total 5 + 5) + 10 power sockets and 10 data points on opposite wall

**L0 2.2 Lunch/activities painted room**
*This is envisaged as a “priming” room for orienting school classes and other groups before setting off into the museum or other Centre spaces.*

2 wireless access points 2 datapoints for w a ps
2 data + 2 power points for teachers/similar to plug in own laptop

**L0 2.3 Lunch/activities adjacent to Digital Studio**
*This space can be interconnected with the Digital Studio and can share some moveable equipment with it. Wireless connectivity and ample supply of data and power points via floorboxes is intended to give maximum flexibility of use.*

3 wireless access points 3 datapoints for w a ps
8 floor boxes for fixed network access, each floorbox capable of supplying 6 data and 6 power points = 48 of each

1 + 1 datapoint and power point “spare” on perimeter of room location tba

1 mobile rear projection screen, shared with Digital Studio
Apple or equivalent pc specification mobile classroom (see below), can be shared with Digital Studio

**L0 3.1 Studio 1 (Art Studio)**
*This is a working art studio dedicated to practical art and craft activities. ICT equipment specified is primarily for focusing on and relaying demonstrations and activities to other spaces. Wireless cameras will enable flexible repositioning.*

2 x wireless access points 2 datapoints for w a ps
2 x wireless cameras/ high quality webcam 2 datapoints for w-cameras
(for relay of eg artist working in studio to gallery areas or to lunch bay projectors)
(data and power points have been increased)

datapoints 6 power points 6 (increase on previous allocation)
**L0 3.2 Digital Studio**

*This space is key to the digital dimension of Learning Centre activities.*

*It should be extensively equipped with modular solutions enabling varying levels of use and flexibility of positioning. From initial capture, manipulation and output of 2D and 3D images, sound and video, it should be capable of adding more specialised equipment (eg VR immersive, haptic) at a later stage of development. A sandbox area could be added later. For this reason false floors, ceilings and walls are highly desirable to take cabling and associated equipment.*

3 wireless access points 3 datapoints for w a ps  
6 floor boxes for fixed network access each supplying 6 data points and 6 power points = 36 of each  
or 4 floorboxes each supplying 8 data points and 8 power points = 32 of each

Apple or equivalent pc equipment  
2 x mobile classroom (option 6) (shared with adjacent LO 2.3)  
(each classroom = 15 laptops stored in unit enabling recharging)

NB wherever the mobile classrooms are stored there should be power supply for recharging the 2 units)

4 x portable digital media case (contains combination of digital still camera, digital video camera + audio capture) for flexible roaming - eg out in galleries - and easy recharging)

4 x12" powerbook for media cases above  
3 x iMac 2 Gb RAM, 400Gb hdrive, 20" display  
moveable rear projection smartboard (previously in L0 2.2)

other equipment  
35 x PDAs with built in wireless capability* + high quality camera + voice record + audio capture  
(*if there were later phased rollout of wireless access throughout museum as part of Learning Centre services for users)

4 x networked colour laser printers  
1 x large format printer (HP Designjet 500 PS or 5500 42" width £2000 approx)  
1 x professional transparency scanner  
5 datapoints for printers

1 x wireless CCTV camera  
1 x mobile videoconferencing system  
Mobile electronic voting system – eg Digivote  
2 datapoints

Power and data points to be positioned where feasible in addition to supply from floorboxes.

**7.2.2 Level 1**

**L1- 7.1 Auditorium**

*The levels of specification and equipment in this room are intended to secure a niche among comparable central London venues for hire and thereby generate revenue.*

*If costs permit supply of power and data built in to each seat, then can include:***
otherwise connectivity can be via wireless with power and data to every other seat.  
NB This latter scenario has been assumed in costings supplied.

2 x wireless access points  2 datapoints for w a ps

Power 240v or 12v and datapoint to every other seat and any additional connectivity via wireless, plus swivel flap surface for laptop
Or
If costs permit, power to every seat
mobile broadcast camera (for capture & transmission of live events to broadcast standard)
webcasting unit (VBrick) wireless camera + encoder/decoder >> MPEG4
Data projector, hydraulic operated, ceiling mounted
5 Data points for above

Electronic voting system – Digivote (can be set up as self contained)
Videoconferencing – ISDN & IP based + multiplexer to link Auditorium eg to Seminar Room 1 (Videoconferencing should be addressed by specialist contractor)
Webcasting Media server G5 PowerMac for streaming media
Videoconferencing
1 x fixed system VSX7000

Wireless headphones
Smart lectern with preset options to control screen, projector etc.
(aim is control of equipment from platform with minimal technical assistance)
(professional document scanner)

11 data points + 11 power points round perimeter of room

L1- 7.2 Seminar 1
This room is equipped to function at a similar level of specification to the auditorium. Flexibility of control arrangements are important to suit presenters’ individual preferences. Some data & power points from auditorium could be redistributed to Seminar 1 if required.

3 wireless access points  3 datapoints for w a ps
2 projectors
1 desktop machine rear of room (for those without own laptop, projection remote controlled from front)
screen, driven by laptop
videoconferencing capability to output from Seminar 1 to Green Room
AV specification for specialist advice

L1- 7.3 Seminar 2
This is intended for smaller group sessions and as an extension to the auditorium. It is also intended to function as a standalone room for videoconferencing when required.

1 wireless access point  1 datapoint for w a p
2 floor boxes each supplying 6 data points + 6 power points = total 12
power & link for videoconferencing
printer (ex L1- 7.1 Auditorium)
data projector and stand
2 data points and 2 power points additional to floorbox provision
Lobby 1
Lobby 2
Lobby 3
These are primarily circulation spaces but with a potential focus for display of work in progress from artists’ studios in Lobby 2 & 3 areas.

3 directional wireless access points each with datapoint
1 x Lobby 1  1 datapoint   1 power point
1 x Lobby 2  1 datapoint   1 power point
1 x Lobby 3  4 datapoints 4 power points

power and data points best positioned at intervals to be agreed; increased

Artists’ studios
L1- 8.1 Studio 3
1 wireless access point 1 datapoint
2 data + 3 power socket
1 wireless camera for activity relay

L1- 8.2 Studio 4
1 wireless access point 1 datapoint for w a p
2 data + 3 power socket
1 wireless camera for activity relay
data point for wireless camera

nb wireless cameras can be combined or removed between studios to suit

L1- 10.1 Green Room
This is a small but well equipped room tailored to the needs of visiting speakers.
Display outputs from Auditorium, Seminar 1 enable presenters to judge cues, timings and size of audience etc before entering.
1 wireless access point 1 datapoint for w a p
(Monitors for videolink:
2 x LCD 32” flat screen monitor + audio output to take video feed from from
a) auditorium and
b) Seminar 1)
2 data points and 2 power

L1- 11.2 Staff 2
2 x G5 iMacs or equivalent spec PCs as desktop educational resource – “staff educational resource machines”
scanner
networked colour laser printer

nb assumption is Staff 2 will be covered for wireless by adjacent AP in Green Room

Software
(costs to be confirmed)
Apple OSX server

MSOffice for Mac
MSOffice for Windows or Star Office
Adobe Photoshop
Adobe Premiere

Dolphin Screen Reader (DDA compliant magnification software, runs under Windows and Citrix)
Dolphin usb pen (personalised preference settings for web browser, plugs into any pc and applies settings)
APPENDIX A  LIKELY FUTURE DEVELOPMENTS IN TECHNOLOGY

The following brief outline is intended to set the Learning Centre in two main contexts: technological and social. More space is given to the former rather than to the latter but both are inseparable dimensions of social applications of computing, or social computing for short.

Technology areas highlighted are intended to pick out a few main elements likely to impact on equipping, connecting and positioning the new Learning Centre, rather than to represent a comprehensive survey of all technology backgrounds. This would be beyond the scope of a brief selective survey and is covered more comprehensively elsewhere by other sources.

Summary: main trends of relevance, of which a selection is expanded below:

- Continuing increase in fixed network bandwidth and in penetration of wireless broadband and ethernet over cable
- Continuing development of mobile networks in 3G and beyond
- Convergence of mobile and fixed networks for transparent user access
- Convergence of broadcast and networks for content, significant for education
- Increasing technology-enabled personalisation of the learning landscape
- A focus on the home by major market players in hardware and software
- Major step changes in visual display technologies
- Miniaturisation of devices underpinned by advances in nanotechnology
- The disappearing computer – advances in ubiquitous computing (ubicomp), ambient intelligence, location based sensing and wearable computing
- Advances in robotics, agent technology and embedded intelligence

However, many of the above areas raise important questions of privacy and data protection, accessibility and usability, reliability and QoS (quality of service) so trends of uptake are not always smooth or predictable. Research may pioneer important breakthroughs, but market development depends on viable manufacturing techniques and ultimately mass uptake rests with the consumer.

Because museums are custodians and interpreters of potential content and associated applications, they have the opportunity to position themselves at a prototype stage of (content for) a technology and test it with visitors as potential users. This could sit well with increasing manufacturer interest in, and research into, user experience.

1. Technology
   1.1 Carrier medium: networks and infrastructure
   1.1.1 Fixed networks – SuperJANET (UK Joint Academic Research Network)

   The fixed network currently supplying the V&A is a SuperJANET spur from Imperial College. SuperJANET4 has a 2.5Gb/sec bandwidth to main nodes; this spur from Imperial College is 100Mb/sec with the offer of 1Gb if required in future, costs allowing.

   Looking beyond the present phase, SuperJANET5 is currently at tendering stage for main contractor with a view to replacing SuperJANET4 from Dec 2006 onwards.
The SuperJANET5 network architecture is envisaged as a high speed core network, capable of operating using 10Gbit/s wavelengths. From late 2008 a number of 40Gbit/s wavelengths are anticipated. The JANET Regional Networks are to have dual, diversely routed connections to this core network, which should be capable of 2.5Gbit/s and 10Gbit/s wavelength operation.

This means that beyond the next 3 years, there would be the capacity to improve on 1Gb/sec bandwidth for the Learning Centre if so required and costs permitted.

Dedicated research networks
Alongside SuperJANET lie the activities of the research network of UKLight, a dedicated research switched circuit optical network and beyond that, GRID computing. The UKLight circuit-switched research network provides the infrastructure to demonstrate the feasibility and benefits of using switched lightpath technologies for e-Science applications, including visualisation of large datasets. This is several orders of magnitude faster than IP packet switched networks.  www.uklight.ac.uk

GRID computing
GRID computing is based on making use of spare CPU (central processor unit) cycles in ordinary users’ computers, connected over the Internet as a virtual supply grid. This enables huge combinations of computational power to be used for research when it would otherwise be wasted. The parallel capacity of GRID infrastructure and services is beginning to be opened up to applications in the (visual) arts, notably with the emergence of a joint research programme between the EPSRC (Engineering and Physical Sciences Research Council) and AHRC (Arts and Humanities Research Council). Access to GRID computing could in time enable museums to access data intensive simulation and visualisation applications, to enable creative interpretations of phenomena and scenarios and thereby for learners to interact with that data.  www.grid.org

It is unlikely that the V&A would generate the need for these kinds of facilities at present but the point is, that there could be the opportunity in future to explore access to high speed research networks via the connection from Imperial College if ever the need arose. Visualisation is one research area of UKLight and museums and galleries could eventually benefit from this. Other potential applications are super high definition cinema!

Beyond the UK research network, extension of increasing amounts of bandwidth to the home by commercial network operators continues. This is via cable at 10Mb/sec (ethernet over cable), via proprietary technology over DSL (digital subscriber line) and wirelessly, to cope with proportionately increasing demands from gaming and comparable bandwidth intensive applications. Via the Regional Broadband Consortiums, all secondary and most primary schools now have broadband. Videoconferencing facilities for schools via SuperJANET and other network operators have been piloted with a view to operation by 2007. The V&A has participated in these trials.

As long as the base network infrastructure and bandwidth within the V&A is capable of upgrade to match developments as they emerge, and costs for this can be met, then base connectivity will be secured.

1.1.2 Wireless networking
Wireless networking focussed on the 802.11x protocol is will inevitably increase in bandwidth, beyond which optical wireless point-to-point is now achieving 1.2Gb/sec. Security and authentication continue to be aspects of wireless connectivity that require maximum vigilance. For consumer and business markets wireless will continue to enable solutions to a diversity of scenarios, including learning and training. Together with mobile devices, wireless networks play a major role in underpinning location aware experiences (see below).

It is worth noting that eg BT are sponsoring research into extending bandwidth for broadband to domestic markets, by use of wireless for the last link into the home as part of Local Loop Unbundling (LLU). BT is also trialling this in 2 UK areas (Belfast and Birmingham) prior to rollout of increased bandwidth. LLU involves the final length of network infrastructure from the local exchange to the kerb in the process of opening up BT’s monopoly of the telecoms infrastructure to competitors. By 2010 UK broadband penetration is forecast to cover 80% of homes.

Wireless broadband is also being tested by the EC funded Capanina Consortium www.capanina.org Capanina aims to deliver wireless broadband at speeds of up to 120Mbits/second from solar powered HAP aerial platforms (HAP – high altitude platforms) such that rural, suburban and moving users can have cost effective broadband communications. The ultimate aim is to have a number of High Altitude Platforms placed in the stratosphere at altitudes of around 20km, such that one platform can serve a region around 60km across. Recent tests have proved successful so far.

The implications of this are that cost effective techniques are being trialled to ensure that
a) rural areas will be able to receive high capacity broadband, so removing the problem of low population areas being regarded as non-viable for broadband enabling of local exchanges. This could enable the new Learning Centre to extend its reach into communities it would previously have been unable to reach.

b) mobility will be no bar to use of bandwidth, perhaps enabling mobile artists’ performances/installations/other communication

Wireless broadband on the move is not new, as many airlines and rail operators provide this; but the question of who pays is usually at the centre of (any resolution to) obstacles to provision. For this reason a cost effective mechanism is of interest.

1.1.3 P2P networks: Bluetooth
(an open standard created by Ericsson for short range communications in ad-hoc wireless networks)

A major trend is that boundaries between different levels of connectivity are dissolving in favour of devices being able to move seamlessly between networks and protocols. This is opening up opportunities for, for example, streaming video from mobile phones running Bluetooth. Much work has still to be done to resolve technical problems but the aim is interoperability between networks.
Perhaps more pertinently for interpretation of cultural heritage, the ability to create ad-hoc peer to peer (i.e. person to person) networks comes closest to the personalised learning experience sought by some current learning approaches.

Personal area networks (PAN) are also enabled by wearable computing (see below), although the problems of network recognition, synchronisation and handover are not trivial to solve.

1.2. Systems and selected hardware

1.2.1 Operating systems:

Windows Vista: Microsoft’s new OS (operating system) is scheduled for release end 2006. Consideration will be needed as to whether Learning Centre pc specification should be based on this or on any continuation of Windows XP as throughout the wider V&A. Licensing structures will need careful evaluation as Microsoft are attempting to use Software Assurance to leverage lock in for some categories of the main licence structure.

Apple & Intel: Apple have announced in recent months the intention to move from IBM to Intel for their processors, with emergence of hardware probably mid – late 2006. This has led to speculation and debate within the Mac community and wider Apple-related IT sector. The essential consideration is, aside from whether the processor switch is an improvement/advantage from varying viewpoints, that it will take time for versions of the OS and software applications written for it to settle down. If the Learning Centre is to purchase Apple equipment then this will need investigation and evaluation.

Linux and Open Source

Linux is the Unix-like operating system kernel that runs a computer and is the underlying theme for which many variations have been written (e.g. Linux Red Hat runs on the V&A’s servers, many people use the Gnu or Suse desktops). It derives its name from Linus Torvalds, the Finnish computing science student, now a veteran guru of the Open Source movement, who wrote a part of the kernel in 1991. It is widely used to run Open Source software and many proprietary applications (except Microsoft’s).

Open Source is the term used to describe the development of software on an open basis, with source code freely available to developers for widely shared inspection and improvement. It is generally agreed that this makes for more rapid and transparent development of software to higher standards of security. This contrasts with the “closed shop” model of development within e.g. Microsoft where only a few programmers see the code and the released product is a “black box” that does not permit inspection by anyone else.

With IBM’s and others’ multimillion dollar backing of Linux and Open Source via establishment of the Open Source Development Labs, Open Source received significant underpinning. Since then Open Source development initiatives and applications have continued to grow steadily. The main advantages of deploying open source solutions are reduced costs (because proprietary licencing structures are avoided), better operating security and access to the underlying code for customisation.

There are many more important beliefs and philosophies that lie behind Open Source, in copyright (or copyleft) for example, but the essential difference with “closed” software is that the Open Source product itself is more robust i.e.,
tried and tested). It is also cheaper, the commercial returns lying more with user support and licensing. Around this contrast with the proprietorial system of software development there have been many industry debates and battles, and Open Source is gaining ground.

Open Source take-up is likely to continue to expand with its adoption by governments and business on cost and security advantage. Open Source Academies have been established in the UK to advise business on using Open Source products and systems. Both the EC and the UK Government have recently launched extensive evaluation projects to quantify the advantages of using Open Source applications. Well known commercial software packages have their Open Source counterparts such as Gimp, the equivalent to Adobe Photoshop.

Continuing Open Source developments include strengthening interest in usability for design of desktop environments, which may overcome some of the shortcomings of the interfaces in comparison to Microsoft’s Windows and Apple’s OS. Current problems include proliferation of software licences and patent wranglings which could to some degree mitigate Open Source success to date.

1.2.2 Hardware
As indicated earlier, it is not the intention of this report to evaluate areas exhaustively, but more to focus briefly and selectively on developments that relate to the Learning Centre’s concerns.

As a general observation, because of the huge diversity of hardware that is and will be available for infrastructure, desktop and personal computing, it would make sense to ensure that connectivity is able to cope with as many different configurations as possible, particularly for connecting visitors’ own devices. This may point towards the advisability of keeping options on operating systems open, to test optimum combinations (see recommendations in main body of report.)

1.2.2.1 Mobile devices
As hardware packs more computing power and becomes lighter and smaller via advances in smaller and smaller component manufacture, this process is testing human capability to detect nuance. With mobile and wireless operators now offering multimedia services incorporating music and video, hardware design is responding with proliferating features underpinned by continued component miniaturisation. From unit sales worldwide, it is evident that the mobile phone is the single portable device of choice for many users. Mobile phone penetration is moving down the age cohorts – increasing numbers of younger children use one, despite the health warnings over use.

Beyond the mobile phone lie a plethora of devices and functionality. Apple have recently added video capability to the iPod, which could find good applications for learning if content partnerships for it emerge. The video iPod launch also ties in with movie-making tools that Apple bundles in with Quicktime 7 Pro. It remains to be seen to what extent video podcasting takes off.

1.2.2.2 Fixed display
One area of hardware undergoing step changes is that of visual display technologies. These step changes are of obvious relevance to museums and
galleries. A recent survey noted that after half a century’s devotion to the cathode ray tube and the TV and computer based screen, “we are only at the beginning of a period of huge flux in display technologies....and that these developments are likely to have a profound effect on education” (JISC TechWatch report 01/05 Advanced Display Technologies)

The elements of these developments are best summed up as
- quality of the image
- display processes and surfaces: screen or no screen? Where can the image (not) be displayed?

Specific aspects of advance are:

Flat panel display – currently dominated by LCD, field emission displays (FED) based on carbon nanotubes, light emitting diodes and surface conduction emitter displays are close behind with claims of lower costs, fast image response times and sleek looks. These are predicted to start appearing on the market late 2006 – early 2007.

High definition TV and DV digital video – Europe currently lags behind US and Japan but is now catching up. The three most significant aspects of HDTV, beyond obvious improvements in image quality, are:

- HDTV is based on widescreen format (16:9) with different standards between the US (1920 x 1080 pixels) and Europe (1280 x 720 pixels) beginning to merge to a common resolution
- The appearance of two blue laser based distribution formats, HD-DVD (15Gb capacity) and Blu-Ray (25Gb capacity)
- The incorporation of copyright protection in distributed content (HDCP) – HD disks will not permit copying/writing to as current DVD disks do.

In addition, projection systems and computer monitors will need to include HDCP compatible connection for viewing HD-DVDs.

All these factors will need to be considered when revisiting equipment specifications for the Learning Centre. In addition, as display technologies can be a vital adjunct to most people’s understanding of representations and interpretations of museum objects and their contexts, the V&A has an opportunity to make a statement here as a national museum of art & design.

Other display related developments:
Flexible displays/e-paper - with advances in electronic printing onto ultra-thin substrates which can then be rolled up, there open up some very interesting possibilities for using these digital technologies in a museum learning environment.

3D
3D image capture systems such as 3D scanners have been around for a while, but affordable display systems are less developed.
With 3D computer monitors predicted to be 3 years away from this capacity, and 3DTv 8-10 years away, research into visualisation technologies continues apace. Markets for e-learning, gaming (both for entertainment and as a learning technology) and other entertainment modes are driving this research.
Research into 3D and virtual spaces as museum learning environments have pointed to promising opportunities. The EC funded project SCULPTEUR has included V&A participation in screen based 3D environments as learning spaces [http://www.sculpteurweb.org/] and this should be built upon. Near to eye displays – these are used in industry, service and specialised sectors (for example to enable firefighters to read a map or ground plan of a building on a head-up display, as they move through that building in thick smoke) important for personalisation and for overcoming the current display limitations of hand-held devices.

It is obvious that these display technologies have good potential for museums and galleries, both as conveyers and interpreters of information, and as technologies that need content to develop – and museums and galleries hold content in abundance.

1.3 Software, content licensing and Web:
Because museums are strongly positioned to provide content as a driver of technology, and receive public funding, questions of digital rights management (DRM) and copyright are essential areas for strong technology solutions. The question of who has what access to what content and facilities over the Learning Centre network will determine the technology approaches used.

The topic of software and licensing is extensive and complex and as such lies outside the scope of this report. Brief mention of it is relevant here as the Learning Centre’s use of technology is very likely to depend on reuse of digital content in some form for some activities.

A recently published report on the Creative Commons licence [http://www.common-info.org.uk/docs/CC-Report.pdf] and the Creative Archive initiative of the BBC [http://creativearchive.bbc.co.uk/] (with two differences, similar to the Creative Commons recommendations)

together point to how best to define and convey the potential of publicly funded digital content for non-commercial use by users and reusers. The intention has been to simplify the sometimes tortuous process of applying for copyright clearance from copyright owners and to outline a series of licences to cater for most non-commercial needs. This has obvious benefits for the education sector.

As regards licences for use of software (as opposed to reuse of digital content) two points for consideration are:

- Licence structures for proprietorial software need careful evaluation for any likely future implications before committing to;
- Licences and patents for some Open Source products have been mired in legal disputes in recent years for which reason equally careful approach is required

Web technologies and applications:
An in-depth forecast for these is beyond the scope of this report, but areas to track are middleware (providing value added functions and services such as authentication) and standards development for web services.

An important trend is the simplification of web programming, with code behind applications moving towards modular chunks which can be more easily assembled by users rather than developers. This means in time that it may be possible for educators rather than developers to build web based environments for the Learning Centre website, and engage online visitors with tailored offerings.

In contrast to models of computing which assume a familiar user focus – the screen, some input device (mouse, joystick), some output device (printer, headphones), we now touch briefly on more pervasive, ubiquitous models of computing – the “sound-surround” of applied computing.

As these models and concepts develop, they dissolve familiar paradigms of computing (seated at screen, using a handheld device) and move computational power – and intelligence – into a variety of environments. The Disappearing Computer is the apt title of the EC IST Framework 6 Future and Emerging Technologies theme ([http://www.disappearing-computer.net/](http://www.disappearing-computer.net/)). The recent V&A exhibition Touch Me illustrated some of aspects of ubiquitous and tangible computing through tactile engagement.

### 1.4 Ubiquitous Computing

Ubiquitous computing ("UbiComp" for short) is best defined as computational capability embedded in environments, in which users may be present. Remote sensors, touchpads, microcameras, RFID tags and other monitoring and input devices are linked by wireless networks to central data storage and artificial intelligence able to reason about that data. The user may or may not be able to engage with this capability through some kind of dialogue, starting with simple actions eliciting a response from the system, through to modelling of the user by embedded artificial intelligence capable of sophisticated reasoning.

The prime concerns of ubiquitous computing are

- How to make the user aware that their environment may have sensors and other devices embedded in it
- How best to give the users clues (or not) to engage with their environment
- Questions of privacy and security for the user – is data from their engagement with the technology being used, by whom, and for what purpose?

Ubiquitous computing is potentially an exciting computing paradigm for the learning experience as it can make use of all senses or a combination of them, simultaneously; but the technologies are can be complex and issues of privacy and security are major concerns.

Ubiquitous computing can be further refined as location based experience, implying a subtle shift in the user’s perspective from passive to active engagement. The use of the word “experience” is significant – see below.
Location based experiences
These can combine mobile devices, wireless networks and sensor
technologies to provide a context related experience with a learning outcome
in mind, or to explore people’s reactions to engaging with disguised
computing capability
http://www.welfare-state.org/current/projects.htm#meta

Location based technologies have been used in museum/gallery
environments for context-aware content delivery. However as with ubiquitous
applications, they raise important questions of user privacy. They illustrate
well the potential conflicts between implementation of advanced technologies
and public perception of the darker side of those technologies, for example
large commercial retailers’ use of RFID tags for product tracking. The tailoring
of content to user location by mobile phone and commercial network
operators will grow with the need by these operators to move up the value
chain to ensure profitability.

Location based experiences can be incorporated into wearable devices with
positioning technologies such as GPS and RFID tags. This dispenses with the
need for a handheld device, important in some industry sectors. The
application of wearable computing could be a memorable learning experience
for engaging with a costume collection, for example.

Intelligent agents and virtual environments
Beyond location based experiences lie intelligent virtual environments –
the convergence of artificial intelligence and virtual reality, where embedded
intelligence and reasoning capability in both the environment and agent users
can interact with a human user.

Intelligent robots
Robotics as a research field has seen considerable advances in recent years,
and acquired a degree of popularity with tv programmes and competitions
such as Robocop, and robotic toys. Remote controlled robots are used to
achieve tasks in environments too dangerous or hostile for humans such as
depth sea or military scenarios. This is now finding application in more
domestic environments with robotic home helps now available in Japan.

Embedded intelligence in robots and agents has always been a highly active
research field with now widening interest and collaboration. One significant
development in the last decade is embodied conversational agents (ECAs),
driven by natural language processing and reasoning capabilities. These are
already in use by eg the financial services industry, to assist people making
choices about mortgages, loans and in other interactive scenarios.
www.lexicle.com/smartfridge.

Intelligent agents able to converse with and reason about human
conversational partners could have possible applications in cultural
interpretation.

Increasing computing power has enabled rapid advances in the rendering of
lifelike qualities of agents and of virtual environments – computer generated
actors (or synthespians), characters and environments have been integral to
many recent films (The Matrix I-III, Shrek, Finding Nemo)

The significance of these now fast evolving technologies is:
The computational advances they represent;
that they are increasingly shaping people’s experience of the visual world, particularly for younger generations immersed in gaming and other virtual environments.

Because technology developments cannot be considered independently of users, it is appropriate to conclude with a quick look at some social factors.

2. Social factors: These are briefly profiled as:

2.1 The inner personal spaces and communities of younger age groups, enabled by mobile technologies and the Internet as a parallel to and substitute for physical space;

Increasing mobility and home working among sections of the working population;

A gradually ageing population requiring support from assistive technology. Assistive technology installed in a person’s home is the difference between continuing to live there longer, more independently and securely in old age, and moving into institutional care. Inclusive design (i.e., design that can be used by a wide range of human capabilities, not just the young and fit) is attracting interest and gathering momentum with the realisation by designers and manufacturers that there is a business case for it.

2.2 Focus on the home

The location of the home is now a major market focus for many IT sector companies and network operators who previously focussed mainly on business and corporate markets. This focus is primarily as an entertainment centre, but also as a learning environment. Working from home as a technology supported activity has become widespread across many industry sectors.

2.3 Government and education:

This topic would require far more space than could be covered here, but the following strands are topical aspects of current UK government policies of lifelong learning:

- personalisation – e-portfolios, DIDA (Diploma in Digital Applications)
  e-portfolios are attracting intense interest at present. The intention is to create in effect a lifelong learning digital portfolio of achievement to move with the learner through the education system and into employment.
  However, resolutions are needed as to the question of where the digital material is hosted – because this brings with it questions of control, both over the individual’s content and over the IP of their work.

DIDA – Diploma in Digital Applications  http://dida.nwlg.org/
This is a consortium-developed suite of entirely digital qualifications to stimulate students’ creative abilities, motivate learning across a range of subjects and and prepare them for the world of work.
In addition to a range of learning outcomes, the aim is to teach use of digital technologies across the curriculum, not simply for their own sake. The intention is for created resources to be searchable to aid the process of reflection.
• learning models - 3D gaming, virtual environments
   As with e-portfolios, gaming is attracting evident interest in the education sector as a learning mode. This is both driven by the need to engage younger users in learning modes based on environments familiar to them, and as a basis for acquisition of wider problem solving skills.

   As an interactive phenomenon, gaming brings challenges of engagement to learning from museum environments.

All the above move e-assessment and digital skills to the forefront of the learning agenda.

Conclusion

Connectivity
Increasing bandwidth on fixed networks is being paralleled by similar developments in wireless and mobile networks. The expanding capability of handheld devices, particularly the mobile phone, together with personalisation of content means learning is increasingly freed from constraints of fixed location, and increasingly tailored for mobile and context dependent use. This will continue to be a major trend, partly because it is technically possible, but also because entire generations are moving through the education system in this way and will expect these technologies to form a percentage of their learning modes.

Hardware/devices
Contrasting with the crystallisation of mediated content into a handheld device, developments in portable display technologies such as head up and near-to-eye displays offer the opportunity to merge users’ attention directed at an object with information displays about that object. This reintegration of attention with gaze, away from downward focus into the hand (and thereby inevitably away from other foci) offers intriguing opportunities for interpretation and learning in museums and galleries.

Location, context and users
Embedded intelligence in agents, environments and virtual environments are opening up new opportunities for social computing, and also new challenges to user engagement, privacy and security. These considerations and more are contributing to increased market interest in researching and defining user experiences as an underlying methodology for design and prototyping of technology products.

In this diversity of future trends, technologies and content applications there is a big opportunity for museums if they can form the right partnerships and find the right resources. This is to move beyond current computing conventions and explore more exciting learning landscapes that map emerging technologies onto cultural resources to create an inspiring learning experience.
APPENDIX B  FUNCTION AND SETUP OF DIGITAL STUDIO: POSSIBILITIES

The equipment outline for the Digital Studio given in the costings is indicative of immediate basic requirements only. By the time the Centre opens, these are very likely to be overtaken, both by the continuous progress of technology and by revised models of teaching and learning.

The rationale for the thoughts below is based on the need to anticipate not just the way that technologies are likely to move on; but where the opportunities lie to best exploit these technologies in environments for learning about, and from, art and design.

Links between spaces

The role of the Digital Studio in the Learning Centre is intended to be central. However it should try to be so in such a way that other spaces and functions link naturally to it. That is, it should form a natural extension of these spaces by its use of technologies. This will obviously be assisted by installation of enabling equipment, but also should be achieved in such a way that its extending role and purpose are clearly linked to other areas conceptually, opening up horizons for future exploration.

An example might be a link between the Digital Studio and Studio 1 – the Art Studio – where an artist demonstrating techniques can be relayed to and enhanced in the Digital Studio, in addition to other areas. That is, the Art Studio points to creative craft techniques as the originating concept, and these are given intriguing extension and enhancement via digital technologies in the Digital Studio. These might for example include augmented reality scenarios, where people can experiment with the original demonstration and overlay it with their own work created digitally, to explore concepts of conjunction between manual and digital.

Another example might be the relationship between the auditorium and the Digital Studio. If the auditorium is designed for convention and presentation, then the Digital Studio might be the origin of intervention to alter the audience’s perception of what is being presented. This could be particularly relevant to artists’ performance pieces. That is, for each space in the Centre, the Digital Studio could act as leverage, both technically and conceptually. Other Centre spaces could relay outputs to, and accept inputs from, other rooms, but the Digital Studio would be unique in leveraging them via digital technologies.

Links between learners

Recent coverage of formal and informal learning points to the influence of context and conditions on the learning experience. Museums should be well positioned to influence conditions to beneficial effect and the new V&A Learning Centre could be an ideal laboratory in which to extend this theory. However museums cannot always ideally influence learning conditions, usually due to constrained resources. Whatever the opportunity to influence, any learning experience should be memorable, very preferably pleasantly so.

The role of personal devices and personalisation technologies should be exploited to anchor the memorable qualities of learning in the Centre, and within the Digital Studio. Looking ahead to 2007, all the indications are that if there is one device that
younger users are likely to own then, it will be a smartphone with full video and audio capture and internet connection capability. Smartphones are widely available now and by 2007 will be the device many young people will own. Personal devices will be, as they are now, both learning tools on their own, and as a bridge between other spaces.

As instance of these other spaces, the mapping of the Digital Studio to the Learning Centre (and Museum) website, and vice versa, could be explored. That is, the reconfigurability of people’s personal spaces in the physical Digital Studio could extend into a virtual space on the website, and vice versa. The aim would be to anchor recollection of learning in both spaces that mapped either way, and to avoid breaking the thread of memory between real and virtual, wherever the user was. Personal devices could bridge the spaces if required. How best to achieve both bridge and spaces?

At present the specification of equipment for the Digital Studio assumes some form of group teaching based on modular supply of laptops and movable rear screen projection. This may meet some needs but clearly there is a need to open up future scenarios to other possibilities. Ideally the Digital Studio should be a very flexible space within which a range of teaching and learning takes place. For example, for some needs it might be appropriate for all the furniture to disappear, and for the entire space to be equipped with and activated by sensors to enable learning through movement. In this respect it might come closer to the stipulation in the brief that “it should not feel at all like school” and to the expressed wish of the schools participating in the consultative study, for movable, interactive furniture and for contrasting spaces (loud, quiet).

There could be scope for extending this to enable Digital Studio users to personalise configurable spaces. Perhaps some part of the Studio could be set aside as a digital den – to retreat to for personal absorption or to share group experiences. Perhaps this area could be responsive to the idea of “the technology enabled room” to enable children, or indeed adults, to configure their ideal learning space. Even if it were not possible to replicate at home, it could be accessed over the web.

Visitors to the website could also contribute to this – their ideas and settings could map to the Digital Studio environment and could form part of an experimental, and memorable, environment for learning. Perhaps, in the current climate of interest in e-portfolios, there might be a role for the Learning Centre to partner with eportfolio hosting organisations. These latter could supply the hosting for content, the Learning Centre the visual environment chosen by the user.

**Future learning landscapes**

If the modular classroom setup is likely to be a first practical step to equipping the Digital Studio, then future scenarios based on ubiquitous computing (embedded computing), augmented reality (digital projections onto real objects), tangible computing (objects with interactive digital attributes) and other responsive technologies could form a second subsequent phase.

In the learning landscapes of the near future, say to 2008, there would be good opportunities for museums to position themselves as testbeds of learning technologies. Much of what is currently used in schools is designed to provide a continuum, not push the envelope. Work done by NESTA on evaluating the use of digital technologies in museums suggests the teaching of visual literacy as museums’ unique contribution to learning.
If the Digital Studio could move on from the classroom model of equipment and towards a more extended model underpinned by applications of ubiquitous computing and augmented reality, then it could enable positioning of the V&A as a leader amongst museums in integration of these technologies with art and design based learning models – teaching “augmented visual literacy”.

NESTA’s work also underlines a danger that the current emphasis by the government on narrow measures of accountability could stifle incentives for the schools based sector to experiment with pushing the technological envelope – hence the opportunity for museums to garner the role of testbeds for future and emerging technologies. Augmented reality and ubiquitous computing applications in museums should enable contextual understanding of the interplay between people, collections and objects. This could be viewed as comparable to the deployment of sensor driven, data gathering applications of ubiquitous computing in the natural environment – aggregated data can be interpreted as patterns on which enhanced understanding can be built.

To do this, the new V&A Learning Centre would need research partners: these could bring expertise in development and application of leading edge technologies, and the Centre could offer exposure to real world scenarios with significant numbers of users. Partnerships like these need careful approach, as prototype technologies can be prone to being flaky (especially as configured in some university research groups) and dependent on individual expertise to reinstate. This could be problematic in the context of eager – especially younger – visitors expecting technology to work and encountering “out of action” notices.

However museums should aim for not so much as state of the art in technology, as state of the art in understanding what technologies are appropriate for what categories of user. The advantages for museums are that if they get this mix right, they can exploit to the full the emotional dimension of computing and thereby reinforce and embed a memorable learning experience.

On the assumption that they could use a range of digital technologies, what kinds are particularly suited to learning models and environments for art and design? This would require more space and time for discussion than is available here, and has been investigated widely elsewhere, but could include image capture and manipulation, both still and moving; augmented reality in the form of computer generated projection onto real objects; avatar and conversational agent technologies; virtual immersive environments, for understanding for example the original context of a design.