Arguing for e-exams

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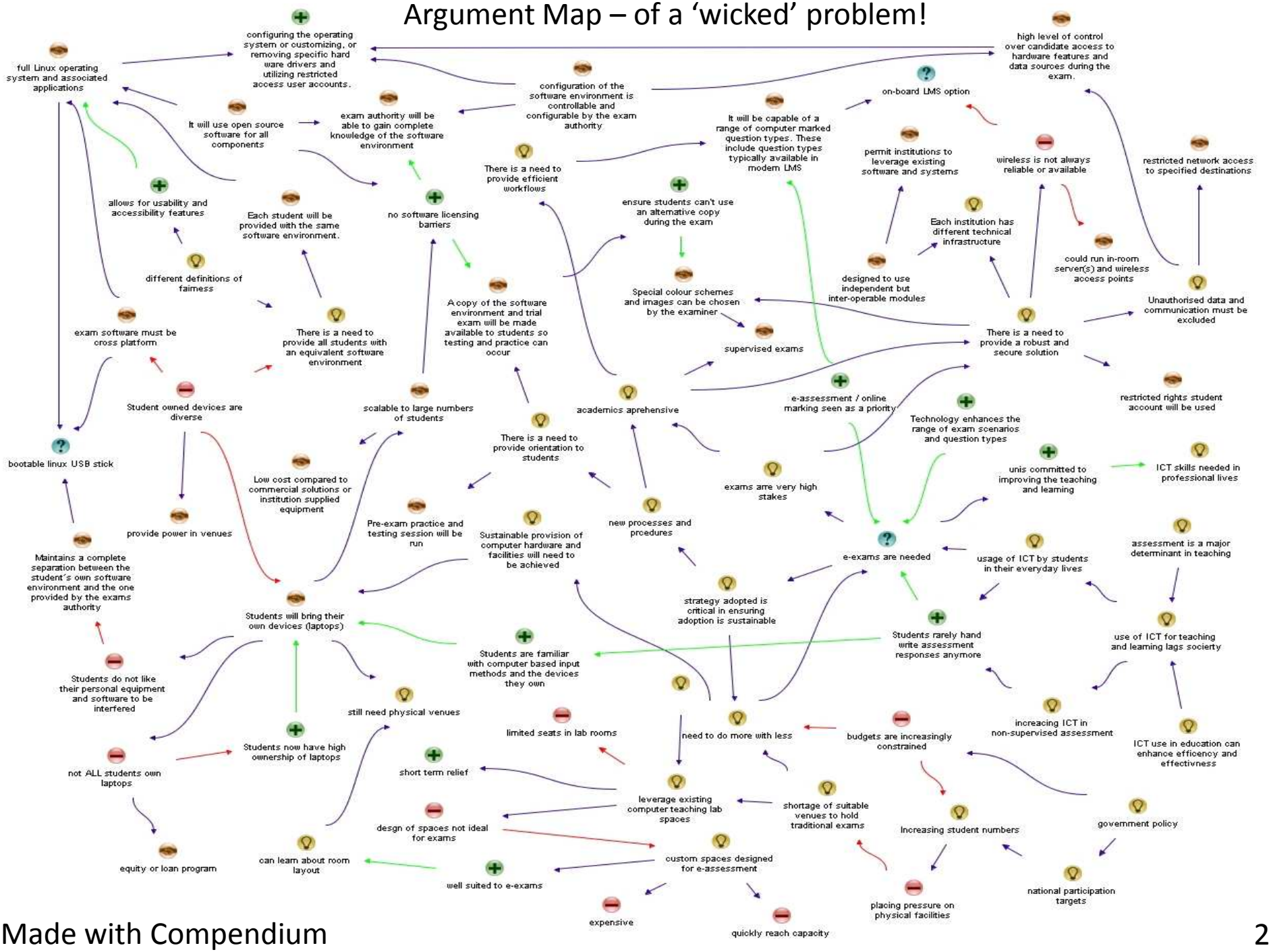
Argument Map – of a ‘wicked’ problem!



Drivers

National

- Realising unfulfilled potential in higher education -

  Federal government see ICT as holding great potential for ^ as it has done in other sectors of the economy (Gillard 2008).

- National participation targets
  - Higher student numbers... &... Constrained budgets...
    - Increasing pressure on physical facilities for exams
      e.g. UQ: 2007-2012 = 30K extra annual sittings.
    - Can e-exams help expand capacity?
- Is a lack of e-exams in higher education hampering the wider uptake of ICT in other areas of education?
  Ref- Andrew Fluck's experiences in Tasmania.

Drivers

Institutional

- Missions, strategic plans, learning plans and graduate attributes of Australian institutions:
  - Feature current knowledge, skills for the modern world... this means ICT skills.
- E-learning plans are significant activity areas with MOOCs, online learning, blended learning, flipped classrooms all depending on ICT success.
  - An internal UQ survey of senior teaching leaders placed ‘e-assessment / online marking’ at the top of their priority list for development.

Drivers

- Increasing use of ICT
  - for a range of daily tasks (ACMA 2012)
  - for delivery of courses and in progressive assessments
  - by students in their study (Riddle, 2008; Riddle & Howell 2008)
  - UQ student ICT survey (McManus 2012)
    - 98% ownership of mobile WiFi enabled devices
    - **91%** laptop ownership highest of any device
    - 80% of students accessing online LMS weekly
- The majority of students already have a familiarity with the technologies that can be used for e-exams

Drivers

- Hand written assessment decreasing
  - Course delivery increasingly online (blended or full)
  - Most non-supervised assessments such as reports, essays and quizzes done by **typing**.
  - The typed input becoming the dominant form of written communication, email, SMS, reports....
  - Students are now more familiar (and comfortable?) with typed input than the handwritten form particularly when it comes to assessment.
  - Complaints from students about long handwritten exams ...my hands hurt >.<

Drivers

- Technology opportunity – to enhance the range of exam scenarios and question types
  - Ability to incorporate a wide range of question types, *much more than just multiple choice!* (@.@)... fill-in blanks, hot spot touch to answer, calculated/numeric, sorting, short response, easy style, multi step scenarios, virtual experiments, software tools, multimedia elements including sound, video, virtual views, virtual spaces, simulations...
    - Examples at **TransformingAssessment.com**
  - Potential to provide individual feedback to students on performance in exams to close the 'feedback desert' (Scoles Huxham & McArthur 2013) of current exams practices.

So?

All of this ....leads to a growing disconnect between the way high stakes testing is conducted using pen on paper exams and students' everyday experiences.

Are e-exams are the next step on from computer assisted marking and e-assessment of progressive assessments?

An e-exams solution is needed....

But first some additional issues to help further refine the requirements...

Issues

- Fairness & Equity, but an inconsistency in definitions of ‘fairness’
  - same environment to all candidates
  - different environments to ensure accessibility to those with disabilities.

  Aim: Provide all students with an ***equivalent*** environment for reasons of fairness while catering to equity issues.

  Therefore an e-exam system needs to be flexible enough to cater for exam authority needs and student needs while maintaining a base level of equivalence.

Issues

Stakeholders

- Academics – Need professional development, documentation.
- Administrators – ditto.
- IT support dept – Need documentation, skills.
- Invigilators – Need training for ICT exam environments, need to be able to identify misconduct (easily).
- Students – Need orientation in regard to the exam environment.
  - Already done with paper exams (sample/past papers, mock exam sessions)

  Aim: Students should be prepared in a way that places them in a good position to concentrate on demonstrating their knowledge of the topic rather than the medium and mechanics of production.

Overall – Need transition strategies for phasing in e-exams

Issues

Exams are of the highest stakes – must be reliable and robust

- Need to be at least equivalent to paper based solutions in terms of reliability and validity ...
  - to be accepted by stakeholders (university administrators, academics, students, parents, employers, governments and the public).
  - or academics in particular will be reluctant to adopt e-exams.
- High risk – if things were to go wrong...
  - students affected with increased distress at a time of already high stress.
  - institutions risk loss of reputation as guardians of standards and as reliable accreditors of graduate achievements.
- Issues in the mix for an R&R exams solution:
  - stability and security of computer hardware, networks, software, and the physical environment includes:
    - controlled elements such as institution owned facilities/networks
    - uncontrolled elements such as student owned mobile communication devices.

Issues

During the exam

- Unauthorised data and communication must be excluded from the exam environment.
- Need a controllable, knowable (by exam authority) software and environment:
  - prevent students accessing unauthorised resources
    web sites, mobile devices, micro communication devices, other candidates, 3rd party helpers outside of the exam room, the hard disk drive of the computer...
  - network or wireless access prohibited or controlled
    to specific locations containing the exam questions and resources or to channels that allow secure transfer of answers.

Issues

Integrity of the exams process and platform

- Look to IT security principles:
  - **Confidentiality** (keep material on a need to know basis restricted to authorised staff/students using IDs, passwords, encryption)
  - **Integrity** (cannot be modified undetectably)
  - **Availability** (correct functioning, available, reliable. Be aware of planned IT outages. Have back-up and contingency plans in place, on-site IT help, secondary/spare equipment, bookings for alternative venues/times)
  - **Authenticity** (of materials, and the identity of the people involved. Iinvigilators should be able to easily identify that each candidate is using authorised software).
  - **Non-repudiation** (e.g. students cannot deny they sat/submitted the item)
  - **Legal** conditions/restrictions (copyright, privacy, confidentiality, sensitive materials)

Issues

Efficiency

- Need to refine workflows to minimise manual processing
  - setting-up exams/scripts
  - retrieval of scripts/answers: network reticulation or batch processing
  - marking of student answers: accommodate automatically marked questions to be used when pedagogically appropriate
- Aim for the introduction of e-exams to be at least cost neutral over the longer term.

Issues

Provision of facilities must be sustainable

- How to provide computer hardware and facilities for large infrequent e-assessment events (exams):
  - Use existing campus computer labs? (Finite in number, small 20~ish room size, problematic layouts/poor design [Dermo, 2012])
  - Build dedicated e-exam space? (good design, but costly, although capital cost done once, still finite, potentially low utilisation out of exam periods)
  - Hire / build temporary space? (costly and high reoccurring)
  - share facilities between institutions? (scheduling issues)
  - provide each student with hardware ? (costly ~ give or rent to students? - reoccurring, maintenance?, low utilisation?)
  - *Rent or build options are not scalable or sustainable.*
- Given the already high ownership of suitable equipment by students -> how can we make use of this equipment?

Issues

- High ownership of laptops – we can leverage these
  - But ...
    - Diversity of devices (hardware, operating systems (Windows, Mac, Linux), software applications.
      - Need a 'cross platform' solution
      - Need to provide same (equivalent) software environment
    - A potential source of unauthorised assistance
      - Need ability to completely control student owned equipment for the exam duration – ref security principles.
    - Students have a lot 'invested' in their devices (for work, for study, for personal and social uses, etc)
      - Need to respect this domain, maintain privacy and integrity of student equipment.
      - Need to return student equipment as 'untouched' when done - separation of the exam environment and the student owned 'host' equipment.
    - Equipment does fail on occasion
      - Need appropriate back-up facilities and processes, data progressively saved, provide power, spare laptops etc

Issues

Varying technical infrastructure between / within Institutions

- How to:
  - Be applicable across the higher education sector
  - Fit into existing software and hardware landscapes
  - Leverage existing infrastructure
  - Cater for flexible needs
  - Not be a nightmare to support...

Existing solutions ...

Include one or more of:

- Built in quiz tools within a Learning Management System (LMS), not designed to be e-exams environments, students have access to other tools within the LMS. Thus requires invigilation - currently requires the campus labs...
- Tests and exams undertaken in fixed computer teaching labs on campus, spaces normally limited to 20 per room, finite number of labs, layouts often not suitable for high stakes exams.
- Proprietary testing software applications. dependent on the use of a particular operating system, few being cross platform. institution owned equipment need(?) many install invasive components into computers in an attempt to secure an inherently insecure environment.
- Outsourced testing centres or services, control is passed to other organisations/individuals. Mainly intended for small numbers, external/distance education students, tend to be costly on a per student basis;
- Online proctoring services, distance education /off-campus at exam time, raises risks of exam protocol breaches, intrusive software installed into student owned computers.

A gap

- Scalable, sustainable, supervised e-exams platform and processes that meet the needs of students, academics, disciplines, institutions,...

Options

- Buy in a proprietary solution?
  - Needs met adequately? Pedagogically sound?
  - Software $ licence fees – costly, reoccurring
  - Closed architecture and restrictions –
    - unknown internals
    - customisation and flexibility?
    - give to students for practice?
    - pull it apart for experimentation/ innovation /research?
    - new features to meet new needs? who decides?
  - Ongoing technical and procedural support?
  - Vendor lock in, can stop supporting it, can go broke.
- Build your own? - fully known but, all risk in one institution, knowledge in few minds – may leave, documentation, support, back-up, ongoing updates?

Nup, lets try something else...

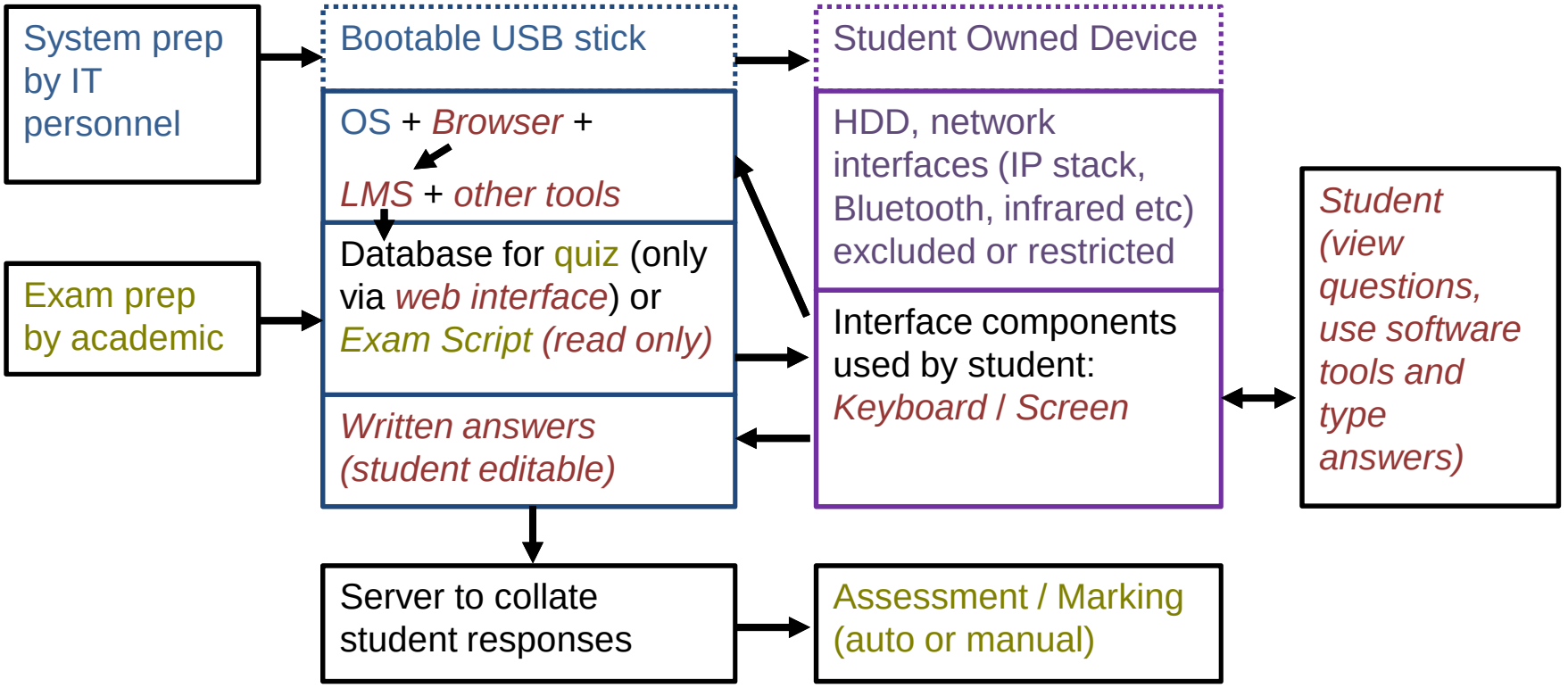
Options

- An alternative model – the case of Moodle
  - Open source, can be fully known
  - Pedagogically based
  - Free libre, available for experimentation, innovation, research, customisation and you can give it to students to take home.
  - Open development, new features from user demands not marketing demands, anyone with the skills to do so can contribute and many do.
  - Scalable from single user on a PC or USB stick up to 100K+ user online institutions (Open U UK).
  - No licence fees (and no resources spent on tracking licences, no intrusive audits).
  - However maintenance isn't free of costs though... but you can...
    - Support in-house or outsource to multiple ‘fee for service’ and ‘hosted solutions’ providers, no vendor lock-in.
    - Get help from the large, open support community of coal face users and technical developers.

A basis for further development

- The well developed ‘eexam’ system (**Andrew Fluck, UTAS**) – ticks many boxes:
  - Bootable USB sticks.
  - Full operating and application suite onboard.
  - Typed student responses (human marked)
  - Student owned equipment used as host and left untouched.
  - Open source code base, commodity components.
- Planned improvements - add
  - LMS / question engine for computer marked question types (Moodle?)
  - Electronic answer reticulation/workflows

Components of an e-exam system for BYOD



- Separation of student owned equipment and the exam environment.
- Exam authority has complete control over the exam software environment.
- Done in a non invasive way – student owned equipment is left untouched.
- Modular architecture so instructions can choose the features and mode of operation that suit them... leverage existing systems e.g own LMS etc....

Planned enhanced modes of use

- **Wireless always on** mode – where reliable, redundant and high capacity wireless network access exists in the exam room
  - Doesn't require an LMS on-board the stick
  - web browser to access a LMS server via restricted network
  - custom network config by institution IT (done once, reused)
- **Ad-hoc wireless** mode
  - LMS will be on-board the stick itself.
  - Periodic connections to upload/update student answers on a collation server in background or via a student initiated final submission with confirmation shown on screen.
- **Non wireless** mode
  - LMS will be on-board the stick itself.
  - Duplicating equipment to reverse copy student answer files/databases from the USB sicks to a collation location
  - Fall back in all cases - manual copying each student's answer file(s)

Research program outputs

- The e-exam system is situated within a wider research program to develop:
  - A working prototype of an exams platform and documentation allowing others to reproduce it
  - A set of example questions that can be used in e-exams
  - A research-informed set of good practice guidelines on e-exam processes and procedures.
  - A guide on preparing students for e-exams.

Further Information

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References upon request.

Citation

Hillier, Mathew (2013) An argument for high stakes e-exams, Transforming Assessment in a Digital Era conference, RACV City Club, Melbourne, 31 July.

Functionality & Strategy Summary

Utilise student owned equipment (BYOD). This will be in the form of a laptop along with any additional hardware such as separate keyboard, trackpad or mouse.
Enable the provision of an equivalent and controlled environment therefore addressing potential unfairness of disparate computer systems in any one exam.
Accommodate reasonable adjustments to cater for equity of access in terms of usability and accessibility resources. This should include features such as text size change, colour contrast adjustment, subtitles on video, transcriptions of audio tracks and to ensure the software environment can be used with alternative input devices.
Work on the vast majority of laptop hardware available in recent years. The ability to function on any Intel based laptops that can run MS Windows, Mac OSX and Linux.
Provide access to a loan or equity program for students who do not have suitable hardware.
Student owned equipment should be completely returned to its prior state after the exam event, leaving no trace. Therefore the system architecture must maintain a separation of the student owned portion of the platform from the exam authority controlled portion without the latter interfering with the former.
Capable of a range of question types including computer marked question types thus facilitating electronic feedback. As available LMSs Moodle and Blackboard.
Capable of sophisticated constructed answer questions that take full advantage of the capabilities of computerised platforms. Including specialist or discipline based software tools such as simulators, calculators, multimedia scenarios will allow students to build, experiment and produce answers within the exam context. For example students could run a simulated chemistry experiment and submit results or progress through a multi stage scenario with multiple decision points submitted for assessment.
Ensure students have prior exposure of the features of the software environment and the processes needed to undertake a live exam. This can be done through provision of supervised pre-exam test run sessions and mock exams to assist students to adjust. A copy of the software environment and trial exam made available to students for practice.
User documents and guides should be provided for students, academics and administrators.
Ensure appropriate transition strategies from paper to electronic. For example, a phase in period where paper and electronic exams are run side-by-side with students having a choice.
Allow institutions to choose the components and options that best suit their needs. Using a modular architecture and open source software for all components (e.g. for test creation, student software environment, question engine, backend post-processing) will allow institutions to put together custom configurations.
Institutions should be able to leverage existing software and systems as they see fit. E.g. use the e-exam software environment but linked to an isolated copy of their own LMS.
The exam authority should be able to gain complete knowledge of the software environment. Using the open source Linux operating system allows this to happen to a greater extent than closed source alternatives.
The configuration of the software environment should be controllable by the exam authority. This includes having high level of control over candidate access to hardware features and data sources during the exam. Options include preventing local hard disk access, excluding one or more network interfaces, restricting network access to a given destination e.g. LMS or exam server, using restricted rights student account so that students will not be able to access any configuration services e.g. root, sudo, system files. Again, Linux is highly configurable which makes it a good candidate for security hardening.
Exam invigilators should be able to easily check if candidates are using the authorised version of the software. Special colour schemes and images can be chosen by the examiner to be used for desktop images along with custom logos and sequence numbers printed on USB sticks will facilitate quick visual inspection by invigilators.
It should be possible to restricted network or internet access to specified destinations. This will facilitate specific access to chosen websites or to allow transfer of student answers using specified network protocols/ports to institutional servers.
It should be possible to establish secure and isolated wireless networks. For example, to run in-room server(s) and wireless access points as an isolated network in places where wireless infrastructure is unavailable.
Is should be scalable to large numbers of students. The BYOD approach means the number of computers required by students will scale exactly according to need. Given computers will be provided by the students themselves it is anticipated whole process will scale in a similar way to paper based exams.
It should be cost effective. The costs of using UTAS ‘eExam’ system has been found to be lower than that compared to commercial solutions. The BYOD aspect of the approach means equipment costs are greatly reduced compared to scenarios involving institution supplied equipment. The use of readily available open source software and commodity hardware meaning only minimal support is needed to keep the platform up-to-date. The ability to freely share the platform across the higher education sector should also enable economies of scale in terms of future development. Given the lack of proprietary or commercial licences fees the costs associated with tracking and auditing usage is eliminated.