University of Technology, Sydney

Faculty of Information Technology

Master of Business in Information Technology Management

The Australian Digital Theses Program

and the

Theory of Disruptive Technologies: a case study

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This Project B has been submitted as a requirement of the

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ABSTRACT

The Theory of Disruptive Technologies put forward by Clayton Christensen in 1997 has attracted significant attention. This case study tests the hypothesis that the theory is generalisable to new situations. It uses datasource triangulation by using document, statistical and interview analyses (including investigator triangulation) to apply the Theory to Australian Digital Theses Program (ADT) and finds that the Program may indeed be a disruptive technology in relation to academic libraries, universities and to the publishing industry.

However, it has greater potential to be disruptive in the latter, and to be a sustaining technology, as defined by the Theory, in relation to libraries and universities.

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Glossary of Terms

ADT	*Australian Digital Theses Program*
CAPA	*Council of Australian Postgraduate Associations*
CAUL	*Council of Australian University Librarians*
DEST	*Department of Education, Science and Training (Australia)*
Dublin Core	*The Dublin Core metadata element set is a standard for cross-domain information resource description (Dublin Core Metadata Initiative, 2003)*
MARC	*Machine Readable Cataloguing*
Metadata	*Data about data. Describes how and when and by whom a particular set of data was collected, and how the data is formatted (Webopedia,).*
Qualified Dublin Core	*Dublin Core metadata qualified by the addition of information. e.g. type of contribution made by Contributor, dimensions of an image, etc. (Cox, 1999)*
XML	*Extensible Mark up Language*

1. Introduction

The purpose of this case study is to analyse and understand the Australian Digital Theses Program (ADT) using the Theory of Disruptive Technologies (the Theory) to properly locate the ADT as a disruptive or sustaining technology in the following sectors:

- Australian academic libraries
- Australian Higher Education
- Scholarly publishing industry

I have assumed the Theory is able to be generalised and can be applied to new situations which have not been dealt with thus far in the literature.

I have chosen to use the ADT as an instrumental case study because of its short history. Its origins can be traced back to 1997, so it can be studied to date in its entirety. It can be used to gain a better understanding of the Theory and the issues surrounding it.

A further motivation for choosing a case study methodology in the Australian context is to increase the corpus of Australian case study literature.

2. Underlying sociological paradigm.

The underlying ontological and epistemological assumptions to this case study are functional in nature. The study seeks to explain the ongoing social order and orderly social change from an objective viewpoint, by applying and testing a theory. As an observer, rather than an actor or participant, I have attempted to remain objective and impartial throughout the study.

While acknowledging that human beings have the capacity to impact on their social environment just as the social environment impacts on them, the Theory of Disruptive Technologies is grounded in the assumption that there is a predictable causal relationship between a technology and the impact it has on the sector(s) to which it is relevant. Man impacts on his social environment by creating new technologies, which in turn can impact on him by disrupting the current paradigm and creating a new one.

In fact, Coser's interpretation of Conflict Functionalism can be seen as a very appropriate underlying sociological paradigm to the Theory, as it seeks to explain the role of conflict in stimulating technological innovation and economic change (Burrell, c1979. p.96).

3. Methodology

This case study takes a nomothetic approach by testing an hypothesis that the causal relationships predicted by the theory of disruptive technologies can be generalised to a new situation – the ADT. However, rather than employing scientific tests and quantitative techniques, I have used datasource triangulation (Stake, c1995. p.112) and investigator triangulation to validate my analysis (Stake, c1995. p.113).

Datasource triangulation has included document analysis, statistical and trend analysis and interviews with a range of stakeholders. Investigator triangulation has been achieved by having my supervisors read the transcripts of the interviews to supplement my analysis with their own.

4. Literature Review

This literature review is an edited version of one of my earlier works – a literature review of disruptive technologies (Lafferty, 2003).

Clayton Christensen first proposed the theory of Disruptive Technologies in his book *The Innovator's Dilemma: when new technologies cause great firms to fail* (Christensen, 1997). Using the disk drive industry to conduct a concentrated case study following the complete history of the industry, Christensen developed a theory for why mainstream, established, well-managed and successful firms fail when newcomers selling inferior technology enter the market. In 2000 he produced a revised edition of his book (Christensen, 2000).

The theory can be summarised as follows :

- Mainstream companies spend their time trying to meet the needs of their current customers, especially their top end customers. This means they constantly upgrade

their technology, often to levels way above what is required by the average customer, but is required or at least desired by top end customers.

- Mainstream companies manage their organisations well and listen to their current customers, responding to their demands and carefully monitoring market size and growth rate to ensure the organisation is meeting market demand, investing in areas where returns are highest and pursuing larger markets.

- Disruptive technologies usually start out with very limited functionality and usually only appeal to a very limited market. They are cheap and not very profitable (e.g. early personal computers, desktop copiers). Mainstream companies ignore them because they are marginal and they would not be able to sell them to their current customers.

- Disruptive technologies, over time, improve their functionality and eventually appeal to a broader market – usually a market that is not tapped by the mainstream companies.

- Eventually the disruptive technologies have enough functionality to be 'good enough' for most people – including a large part of the market currently serviced by the mainstream organisations. They are also cheaper. Suddenly the disruptive technology is acceptable and the mainstream companies lose their business to the smaller newcomers.

- Usually the newcomers end up with even bigger markets than the original companies and become quite enormous. At that stage, they become mainstream and the cycle starts again.

Christensen posits five principles to explain this apparent conundrum (Christensen, 2000):

Companies depend on customers and investors for resources. Those that don't meet the demands of *current* customers and investors don't survive. Thus, killing ideas that don't meet the needs of customers and investors is a successful strategy in successful companies.

Small markets don't solve the growth needs of large companies. Disruptive technologies allow new markets to emerge – usually small. Waiting for new markets to be 'large enough to be interesting' is too late if a technology is disruptive. Even companies that start off successfully because they can leverage a disruptive technology, become too big to repeat the success. As Christensen points out, a $40billion company needs to find $8billion to grow 20%. A $4billion company only has to find $800million (Christensen, 2000 p.xxiv).

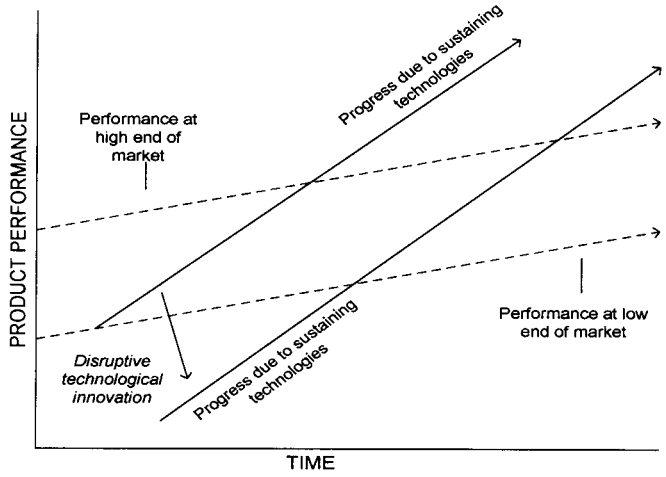
Markets that don't exist can't be analysed. 'Sound market research and planning followed by good execution according to plan are hallmarks of good management' (Christensen, 2000 p.xxv). However, with disruptive technologies, it is impossible to quantify future growth or returns. The appropriate approach with disruptive technologies is quaintly called 'discovery-based planning' – which in fact means 'wait and see'.

An organisation's capabilities define its disabilities. An organisation's capabilities exist independently of the people who work in it. An organisation's capabilities reside in its processes and its values. These not only define what an organisation can do, but also what it cannot do. Regarding processes, Christensen's argument is that because they rely on the same thing being done the same way every time, they work against an organisation implementing change.

'Values' are 'the criteria managers and employees… use when making prioritisation decisions' (Christensen, 2000 p.xxvii). Values may set out the profit margin required before a product is considered viable; they may identify the key stakeholders who are to be listened to when making decisions. Such values can make it impossible for a company to look at a new, small market.

Technology supply may not equal market demand. 'products whose features and functionality closely match market needs today often follow a trajectory of improvement by which they overshoot mainstream market needs tomorrow' (Christensen, 2000 p.xxvii). Such products, which under-perform today in terms of customer expectations, will meet performance expectations tomorrow.

Figure 1: The impact of sustaining and disruptive technological change



Customers will initially base choice on performance, but once there are competitors who equal performance, customers look to reliability.

When that is met by a number of competitors, they look to convenience.

When a number of competitors meet that need, then they look to price.

Another concept that Christensen introduces is that of *sustaining technologies*. These technologies may be radical and innovative, but they support the incumbent organisation in its core business – in continuing to do what it currently does. *Disruptive technologies* on the other hand disrupt the market, change the business paradigm and create a whole new market for a different product usually driving out the incumbent organisations.

In *Disruption in Education* (Christensen et al., 2003), the authors expand the theory to include 'disruptive innovation'. They identify two disruptive growth strategies -

Type 1: 'compete against non-consumption' and establish a completely new market for a product or service (Christensen et al., 2003 p.46). This targets customers who have not been able to do something for themselves, who will welcome a simple product without being demanding, and involves products or services that help customers do more easily and effectively the 'something' they are already trying to do.

Type 2: 'compete from the low end' by 'deploying a business model that profitably serves less-demanding customers that the market leaders are actually happy to shed' (Christensen et al., 2003 p.47).

Liefer *et al* look at the development of disruptive technologies in terms of radical innovation within the organisation. They claim that

> *'Radical or breakthrough innovations transform the relationship between customers and suppliers, restructure marketplace economics, displace current products and create entirely new product categories'(Leifer et al., 2001 p.102).*

They note that research has shown the radical innovation life cycle to be long term – often 10 years or more -which stops and starts and is generally unpredictable(Leifer et al., 2001 p.103).

4.1. Publishing & scholarly communication

Publishing has been in a state of flux for at least the last 8-10 years. Electronic versions of scholarly journals are increasingly either being published in tandem with print or in place of print. Considerable energy is spent on intellectual property rights in an electronic age, where technology can be used to moderate the effects of copyright law by limiting legitimate access to material. Solomon quotes Hanard on the practice of scholars 'trading copyright for managing the publication and dissemination processes' (Solomon, 2002). He states publishers' 'fiduciary responsibility is to their stockholders, not to academia, or for that matter, the public'. His particular concern is that he sees current publishers cornering the market on scholarly knowledge largely paid for by public money.

He goes on to note what he considers to be the 3 main purposes of scholarly communication:

- The dissemination of information
- The facilitation of the exchange of ideas (slow processes around publishing journals do not really achieve this).

- The formation of a constantly evolving archive of ideas (the dissemination of hundreds of copies to hundreds of libraries is a very effective way of doing this. The practice supports a widespread belief that paper will make the information immutable (tinker proof).

However, the publishing industry has already endured disruptions caused by changes in printing technology. While typesetting companies vied with each other to provide the highest quality typesetting, desktop publishing quietly moved into the low end of the market and when it was finally 'good enough' old-style typesetting systems disappeared (Alexander, 1999).

Alexander goes on to document the same demise of proprietary typesetters once postscript imagesetters became 'good enough'. He argues that today print publications and print products represent 'performance oversupply' – most readers only want bits and pieces of a publication and skip the rest. They would probably prefer to access/receive only the bits they want. A new generation is also developing where the Web is the *first* stop and paper the last and the item required is a chunk of information.

Publishing system providers are facing a situation where the Web is no longer low end, but in many cases the main game. They face the fact that a group of web-only publishing systems vendors is developing and there is a risk postscript imagesetters will go the way of their predecessors.

Alexander is of the opinion that at this stage, web-only publishing systems do not seem to be major competition, however, the writing is really on the wall. The only thing we can be sure of is that disruption will always take players unawares.

McKiernan has quite comprehensively summarised the sustaining and disruptive technologies currently playing a major role in scholarly publishing (McKiernan, 2002):

Sustaining

- Online submission of manuscripts, emailing to referees, electronic transfer back to the author, electronic editing and resubmission and accelerated publication
- Online registration of potential referees

- Alerting services when new material is published in a reader's area of interest
- Personalisation of lists of e-journals for individuals
- Electronic indexes and electronic searching
- Provision of referencing capability – eg export into Endnote, Reference Manager, ProCite and Medlars format
- Citation indexing
- Discussion forums and lists linked to individual journals or articles
- Dynamic articles - which authors can augment rather than submitting letters or new articles

Disruptive

- Indexing and searching - most indexing and abstracting services have already gone online, disrupting the previous business model, but most players have managed to stay in the game and thrive. However, linking out to databases and full text may challenge current publishers or lead to a re-organisation of the publishing industry to make this possible at all levels.
- Authors encouraged to submit supplemental data, including computer codes, with their manuscripts.
- Translation services – *Cultivate Interactive* is a product which enables readers to automatically translate English language articles into different western languages in real time. Readers of Astrophysical Journal can link to BabelFish and have the abstract translated.
- bmj.com – British Medical Association – NetPrints™ is a 'repository of non-peer-reviewed original research'. This service also provides an alerting service, including full citation and web address.
- Demonstrations – incorporation of multimedia components, animations of complex concepts, video, embedded video clips, interactive graphs, tables and 3D, 360° models.
- Inclusion of output files from programs, data sets.
- *Internet Archaeology* – 'links to interactive maps, export of data sets, including underlying geospatial data, to a local database or to a geographic information system' (McKiernan, 2002 p.315).

- *Science* – includes supplemental information such as 'tables of data, explanatory figures and details of experimental methods' (McKiernan, 2002 p.316).

Incumbent publishers are already fighting back on some fronts, resisting disruptive technologies and fighting to retain their revenue streams. NetPrints™ for example, lists 22 biomedical journals that will not publish manuscripts that have appeared on preprint servers. It also lists 29 that will (Netprints, 2003).

More radically, McKeirnan cites Bachrach who sees journals becoming object-oriented – 'component features, functionalities, and content are interconnected and cross-referenced into an interrelated, dynamic, interactive experience'. (McKiernan, 2002 p.318) – a radical departure from current publishing, but of great utility to many readers.

In considering the implications of the journal *Paediatrics* moving online, Kent Anderson predicts the demise of serials vendors, subscription agents and librarians in the dissemination of scholarly information (Anderson, 2000 p.237).

However, he acknowledges the pattern of access observed on the *Paediatrics* web site - demand for information at the article level - could pose a threat to publishers. He also sees a threat in document delivery companies, which can provide article delivery without the need for users to subscribe. Hence, the internet could also flag the demise of the subscription business model for journal publishers.

Anderson also speculates that the provision of peer review and indexing services may be examples of 'functional oversupply' described by the disruptive technologies model, making it easier for a new scholarly communication model to invade the traditional market. In contrast to Alexander, he suggests it is so long since publishers have faced a disruptive technology, they would have no idea of the minimum market requirement (Anderson, 2000 p.244).

Blackwell and Romano examine the emergence of the e-book in the publishing world. Blackwell notes that for publishers, e-books represent an enormous disruption to established models. A whole new approach to content management is required, with access required at chapter, section, page, word level (Blackwell, 2001 p.45).

However, publishers have a vested interest in retaining their own branding and remaining within their comfort zone in the market.

Almost ironically, Blackwell sees the role of vendors and librarians remaining the same.

Romano graphically describes the advantage of the electronic over the print product

> *'400 pounds and 2 million pages of printed text can be distributed on a one ounce DVD'.* (Romano, 2003).

He notes that there is currently no standard business model for producing and distributing e-books, but flags short print runs, print on demand and multi-channel distribution as models that will emerge.

The risk he sees in e-books is that in all current models, content is held on a remote server and that at any stage, the publisher could go out of business or choose to withdraw the title and there may be no remaining copy in the world – unlike the print paradigm which sees multiple copies distributed to multiple locations.

4.2. Higher & continuing education

Higher and continuing education can be looked at in terms of Type 1 and Type 2 disruptive opportunities (Christensen et al., 2003 pp.46-47).

With regard to Type 1 – competing against non-consumption, the authors note there are at least 2000 corporate universities in the US. In 2001, General Motors provided almost 200,000 student days of education (Christensen et al., 2003 p.48).

The theory of disruption indicates these programs will continue to improve until they threaten even the top business schools and the universities market.

Christensen *et al* also discuss Type 2 disruption, where alternatives start at the low end and become 'good enough' to take over the market. An example he uses is the 2-year community college program for registered nurses in the US, which provide nurses with the same qualification and skill level as 4-year university trained nurses – but without the theoretical underpinning. Students are moving away from the 4-year

model in favour of the shorter courses with 60% of registered nurses now graduating from the shorter course (Christensen et al., 2003 p.52).

In their move into Distance Education, where so many profits were to be realised, he argues that established universities fail because they are still 'competing against consumption' instead of targeting untapped markets or low-end of market.

In line with the theory of disruption, that the disruptive technology not only replaces a market but expands it significantly, Gibson believes disruptive technologies are

> '*likely to be increasingly effective in delivering relevant knowledge to larger audiences than are reached by current programs'*. (Gibson, 2000 p.74)

The National Academy of Sciences is far more radical in its expectation of disruptive technologies.

> *'Digital technology will not only transform the intellectual activities of the research university but will also change how the university is organised, financed and governed. The technology could drive a convergence of higher education with IT-intensive sectors such as publishing, telecommunications and entertainment, creating a global "knowledge and learning" industry'* (National Academy of Sciences, 2002 p.2).

The Academy considers the end of the university a distinct possibility unless institutions respond to disruptive technologies early and identify future or possible changes and develop appropriate strategies.

Several alternate models are appearing, although which disruptive approaches will become the successful ones is not yet clear.

Some models for the virtual university include

- Michigan Virtual University – a broker of educational products from a variety of institutions
- University of Phoenix – offering a complete array of university offerings, without the physical overheads

- Companies creating online universities and selectively outsourcing the various components

Moore puts forward some current models of collegiality – the cornerstone of universities, which are based on open-source models and a sharing of knowledge and information (Moore, 2002 p.44):

- Knowledgeware: MIT/Stanford collaboration on Open Knowledge initiative (http://web.mit.edu/oki/) aimed at developing a learning management system and providing 'web-based tools for storing, retrieving and disseminating educational resources and activities.'

- Courseware: MIT's OpenCourseWare – instructional materials available free on the web (http://web.mit.edu/ocw/) and MERLOT (http://www.merlot.org/home.po) web available 'knowledge objects' that have been evaluated for quality.

She suggests this approach may ensure more cooperation and quality control, prevent individual institutions trying to implement disruptive technologies before their time, and benefit higher education as a whole.

In the area of research, the Academy believes institutions seem more prepared to take on new technology.

Technology is

> *'enabling scientists to address previously unsolvable problems – custom-designing new organic molecules, analysing the complex dynamics of the global climate, or simulating the birth of the universe'*. (National Academy of Sciences, 2002 p.30).

Technology has in fact created a fourth modality of research: in addition to observation, theory and experimentation, we can now add *simulation*.

Again, with regard to research, new organisations, 'collaboratories' (dispersed networks of researchers and laboratories) have already been created – supporting the claim that new organisational structures will develop.

Researchers use virtual reality simulation of remote archaeological sites and materials, social scientists analyse massive datasets, and scholarship in general is moving from the individual, specialist scholar to multidisciplinary teams of scholars.

In teaching and learning, learners are driving change. They do not expect and are not used to learning sequentially. The traditional model of the University is threatened by

- Simulation
- Games technology
- Telepresence
- Teleimmersion (geographically separated sites collaborating in real time)
- Email - this has already altered faculty/student interactions
- Online teaching and learning systems

The National Academy of Sciences asserts that technology is fundamentally changing the relationship between people and knowledge, but the inertia in 'knowledge institutions' such as universities has meant change has been relatively slow (National Academy of Sciences, 2002 p.5).

If knowledge is the core of the university and technology alters the ability of people to process information by orders of magnitude, there must be an impact on how universities fulfil their missions (Wulf, 2003 p.15).

4.3. Libraries

From the above discussion, it should come as no surprise if at some time in the future, the university disappears in the face of disruption. However, it may be that the institutions survive and only their libraries disappear.

Studies have already shown that 88% of researchers and 76% of coursework students already go online as their first option in their search for information (Greenstein and Healy, 2002).

There is nothing to stop commercial or other competing organisations setting up an alternative to library reference services if they can provide them online. With so many information resources online, they wouldn't need physical reference resources at their fingertips to answer questions, either.

Giglio reports a company, BrainMass with tutors in 30 countries including Australia, available online ready to answer student study questions (Giglio, 2003). BrainMass is probably already answering 'reference' questions across most time zones.

The threat does not stop at the reference desk. Companies such as Questia (http://www.questia.com/) which styles itself 'the online library', are bypassing libraries and setting up subscription-based library services online, with access to e-books and e-journals (Cleyle, 2002).

Another service, eBrary works on a pay per print model and is trying to partner with libraries by having them provide links from their sites and receive a fee in return for connections made through their sites(Cleyle, 2002 p.289).

Cleyle urges libraries to 'walk away from the paper paradigm' (Cleyle, 2002 p.291) and realise they are no longer managing assets, but providing a portal to the world.

Finnerty uses September 11, 2001 to demonstrate how the current library model is no longer necessary. Lehman Brothers corporate library established itself in a hotel ball room. Vendors chipped in with electronic document delivery. Document production was arranged with another company and the Library met its user needs without any print collection (Finnerty, 2002 p.10).

If we listen to Hawkins, we would have to accept that the disruption has come and gone. He suggests that the traditional system of library collaboration and rigorous selection of information has been disrupted by the rise of freely available information resources on the Internet and claims

> *'there is no clear and defined role for libraries with regard to the digital resources accessible through the Net'* (Hawkins, 2001 p.54).

This seems to defy reality. Much of the information available electronically is *very expensive* and information users still want some assurance that the information they access is reliable.

While academic staff and students find the internet more convenient, library-deployed resources enjoy a greater degree of their trust (Greenstein and Healy, 2002).

Wulf asserts that 'the library must become the facilitator of retrieval and dissemination' (Wulf, 2003 p.16), as opposed to builders of collections.

However, the National Academy of Sciences manages to put Wulf's view in a more interesting form. In its future, information users will 'go direct' far more than they do now, with libraries somehow still acting as facilitators of information retrieval and dissemination. Disciplinary boundaries will blur, but there will be little distinction between the library and the information resources with which it is associated (National Academy of Sciences, 2002 p.33).

This is already happening to some extent. People who use libraries online don't always realise they are in library space, particularly if they have bookmarked resources. Oftentimes they just know they are 'on the Web'.

Wulf sees a future where the library 'collection' is automated: collecting, organising and summarising information.

It is worth looking at alternative future roles for academic libraries and librarians considering the views expressed thus far.

Crow and others see a role for academic libraries in the emergence of institutional repositories. With the incredible increase in the cost of electronic serials, aggregations and publisher databases, a movement is afoot to provide alternative models. One such model is a global network of interoperable repositories using Open Archives Initiative compliant software.

The model preserves the intellectual output of the institution while contributing to a *'fundamental, albeit long term change in the structure of scholarly publishing'* (Crow, 2002 p.5).

Solomon sees librarians as the logical ones to implement the archives and new business model as this is their area of scholarship and research (Solomon, 2002).

Crow sees librarians' commitment to preservation as the key driver for having them involved and again sees this as an opportunity for libraries to move from a custodial

role ‘to contribute actively to the evolution of scholarly communication’ (Crow, 2002 p.20).

I have experienced considerable defensiveness on the part of academic staff who do not believe librarians should be involved in shaping scholarly communication at all.

I also foresee the role of preservation being assigned to archivists, while the size of the repositories that might be required signals a significant role for IT departments.

It may be that the role of libraries will be to organise and provide access points, to assist users to find the information they want, and to collaborate globally to ensure interoperability.

Interestingly enough, Monash University has pre-empted even the predictions canvassed here. The University Library is heading up a project to establish an e-press to ‘publish journals and other academic resources online’ (Thorp, 2003). It will include peer review and approval by editorial committee. Monash University sees the e-press as part of a global movement to find more cost effective ways of publishing scholarly output.

4.4. Strategies

Christensen canvasses a number of strategies for addressing disruptive technologies that may threaten an organisation:

Try to accelerate the growth rate of the emerging market so that it becomes big enough quickly enough to justify entry. (Christensen, 2000 p.148).

Try to change the processes and values of the current organisation. (Christensen, 2000 p.197).

Wait until the market is big enough to be interesting before entering. (Christensen, 2000 p.148).

Place responsibility for commercialising disruptive technologies in organisations small enough that smaller revenues and profits are acceptable and meaningfully reflect their performance. (Christensen, 2000 p.148).

Allow enough in reserve to have a second or third attempt at the market.

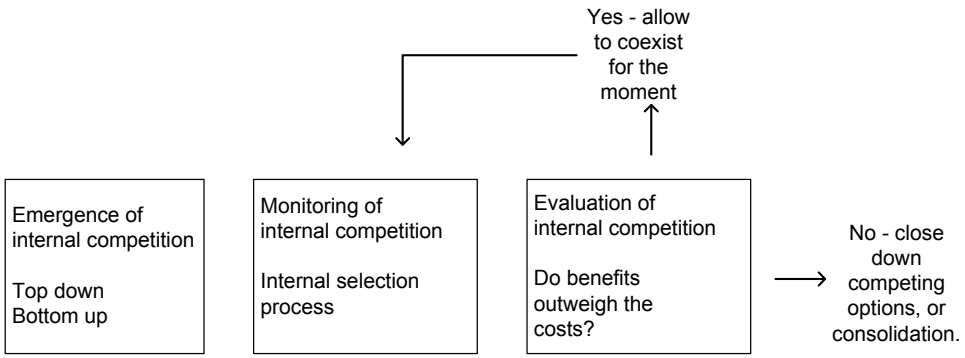
Engage in 'discovery-driven planning'. (Christensen, 2000 p.181).

Engage in 'agnostic marketing' - 'market under the explicit assumption that no-one… can know whether, how or in what quantities a disruptive product can or will be used before they have experienced using it' (Christensen, 2000 p.182).

Another set of strategies can be developed looking inward. Birkinshaw suggests establishing healthy internal competition to deal with competing technologies (Birkinshaw, 2001). His research was into R&D, but can translate to other methods of product development.

Because the organisation can't know what paths the future will take, or which products will be successful or not, internal competition, managed well, will create flexibility and ideas and new products for the future. This approach requires having teams working on several different technologies at once. He represents the internal competition life cycle thus (Birkinshaw, 2001 p.23):

Figure 2: Internal Competition Life Cycle



There are two ways of developing competing technologies -either *unplanned*, for example 3M discovering it had two divisions working on developing security gates, or *mandated* from above to ensure the organisation generates options from which it can choose.

Birkinshaw's strategies for managing this internal competition are :

- Have processes in place to catch competing products early

- Bring the competing units together as soon as possible – they will bring different perspectives and technologies and will either develop one better product, or improve both products.

- Accept co-existence of the products as a possible outcome – with market uncertainty it can be risky to close any project down prematurely. He uses Ericsson as an example – it had three mobile phone technologies developed in tandem but when there was no agreement on global standards, it found it needed all three to cover different markets.

- Manage the 'losing' team – all teams contributed to the outcome and should be rewarded and encouraged to continue to generate ideas and compete.

Geroski's strategies revolve around identifying threats early and being prepared to act (Geroski, 1999 p.111):

- Identify a consumer need not currently being met
- Look for economic ways to meet the need
- Iterate the first two steps until a viable activity to meet the need has been identified
- Identify how distinctive and sustainable, this activity is (e.g. it can't be easily copied, won't die soon)

This requires that the organisation look at itself without any preconceptions or entrenched ideas, or the feeling that current practices need to be protected and not cannibalised. He suggest having someone from outside the organisation look at it with fresh eyes.

He quite rightly states that all the current activities in the organisation will disappear at some time. The important thing is knowing when to discontinue an activity and introduce a new one.

He also suggests that once an organisation knows what might be the disruption, it can begin to identify which competitors might have the capability. Once they have been identified, they can be monitored to see if their pattern of investment suggests they are

accumulating the resources to make a move. The organisation must then try to be first mover or close second mover.

5. The Case study

5.1. Description of the Australian Digital Theses Program

The Australian Digital Theses Program (ADT) is administered by the Council of Australian University Librarians (CAUL). Its aim is 'to establish a distributed database of digital versions of theses produced by the postgraduate research students at Australian universities' (UNSW Library, 1997) and is limited in scope to research – Doctoral theses and Masters (research) theses. It provides a 'single point of access to Australian fundamental research' (CAUL, 2002).

The ADT consists of a central repository of metadata describing Australian research theses which provides linked access to digital versions of theses residing in local repositories hosted by individual Australian universities.

The central repository is hosted by the University of New South Wales Library, which also provides technical support to members.

The ADT is overseen by a Policy Committee, which consists of representatives of CAUL, the National Library of Australia, the publishing industry (ProQuest Learning and Information), the Council of Australian Postgraduate Associations (CAPA), and the Deans and Directors of Graduate Schools (DDOGS) (Wells, 2003).

The Program began in 1997 as the Australian Digital Theses *Project* involving 7 institutions and funded by an grant from the Australian Research Council. It became a formal Program of CAUL in 2002.

The original partners were (UNSW Library, 1997)

- University of New South Wales
- University of Melbourne
- University of Queensland

- University of Sydney
- Australian National University
- Curtin University of Technology
- Griffith University

The ADT also has international connections, as a member of the international Networked Digital Library of Theses and Dissertations (NDLTD) whose stated objectives are (NDLTD, 2003)

- '*To improve graduate education by allowing students to produce electronic documents, use digital libraries, and understand issues in publishing*
- *To increase the availability of student research for scholars and to preserve it electronically*
- *To lower the cost of submitting and handling theses and dissertations*
- *To empower students to convey a richer message through the use of multimedia and hypermedia technologies*
- *To empower universities to unlock their information resources*
- *To advance digital library technology'*

The ADT is a member of the NDLTD's Steering Committee, Standards Committee, Strategic Planning Committee and Promotional Committee.

5.2. Document Analysis

I have analysed a number of documents, listed in **Appendix 1** associated with the ADT Program and its predecessor, the ADT Project.

Most of these are available on the ADT website or from links from the site. The latest proposal to DEST was however made available by UNSW Library.

In the analysis I have attempted to

- Compare and contrast the ADT product with those provided by mainstream publishers, universities and academic libraries.

- Compare and contrast the ADT product with what is being demanded by the customers of mainstream organisations and others. (e.g. researchers, government, industry, libraries, university administrators, etc.).
- Examine the values (as defined by the Theory of Disruptive Technologies) of current mainstream organisations to see if they are able to respond to the ADT.
- Track the ADT's functionality as it has developed over time and consider it in the context of current 'performance oversupply' if any, in the mainstream markets of the three sectors. Is it, for example, becoming 'good enough'?
- Consider the future viability of the Program in the market of scholarly communication.

5.2.1. ADT product compared to mainstream product

The analysed documents reveal that the ADT provides an alternative to the deposit and archiving of print theses. Traditional practice is for each university library to hold one archival print copy of each thesis produced by students of its institution. Access to the document by third parties is difficult, time consuming and costly.

Under the ADT model, university libraries continue their custodial role by hosting their institutions' electronic theses on institutional servers (ADT Project, 1997a).

In the print environment, each thesis is catalogued on the library's catalogue and on the National Bibliographic database (NBD). Cataloguing standards are used, such as MARC (MAchine Readable Cataloguing), but this data cannot be harvested. Finding references to theses on the NBD has proven to be very difficult (Wells, 2003 p.3).

The ADT provides access via the web using Dublin Core metadata which can be harvested by any number of other web services such as search engines, which makes discovery much easier. In fact, the original aim was to rank highly on major search engines. The ADT also provides access to the full text. As more and more web services become Open Archives Initiative (OAI) compliant this harvesting will become increasingly international. One issue identified by the Program is the risk of harvesting by commercial organisations of the ADT metadata without acknowledgement of or compensation for the Intellectual Property in the metadata (ADT Program, 2002).

Another difference between the mainstream and the ADT is the plan for the latter to become a national roll-out of metadata for ALL Australian research theses – including retrospectively adding metadata for all theses produced prior to the digital era (Wells, 2003 p.3). Again, the NBD does provide MARC records to describe many, but not all, Australian theses along with all other material it records, but the ADT is unique in only managing metadata for and access to theses.

This differentiates it from other publishing models as well. Most traditional and web publishers provide access to a variety of articles, papers and other forms of scholarly publishing. They provide access to 'cut down' versions of some theses, if the authors re-work their material into an article or conference paper, for example.

The ADT model if adopted for thesis submission (as opposed to deposit of the institution's library copy) would provide a more cost effective way for students to submit their theses than is currently the case. No more binding, multiple copies, etc. However, most universities are not keen to move to electronic-only submission. As the ADT does not have preservation and long term archiving of electronic theses resolved at this stage (CAUL, 2002 p.3), such caution can be well understood.

Another area where universities provide more flexibility than the ADT is in format. The ADT is unable at this stage to support 'non-standard' (indeed, non-PDF) formats(Cargnelutti, 2000) such as multimedia, although it sees the progression to other formats as a real opportunity (CAUL, 2002 p.4).

The ADT is unique in its scope and its approach. The model may well inform the establishment of institutional repositories around the country for other forms of scholarly publishing.

5.2.2. ADT product offerings to customers of mainstream organisations

The main customers of the ADT are the authors depositing their work and the consumers of that work. However the ADT Business Plan 2002-2006 also identifies the research community, the Library community, government, industry, the public and publishers as stakeholders (CAUL, 2002 p.5).

Proponents of the ADT see it as a 'vehicle for innovation in scholarly publishing' (CAUL, 2002 p.1). It provides a key model for developing other institutional repositories and these in turn are seen as a significant way of challenging the current publishing and scholarly communications paradigm. Universities and their libraries have a key stake in alternative models.

Australian researchers report having difficulty finding information about Australian theses or their content (Wells, 2003 p.3) – there is an identified demand for that content, but also for information *about* it. The ADT provides that information as well as access in many cases to the full text. The original plan was for the ADT to only describe theses where it could provide linked access to the full text, however, recently its scope has been expanded to that of a discovery tool, providing metadata even when the full text is not available on line. This will greatly increase the utility of the ADT to its users. Demand will drive the selection of theses to be retrospectively digitised.

Students strongly support electronic submission because of the wide exposure they can obtain for their work. CAPA, in its Standing Policy Values for a National Theses Collection calls for a 'national access and retrieval system for postgraduate theses'. Part of the policy demands that the system

> *'enable free national and international access to all Australian theses for postgraduate, academic and not-for profit (sic) research purposes and reciprocal rights for Australian access to overseas theses collections'* (CAPA, 2003 p.52).

Students are already self-publishing to the Web and self-archiving (ADT Project, 1997b) – but the ADT provides a much more robust system with the potential for long term archiving and enhanced discovery.

There is, therefore, an author demand for the services offered by the ADT. The international context in which the ADT operates greatly enhances their exposure. As previously noted, the harvesting of the metadata by other organisations and search engines provides further avenues for exposure.

Proquest, as a member of the ADT and the publisher of theses through UMI/Bell & Howell does already provide access to dissertations lodged with it by institutions and individual authors – but at a cost, both in the deposit and in the retrieval by online

customers. The ADT is proposing to run a benchmarking exercise with ProQuest Learning and Information for retrospective conversion of theses and also for comparing local software solutions against ProQuest's online submission service for individual theses (Wells, 2003 p.4).

There *is* a risk, in that the success of the ADT and take-up by authors depends on the continued enthusiasm and commitment of member institutions and their libraries. However the increased exposure of an institution's research output is a considerable advantage for the institution as well.

One of the ADT's competitive advantages identified by the 2002-2006 Business Plan is that it is the 'only game in town' in relation to Australian theses (CAUL, 2002 p.3). Commercial publishers and database vendors, together with the ongoing refinement of rights management are actually limiting access to research output via avenues other than the ADT and the NDLTD.

However, while all 38 Australian universities belong to the ADT by virtue of belonging to CAUL, only 28 have formally joined (ADT Program, 2003a) and only 21 Australian institutions currently participate (Wells, 2003 p.2) in the ADT. This limits the access a considerable number of authors have to the exposure offered by the ADT for their work. The Program is looking at the potential of the National Library hosting theses for individuals who are either independent scholars or not supported by their home institution.

A further risk to the Program is the policies of mainstream publishers. The Program has already encountered instances where students have withdrawn from the Program because they wish to publish their work separately (Cargnelutti, 2000).

5.2.3. Comparison of ADT values and those of mainstream organisations

As mentioned previously, the definition of 'values' given by the Theory of Disruptive Technologies is 'the criteria managers and employees… use when making prioritisation decisions' (Christensen, 2000).

As the ADT has evolved, the Program's values have evolved. While it has remained true to its value of only hosting and describing Australian research theses, it has

moved from only providing metadata for theses available electronically in full text, to deciding to provide descriptive metadata for all Australian theses, whether available online or not. In the successful proposal put to DEST in 2003, it has also changed its emphasis from only retrospectively digitising high-demand theses, to proposing the bulk retrospective digitisation of all Australian theses (Wells, 2003 p.4).

The ADT departs from the mainstream university in that it aims for the norm to be electronic submission by candidates to the University of their theses. More institutions are beginning to mandate electronic deposit of at least the library copy of each thesis, to enable addition to the ADT (ADT Program, 2003b). However, in one institution where submission of an electronic and a print copy is mandatory, some faculties have made representations for the electronic copy to be voluntary. According to the ADT internal discussion list, they report they have encountered problems with publishers, e.g. the American Psychological Association, refusing to accept articles where data have been published elsewhere, including on the ADT (Mandl, 2003).

The ADT also has a national focus, whereas institutions provide awards on an institutional basis. There is possibly a national and international focus in terms of judging the quality of a work against norms for quality between institutions.

One of the values which has emerged and been espoused by the ADT is that of ensuring authors retain control of their intellectual property. CAPA's call for a national access and retrieval system demands that it 'respect[s] the intellectual property, including moral rights, of Australian students' (CAPA, 2003 p.52). It sees the fully-implemented ADT as being able to provide this.

These values are in contrast to the mainstream publishing industry, in which academic authors routinely give away their intellectual property to publishers who, as noted earlier, owe allegiance to their stockholders.

In the ADT's DEST submission, it is proposed that the ADT provide candidates with experience in publishing and making their research available through open access (Wells, 2003 p.3). This is not a value previously espoused by the Program, or in fact by Australian universities, but has emerged as a greater commitment has developed to changing the current publishing paradigm.

The DEST submission also aims to embed the ADT in the wider development of institutional repositories, whose aim is also to disrupt the current scholarly publishing paradigm by making institutional research available independently of publishers, with authors retaining their intellectual property rights.

CAPA's Standing Policy Values for a National Theses Collection go so far as to require the national access and retrieval system which it sees the ADT becoming, to be controlled by Australian University Libraries (CAPA, 2003 p.52). While the ADT is currently administered by CAUL, it is surprising to see another organisation demanding library involvement.

5.2.4. ADT functionality

ADT technology and scope has been steadily expanding since its 1997 beginning. Developments in functionality are set out in Appendix 2.

It is clear from the steady development over the years, that the Program is becoming more relevant to users as time goes by.

The level of participation has trebled from 7 to 21 in six years.

There are plans for the quality of metadata to improve by becoming OAI-PMH compliant, by removing duplicate records, improving the authority control of author entries, by using qualified rather than unqualified Dublin Core metadata and by including an abstracts field within the metadata(Wells, 2003).

The ADT is becoming more standards-based, embracing Dublin Core metadata (ADT Project, 1997a), now embracing Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) (Wells, 2003 p.1), and moving towards new software that is Open Source based (Wells, 2003 p.5).

The ADT will still require less stringent attention to quality than the MARC records of the National Bibliographic Database (NBD), but because its metadata will be harvestable (unlike the NBD) and will be a small subset of that database, it will be much easier for searchers to find theses of interest to them.

However, the PDF 'standard' continues to be an issue. When documents are converted to PDF from electronic, the result is a relatively small document of only 2-4mb. However, when a print document is scanned the result can be 16-

20mb(Cargnelutti et al., 1999). Scanned images, as opposed to converted documents are also inaccessible to some people with disabilities. Finally, the PDF format does not in any way accommodate other formats, which, in an increasingly digitised age, is and will become more and more unacceptable.

By relinquishing its strong commitment to full-text only theses, the ADT has moved towards a model of bulk loading of metadata, including the conversion of NBD MARC records to Dublin Core (Wells, 2003 p.6). This is a move away from description and submission of a thesis by the individual. Streamlined processes will also be explored with vendors, which may change the functionality substantially.

Theses that are requested will still be digitised as needed, but the new model will provide much greater access, much more quickly to the whole body of knowledge represented by *all* Australian research theses.

The search interface is limited, and the current software limited. However, a new interface is being tested and a software upgrade is proposed as part of the 2003 DEST submission.

Its connection with an international consortium, the NDLTD, providing access to new technological developments as they are developed will ensure it continues to move forward.

The considerable issue of preservation and perpetual archiving continues to be a stumbling block. Although the promise of preservation is raised in many of the ADT documents, there are regular admissions that the matter has not been resolved.

Several institutions have moved to an *electronic + print* submission requirement for theses (ADT Program, 2003b), but until the preservation issue has been resolved, it is unlikely that the ADT will be the sole source of Australian theses.

5.2.5. Summary of Document Analysis

From the above analysis, it would appear that the ADT could be a sustaining technology for universities and academic libraries.

It appears to pose no great threat to universities in continuing their education of masters and doctoral candidates. Such candidates will continue to submit theses, although universities may change their rules to require electronic submission.

However, the international exposure provided by the ADT may provide a way of comparing the research output of different institutions, which in turn may lead to changes in the way institutions approach the marking and review of that output. It may even lead to greater gulfs between different types of university.

The ADT is currently limited in its document standard to PDF, but electronic submission may well eventually lead to the submission of a much greater range of media than is currently the case in the 'print' world.

Through the involvement of CAUL, academic libraries appear to be under no threat. It seems to be likely that they will continue to hold their institutions' archival copies, no matter what the format. The support by CAPA provides extra protection, as does library involvement internationally in the NDLTD on which the ADT is modelled.

However, the involvement of and benchmarking against a commercial dissertations supplier may lead to libraries becoming redundant in the process of submission– it may be outsourced on a national basis to Proquest-UMI/Bell & Howell or a similar organisation.

If submission is direct to the commercial supplier, and metadata is auto-generated, then all that is needed at the institutional end may be a server to hold the archival electronic document.

Because the ADT is not yet 'good enough' in terms of document standards, search interface and preservation/archiving, and because CAUL has taken ownership of the Program, it is likely, however, that the ADT will be a sustaining technology for academic libraries and go quite some way to ensuring their involvement in the development of more institutional repositories within their universities.

A further comfort for academic libraries is the fact that the NDLTD and the OAI have both grown out of the international library community (2003c).

It appears more likely that the ADT will be disruptive in the realm of scholarly and commercial publishing.

It provides a free alternative for authors and users of theses. It is improving in functionality and scope, and work is being done to improve the metadata and search interface.

Authors do not have to relinquish their intellectual property, nor pay a publisher to take it, and can limit access to some extent using the ADT. Through OAI compliance the ADT will provide increasing exposure to authors' works nationally and internationally.

The ADT also exposes authors to new models of open archives publishing, which may affect, in the long term, the way future academics choose to publish their output.

Publishers such as Proquest , by being part of the ADT, are able to test the market and provide input, technology and expertise. This inside knowledge will provide them with the opportunity to remain relevant in the new publishing paradigm. It will also give them advantage in the growing institutional repository environment.

It has been noted that some publishers are fighting back by refusing to publish material that has appeared in an institutional repository such as the ADT, causing authors to withdraw from the Program.

However, to a large extent, the ADT is competing against non-consumption, providing access to a resource for which there has been a demand, but to which access has been limited. How great the demand is, has yet to be quantified.

However as the ADT matures and becomes 'good enough' in terms of technology, coverage, exposure offered, intellectual property retention and cost effectiveness, it is likely that authors and users will abandon the more costly 'performance oversupply' of commercial publishers and look to the ADT and its peer programs to meet their needs.

Publishers have no doubt been aware of developments such as the ADT. Whether they have considered the ADT enough of a threat to justify a change in strategy is not clear. After all, the OAI-PMH is available to them too, and some publishers may see an advantage in adopting it sooner rather than later.

However, programs such as the ADT are still to clarify their own position on relation to commercial suppliers harvesting their metadata. Such harvesting increases exposure to the theses the ADT describes, but does it want to give away intellectual property to organisations that do not reciprocate?

The ADT, in its Business Plan lists as an opportunity in its SWOT analysis, the possibility of authors or institutions charging for online access (CAUL, 2002 p.4). So

will the business model change yet again, and if so, will it meet the demand for exposure expressed by authors, for example, through CAPA?

Will the ADT disrupt the indexing and abstracting paradigm of current scholarly publishing, through OAI compliance, or only in the provision of full text?

5.3. Analysis of statistics and trends

There is very little statistical information available about the ADT. Using the statistics quoted throughout the documents analysed above, and statistics available from the ADT website, I have produced the following summaries:

Table 1 ADT uptake

ADT Statistics					
	1997 (ADT Project, 1997b **)**	**2000 (Feb)** (Cargnelutti, 2000)	**2002 (Sept)** (CAUL, 2002)	**2003 (July)** (Wells, 2003)	**2003 (Oct)** (ADT Program, 2003a)
Approx no. of research theses produced in Australia	4000	4000	4000	4000	4000
Members	7	7	22	28	
Contributing members		5	13	21	
No. of theses		61	600+	1400	1600
GOALS					
Active libraries			Goal: 50%		
No. of new theses			Goal: 1000		
No. of retrospectively converted theses			Goal: 300		
Increased use June 2002-2003. (No. of external sites pointing to ADT; searching metadata repository/ linking to full text, etc.)			Goal: 10%		

Table 2 ADT Usage

4 MARCH- 8 SEPTEMBER 2003	
Visits (2003a)	
Unique visits	45,518
Unique hosts	21,645
Geographical (2003b)	
Australia	42.2%
Numeric IP (does not provide geographic or domain information)	28.1%
Other	29.7%
No. of countries outside Australia	93

Clearly, uptake is increasing at least as rapidly as hoped. It is not possible from the statistics to identify how many new theses are being added and how many are retrospective conversions.

The goal of having more than 50% of the 38 Australian university libraries contributing has been reached and clearly contributions are increasing geometrically.

Usage statistics look impressive, but there is nothing against which to compare them. It is the documented plan that new software will provide greater management and statistical information (CAUL, 2002 p.8).

From the above, it is not possible to comment on the disruptive or sustaining nature of the ADT with regard to universities or publishing, but as uptake goals are being reached, it would again suggest the ADT is a sustaining technology with regard to Australian academic libraries.

5.4. Interviews

Five interviews were conducted with a range of stakeholders. They included

- a commercial vendor familiar with the Program
- a PhD graduate who had lodged her thesis in the ADT
- a representative from an institution which, while a member, had chosen at this stage not to activate the deposit of its theses with the Program (the 'non-ADT' respondent)
- an academic familiar with the Program (academic respondent)

- an ADT Technical Committee member (TC member)

As stated earlier, I have conducted an analysis of the interviews, as have my two supervisors, to achieve investigator triangulation.

Again, I have concentrated on analysing the interviews under the following headings:

- ADT product and product offerings compared to mainstream product (academic libraries, universities, publishers)
- Comparison of ADT values (as defined by the Theory of Disruptive Technologies) and those of mainstream organisations
- ADT functionality
- Future viability

5.4.1. ADT product and product offerings compared to mainstream product

Academic libraries

Three interviewees provided comment on the ADT product offering in relation to academic libraries. The PhD graduate saw the ADT as providing much better access to theses than the access via the traditional 'dusty library shelf'. She compared her attempts to access overseas theses via faxes from family friends in the country of interest with the easy global accessibility of the ADT.

The TC member considered the ADT a natural extension of the library role of ensuring that any form of 'valid content' be findable and accessible from anywhere.

The 'non-ADT' interviewee was very much against the ADT being the repository for theses. In her institution, the Library catalogue was the source database for all library-held material. She thought it inappropriate that people should have to consciously decide to look for theses in a separate database, rather than finding a thesis, along with other material in the catalogue. This view seemed at odds with the reality of the ADT.

I used the PhD interviewee's thesis as an example, and searched both the ADT and her institution's library catalogue. There was an entry for her hard copy thesis in the catalogue, but the entry also provided a link to the full text version in the ADT. The two systems are not incompatible. The non-ADT respondent explicitly expressed

support for a separate interface, but wanted it generated from the library catalogue, not from the entry of metadata into the ADT.

However, on the other side of the coin, she saw academic libraries becoming the creators and publishers of information, not so much through the ADT, but through the creation of related institutional repositories.

Universities

There was more commentary with regard to universities. The PhD graduate considered the ADT provided a better opportunity for the promotion not only of individual authors, but also of the institutions to which they belong. She saw the ADT as a vehicle to aid career development, although she conceded that to date, she was not aware of anyone accessing her thesis independent of her directing them to it.

The TC member and non-ADT respondent saw the ADT in similar terms – the increased exposure of the author nationally and internationally and the opportunity for career advancement.

The TC member also considered the ADT a vehicle for the greater facilitation of collaboration and of communities of interest.

The academic respondent was concerned the ADT, because of the greater exposure it provided, also created a risk that ideas that could be commercialised would be appropriated by third parties, particularly if an author had either chosen not to, or had not thought to protect them, prior to lodging their work with the ADT. He saw the ADT providing less protection than the single copy of the dusty library shelf.

In contrast to this view, the TC member considered the 'massive exposure' available through the ADT to be a bonus, as plagiarism of an author's work would be much more detectable. (However, this might not protect an author from others commercialising his/her work).

The academic respondent did agree however, with the view that exposure provided potential benefits – not only to authors but to supervisors. (To date, the supervisor's name does not appear to be included in the metadata on the ADT – only in the acknowledgements within the online theses).

He also saw the ADT as a means for attracting overseas researchers to Australia, because it provides a showcase of the research being done here.

Another role the academic respondent saw for the ADT, was that of a datasource to be mined by DEST to conduct research on the research being done in Australian higher education. The Program may therefore have implications for research-related policymaking and funding decisions.

Publishing

There was no great variance in opinions with regard to the traditional publishing paradigm. The PhD student saw no conflict between lodging her thesis with the ADT and then publishing journal articles based on the thesis. She noted that the format of the thesis is very formal and based on a strict structure which is very different to that of a journal article.

She also noted that her journal articles built on the contents of the thesis, so were quite different in content as well as structure.

The academic respondent talked about the general disagreement existing as to whether lodging a thesis in the ADT is equivalent to a publication. Within academe it appears not to be considered so, but how commercial publishers may view it now or in the future is difficult to predict.

According to the TC member, publishers such as Elsevier do not consider theses in the ADT to constitute publications. However he noted that publishers were generally keeping a watching brief on the ADT and that the Program had influenced the model that Proquest/UMI used for dissertation submission to its commercial repository.

The non-ADT respondent noted there was considerable resistance in her institution to the ADT and similar eprint repositories because of the resistance of some publishers to accept material that had been made available through a repository, but her focus was more on repositories of materials other than theses.

The commercial vendor did not consider the ADT to offer an alternative publication paradigm. The vendor's only comment with regard to the product was that an author wishing to publish their thesis as a monograph would have issues with submitting it to the ADT. Such an author may well only want the metadata for their thesis to appear.

The academic respondent did however suggest projects such as the ADT might result in changes to the repackaging of information, with searchers going straight to the source and bypassing traditional publishers, and by extension, traditional publications. He noted though, our penchant for bringing like material together – for bundling by subject or discipline – something the ADT does only through subject words and keyword searching of abstracts.

He also wondered about online refereeing. The refereeing of theses is done prior to deposit on the ADT. He didn't see online marking of theses being attractive to markers any time soon (although refereeing via email of journal articles is already beginning to take hold (McKiernan, 2002)).

5.4.2. Comparison of ADT values and those of mainstream organisations

It is in the area of values – the criteria used for prioritising decision making, that the greatest amount of confusion, ambiguity and ambivalence emerged.

Library involvement

The vendor saw a risk to the Program in its genesis in academic libraries. She thought there needed to be much greater buy-in from the academic community and much greater marketing to the same group. The non-ADT respondent described 'huge' resistance from academics at her institution to not only the ADT, but also to e-print repositories. Her library encounters little interest in its attempts to promote these developments. Considering CAPA's stance, and the critical interest candidates could be expected to have in the ADT, it is interesting to note that at this point, according to the respondent, nobody has approached the research students at the institution to find out what their view of the ADT would be. Perhaps this is a function of the Program being seen as a library initiative.

The academic respondent also queried why the Program was a library initiative and wondered about the motives of librarians in pushing it. He did see it as a part of the trend of libraries to take on more of a knowledge brokering role in their institutions and their greater awareness of the research going on in the institutions they serve. He observed that it also fitted with recent library lobbying to change the current paradigm

where institutions and their staff give away scholarly work to publishers and buy it back at great expense.

The TC member saw the ADT as 'one of the most significant things academic libraries have done' and a rare example of them achieving something concrete. He said one of the greatest challenges had been to convince CAUL members to take on ownership of the Program, but now that it was becoming more mainstream, 'everyone wants to own it'.

Free access to theses

The vendor/publisher was unconvinced about the nature of free access to the ADT. She saw a possibility that its content might be free to the Australian community, but provided at a charge to others. This seems to be in considerable conflict with others, who saw free, global access as one of the ADT's key attributes and a major advantage to authors and institutions in promoting their work.

Mandatory electronic submission of theses

The TC member was keen to have institutions mandate electronic submission of research theses, albeit alongside the print, while the academic saw this as something that is currently not acceptable. He did think that people could be motivated to do things differently when policies changed, but currently it meant too much extra work for students. The non-ADT member saw mandating electronic submission or deposit as the only way of developing critical mass - citing US institutions and their huge theses repositories.

The vendor, speaking from experience, said it can take five years to get rules changed in universities to mandate electronic submission, and thought the risk of failure in that five years to be quite high.

She was also keen on exploring the role of publishers and vendors in the electronic thesis submission process. Although this has been flagged in the most recent DEST submission (Wells, 2003 p.4), it seems at odds with the idea that each institution be at liberty, apart from complying with a very few standards to do its 'own thing'.

Both the TC member and the vendor thought it imperative that a critical mass be achieved and that the remaining institutions who currently do not contribute, be somehow included as soon as possible. Another investigator noted the Catch-22 nature of the problem: without critical mass, it will not be worthwhile for people to search the ADT, but people will not contribute content unless there is evidence of demand.

ADT as metadata rather than full text

Another area of conflict lay in the emphasis on adding to the ADT retrospectively – i.e. adding theses from times past. The latest submission to DEST emphasises the addition of retrospective information, if only metadata and abstracts (Wells, 2003 p.1). The PhD student and non-ADT respondent saw the provision of metadata and abstracts only, as a much lesser product than the full text, while the academic respondent considered retrospective additions to the collection to be of low priority.

ADT as voluntary program

Apart from the PhD graduate and the non-ADT member who did not comment, all saw the voluntary nature of the ADT to be a potential point of failure. Not only is submission by author voluntary in the majority of institutions, contribution at the institutional level is also voluntary. This limits the effectiveness of the ADT as a real showcase of Australian research, although one respondent conceded that it probably produced a representative sample.

Whilst ever some institutions remain outside the Program, there is a possibility the current impetus and interest will wain. Whilst ever deposit is voluntary at an author level, there is potential for the rate of deposits to stagnate or drop.

The vendor noted that she did not really know where the ADT would go, but wanted to be there to contribute market knowledge and to be in the right place at the right time, if it became a potent force in the market.

Collaboration

Both the vendor and the TC member had differing views of the collaborative nature of the Program. The latter saw the collaborative nature of the Program as a plus, as collaborative projects are more usually rewarded with funding by external bodies than 'stand alone' projects. The vendor noted that while this is currently the case, policies may not always reward collaboration. She considered it imperative that the Program commercialise and become financially independent as soon as possible, before funding dries up.

It is clear that if collaboration is to continue, particularly between institutions and commercial publishers and vendors, the relationships will need to be managed carefully and potential conflicts recognised and resolved.

5.4.3. ADT functionality

Preservation

The TC member made it clear that he did not expect the ADT Program as such, to address preservation issues. He saw preservation as a separate issue, which, while needing to be addressed, was not in the purview of the Program. He indicated that more work could be done with XML in this area, but it had not been looked at as part of the Program.

The non-ADT respondent noted that one of the main points of resistance in her organisation to the ADT was that fact that it is not a preservation format. Academic staff there see the only possible reason for depositing in the ADT to be preservation – as that is not available, they argue there is no point in taking part.

Standards

Clearly, the ADT's inability to support non-standard formats is a matter of considerable concern, as is its inability to date to deal with preservation issues.

The TC member strongly emphasised the need for the Program to be standards compliant and conceded that the use of PDF was not strictly within that realm. However, he defended the use of PDF as being the software most closely resembling a document standard at this stage. He expected the 'PDF standard' to change when a 'real' standard came along.

I had an expectation that the PDF format would prove to be one of the major reasons for the 'non-ADT' member institution to have resisted taking part. However, although their Disabilities Unit resists PDF because of the accessibility problems it creates, it was not a major issue for the respondent. Her library routinely makes material available in PDF.

The TC member noted that in terms of standards compliance, the Program is becoming much stronger. It is working towards OAI compliance (a standard that had not existed when the Program started), Z39.50 compliance and qualified Dublin Core metadata compliance. In these ways, the Program will become more and more interoperable with other compliant systems and is working towards being 'good enough'.

The inability of the Program to deal with film, website, and other non-text, non-PDF formats was acknowledged by the TC member and highlighted by other respondents. The non-ADT respondent also noted that lodging print theses is difficult too, if they are accompanied by graphical images, maps, audio, or other formats. Until these formats can be addressed, the ADT can never be the single, comprehensive source of all Australian research theses, whether from now forward, or retrospectively.

This one factor has the potential of causing the Program to fail in the longer term. However as standards develop for expressing material digitally, the Program should be able to convert and pick up these works. There seems to be an expectation that in this area, the ADT will still become 'good enough'.

User interface

The PhD graduate concentrated on the ADT user interface. She expressed frustration in the search functionality of the interface – its poor organisation and the display of a long list, rather than a select list. The non-ADT member echoed her frustration. She also thought the interface for depositing a thesis to be to difficult to use and too much hard work. She was of the opinion that the only theses that would be deposited would be those where library staff did all the deposit work.

During the interview, the PhD graduate logged into the new test site and found the search functionality had greatly improved. At that time she expressed satisfaction that it was becoming much easier to use.

Another area of mild concern for the graduate was her experience of a considerable delay between depositing her thesis and having it appear on the database – a period of weeks elapsed. If the ADT is to be an alternative form of scholarly communication, this sort of delay will need to be addressed.

Access

One of the advantages the non-ADT respondent saw in the repository, was service to distance education students. Currently, her library responds to requests for theses from these students by sending them a microfiche copy. As she says – how are they supposed to read it? A web-based solution would work much better for them.

Metadata Vs Full text

It is believed by the Steering committee that the plan to add metadata and abstracts retrospectively for theses produced prior to the ADT is another area where functionality will improve. However, the non-ADT respondent was convinced, erroneously, that the ADT already contains metadata for theses that have not had the full text deposited. For her, this was one very important reason for resisting joining the ADT – she believed people will expect 'something special' from a specialist database. If the plan is brought to fruition, others may lose interest. Considering the lack of interest in this feature from other respondents, it may be in the Program's interest to review this strategy with a wider range of stakeholders before proceeding.

The TC member discussed the difficulty people have in finding Australian research theses, even using the National Bibliographic Database. He identified one researcher who has painstakingly developed his own database of information about 50,000 Australian theses because there is no comprehensive repository currently in place. Even the printed list of theses previously produced by the University of Tasmania has ceased production.

This may indicate either that the ADT as a metadata repository is not worth pursuing (if the printed list was abandoned, why develop an online one?) or that it will become more relevant and useful, simply by providing a good proportion of that missing metadata – even if there is no link to the thesis itself in either standard or non-standard format.

Version control

Finally, during the interview with the academic respondent, the possibility was raised that a different version of a thesis might appear on the ADT than was submitted for examination to the institution. There is a risk that the print copy in the library might be slightly or even significantly different to that deposited electronically.

While this is not a matter of technical functionality, it is certainly an area where the ADT will have to be able to provide watertight assurances if it is to be considered a 'good enough' alternative to the traditional way of storing and providing access to research theses.

5.4.4. Future viability

The academic respondent expressed some concern about the lack of comprehensiveness of the ADT. His assumption was that content would not be retrospective and he expected it to take many years for the content from 'now' forward to grow, especially because of the Program's voluntary nature. His concerns also included the nature of the form of thesis supported by the ADT.

He was interested in the possibility of a 'theses in progress' aspect to the Program to enable current researchers to work collaboratively, rather than their work being available only after the event (of the thesis' submission).

The TC member was of the opinion that the Program had already succeeded, despite its 'high propensity to fail'. He believed that 'five years down the track' people are finally understanding what the ADT is – including members of the original seven member institutions! He believed it will expand to include New Zealand as and when institutions there are ready and he believed its increasing standards compliance will increase its ability to communicate with international systems – all of which will increase its future viability.

He considers the ADT a template for other forms of institutional repository, where the work being done by institutions can be showcased.

The vendor was less convinced about the future viability of the Program. She did not dwell on the functionality of the ADT, but the business model and business plan. She was concerned that funding would dry up, that the Program would remain unviable without external funding and that the current business model (2002-2006) is too short term.

She seemed more willing to look at the ADT as a marketing tool for funding and floated the idea that if the Program concentrated on obtaining content in areas of research strength of importance to the Government, it might be more likely to attract further funding.

If DEST then used the ADT as a data mine for Australian research as suggested by the academic respondent, the research emphasis, might, of course, simply reinforce the Government's priorities.

Although she couldn't predict where the ADT was going or where it might end up, she definitely wanted to be there, helping to shape its direction and being there for any market opportunities that might arise.

The non-ADT member, thought the ADT was already passé – that the development of other repositories had already passed it by. She believed all material from an institution should be in one vast repository with one search interface. She did not seem to understand the distributed nature of the ADT, but even so, considered an interface that provided access to theses only as far too limited.

The PhD graduate simply expressed the hope that the ADT would spread, that more people would find out about it and that there would be further contact from people who come across the theses lodged therein.

5.4.5. Summary of interview analysis

From the above summary and analysis, it seems unlikely that the ADT will prove to be a disruptive technology in relation to academic libraries. It provides better access to Australian research theses than is currently the case with libraries, but it simply helps libraries do their job in a better way. It assists them in providing access to valid content.

The collaborative nature of the Program is in keeping with the way Australian academic libraries conduct business.

The ADT, as an initiative of academic libraries, seems to have raised the profile of some academic libraries within their institutions, embedding them more in the research effort of those institutions. In fact, as one of the 'rare' successes for libraries, it appears to have become a sustaining technology, the success of which, they can build on.

Other academic libraries appear to still be struggling to make an impact, to influence their academic colleagues to take up this new product.

However, for libraries that hope to continue to conduct their business as they always have, with the library catalogue and their own institutional users as their main focus, the ADT may well prove disruptive. As access points shift and the ADT is harvested in a way library catalogues cannot be, their researchers may find other organisations or units more willing to assist them in exposing their work.

With regard to universities themselves, the role of the ADT is a little more ambiguous. It certainly provides a way for universities to continue to do what they have always done – accept, store and make available research theses authored by their students.

The risk of loss of 'version control' between the print and electronic versions of a thesis causes some concern, but would appear to be something that requires changes in procedures rather than a change of disruptive proportions.

The ADT has the potential to be a sustaining technology by attracting overseas researchers and raising the profiles of Australian institutions. It also seems to be a vehicle with the potential to foster collaboration and communities of interest – all of which are in line with how universities currently do business.

However, it may also be disruptive. The universities which are currently denying the utility of the ADT may find themselves left behind in many ways – in attracting overseas researchers and students, attracting research funds and demonstrating their research output.

The risk posed by the potential commercialisation of ideas by third parties may change the way universities and their students approach intellectual property rights and potentially how they do business in this area.

The opportunity the ADT offers to 'outsiders' to compare institutions by quality of their research output may well provide a disruptive effect on universities – either forcing them to change how they evaluate their research, or perhaps forcing some of them out of business.

If it becomes a mine of information for DEST or other Government departments, it may change the way universities relate to the Government, how they prioritise their research efforts and how they obtain funding. At this stage it is difficult to see where this would lead, but there is again, the potential for disruption.

If theses within the ADT come to be regarded as publications, the ADT may prove very disruptive. It may change how students and academics publish, perhaps bypassing the publishing industry altogether.

Or it may simply be that the ADT taps a market not currently tapped by mainstream companies – those in the community without the financial resources to pay for expensive databases, but nonetheless with an appetite for original research.

If the ADT proves to be a blueprint for other institutional repositories and it becomes the norm to go straight to the 'source', promotion within universities and perhaps even structures, may change radically – but at this stage it is far too early to tell.

As with my document analysis, it seems that the ADT has the most potential to be a disruptive technology within the area of commercial publishing.

It is interesting that the vendor interviewed is basically keeping a watching brief – being there in order to be involved in any developments. She is also very concerned to get the Program to the point where it has critical mass and is in a position to be commercialised. This translates well to the strategy suggested by Christensen of trying to accelerate the growth rate of the emerging market so that is becomes big enough to justify entry ((Christensen, 2000 p.148).

Her continuing interest is also a form of 'agnostic marketing' – we know where the ADT will end up, or how it will be used, but she is in the market and ready to be wherever the market develops.

The vendor's involvement also fits in well with Geroski's strategy of identifying threats early and being ready to act(Geroski, 1999 p.111) – in this case by monitoring

a potential competitor. However in this case it is clear the vendor would like to establish a role within the Program rather than competing with it.

The most telling signs that the ADT is a disruptive technology with regard to commercial publishing is its increasing functionality and acceptance. It may not support all formats and it may not yet be comprehensive, but it is moving that way. It is becoming more standards compliant, more interoperable, more easy to use, and it is still free - unlike most proprietary full text databases.

It is succeeding in spite of the fact that it has not been commercialised, only has a medium-term business plan and despite the fact that its content does not play to any particular stakeholder's interests.

The ADT's ability to be a disruptive technology in relation to commercial vendors and publishers seems, from the above discussion, to be very real.

The five year timeline suggested by the vendor, for having rules changed and the five years it has taken for people, even those involved from the start, to understand where the ADT is coming from and what it is, is very much in line with the timeline of disruptive technologies described in the literature (Leifer et al., 2001 p.103).

Overall, the ADT's greatest potential for success lies in its Type 1 disruption. Although Proquest/UMI provide access to Dissertations Abstracts, and now to full text dissertations, it is not Australian–based and it is not free. The ADT is competing against non-consumption. It is developing in a market where demand has hitherto been largely untapped, at a price that can't be beaten. Eventually it will be interoperable with similar efforts globally, and it may well change the way people access research and the form in which it is accessed.

6. Discussion

This case study attempts to test the Theory of Disruptive Technologies by applying it to the ADT and looking for causal or potential causal relationships between it and changes to the sectors upon which it impacts.

The ADT fits the definition of a Disruptive Technology in a number of ways. It is not attempting to address the demands of the mainstream customers of academic libraries, universities or commercial academic publishers.

It is competing with non-consumption – attempting to provide access to Australian theses by people who have been trying, without much success, to do so on their own. It is not competing with libraries to provide access to the same range of material supplied by libraries. Although it is trying to influence the way theses are submitted, it is not attempting to change the core university activity of training researchers, evaluating theses and storing them in their libraries.

It is also not attempting to lure away the mainstream customers of publishers. It is providing access to a very limited product in the very limited form of a research thesis.

Currently, the ADT does not have particularly good functionality, but it will improve overtime – a key attribute of a disruptive technology. Eventually, it may well appeal to a broader market, but currently it appeals to a largely untapped market – again, a key indicator of a potentially disruptive technology.

At the moment, as with disruptive technologies, it is impossible to quantify the future growth of the ADT.

So far, so good – the ADT has many of the attributes of a disruptive technology.

When we apply the Theory to the ADT in terms of the three sectors we have discussed, it has the potential to disrupt all three. However, it also has the potential to be a sustaining technology in two of the three:

6.1. Academic libraries

Academic libraries which attempt to hold on to the traditional ways of providing access to information – through their catalogues, to their traditional user base – may find as the ADT functionality improves, and similar OAI-compliant products develop, that their traditional users will simply move to a technology that provides access to what they want in the form they want, and is 'good enough'. The bibliographic records may not be as well structured as in the catalogue, the corpus of knowledge to which it provides access may not be as broad, but it may provide access to a more targeted range of knowledge in a way they find acceptable.

The ADT may also prove to be a Sustaining Technology for academic libraries. It supports them in providing access to information and in storing their institutions' research candidates' theses.

By raising the profile of academic libraries that embrace and promote it, it also has the potential to re-invigorate libraries within their institutions and increase their relevance as knowledge brokers and partners in research.

6.2. Universities

Universities may also discover the ADT is a Disruptive Technology.

It may provide Government and other external stakeholders with the information they need to critically evaluate and compare research output at an institutional level. In this way it has the potential to change the way institutions attract researchers, students and funding and could therefore eventually disrupt the current structure of Higher Education in Australia.

By changing the way theses candidates publish their research output, the ADT may lead to new Open Archives/open access publishing practices in younger academics, which may eventually spread within universities and change the way research output is disseminated and rewarded. And this may of course lead to structural changes within those institutions.

As with academic libraries, institutions which try to resist these changes may be left behind, clinging to a paradigm that is no longer relevant to their students, their funding bodies or their peers.

However, as with academic libraries, the ADT also has the potential to be a Sustaining Technology. It assists universities in doing what they have always done – training researchers, evaluating theses and rewarding their production.

By raising the profile of universities and their research internationally, it has the potential to attract researchers and students from a much wider and perhaps higher quality pool.

6.3. Commercial academic publishing

It is very much within the publishing paradigm that the ADT has the potential to be most disruptive. It has the potential to train new researchers in alternative ways of publishing their research output via open archives and to provide access to original research to an entirely new audience currently excluded from access to academic publishing by prohibitive pricing and licencing arrangements.

Commercial publishers do not seem to see the ADT as a threat. The format it offers is different from their traditional offerings and different from the apparent trend towards accessing 'chunks' of information. A thesis is not only greater than a chunk, it is considerably larger than the average journal article. Theses are not considered to be 'publications' in the general sense of the word, although this may change.

Finally the ADT functionality is not currently good enough to take on traditional publishers and not currently likely to woo away publishers' mainstream customers.

All in all, the ADT would seem an ideal model for a Disruptive Technology to radically alter the academic publishing paradigm.

7. Limitations of the research

The original research described in this paper has some limitations. The interviews were not conducted using a random sample. It was important to interview people who were associated with the Program and aware of its focus and direction. Only the PhD graduate interviewed could in any way be considered to have been randomly selected, and then, selection was based on accessibility to the author. It would have been desirable to interview more people with a wider range of views, but this was not possible within the time available.

The research focussed very narrowly on the Australian Digital Theses Program and did not consider the impact or implications of similar projects taking place overseas. In particular, it would have been desirable to look both at the NDLTD and the ADT in the context of the NDLTD.

It would also have been desirable to look at the ADT in the wider context of the developing trend towards institutional repositories.

8. Conclusion

The Theory of Disruptive Technologies can be applied to the ADT. The ADT appears to fit the requirements of both a Disruptive and Sustaining technology in relation to academic libraries and the universities they serve and of a Disruptive Technology with regard to academic publishing.

This case study has successfully applied the Theory to a new area of study, making it clear the Theory is generalisable to new situations.

Whether the ADT fulfils its potential as a Disruptive Technology, however, has yet to be seen. Its beginnings in 1997 suggest the timeframe for it to demonstrate that potential still has at least four years to run. It will be interesting to see what happens during those years.

9. Opportunities for further Research

The Theory of Disruptive Technologies was developed relatively recently. It may be exciting and interesting to apply it to the ADT in different ways, or to a broader range of theses repositories, or to institutional repositories in general, as they develop from fledgling into mainstream forms of scholarly communication.

Further research, therefore, may involve the Theory of Disruptive Technologies in the

- follow up of this case study in three to four years in order to test the predictions made. This is in keeping with the timeframes for Disruptive Technologies discussed in the literature.
- emerging global development of institutional repositories (perhaps from a disciplinary perspective).
- more intense study of the ADT over a longer timeframe, with regard to one sector only : academic libraries, *or* universities *or* the publishing industry.
- study of the ADT to identify any differences in its effect on the disciplines of the theses deposited. This is in keeping with the suggestion that the disciplines selected may influence Government support for the Program.

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Appendix 2 : ADT Functionality

	1997	1999 conference paper	2000 workshop	2002 business plan	2003 DEST Submission	2003 email to members
LEVEL OF PARTICIPATION	7 participant institutions	7 participant institutions, but much greater number will to needed to become a **national** resource	National roll-out, July 2000. Now open to all Australian universities. 20 retrospectively converted theses available.	Expanding nationally. 22 formal institutional members. All 38 CAUL members are members by default. Aim has expanded to include Council of New Zealand University Librarians (CONZUL).	21 *actively engaged* institutions. Access free for individuals and for member institutions. 1400 theses now available through the ADT.	
METADATA	Auto-generates metadata. Same Dublin Core metadata as the NDLTD. Aim is to rank high in major search engine retrieval.	Auto-generates Dublin Core metadata	No more mention of search engines		Propose adding Abstract field to metadata. New software will require higher quality metadata, qualified Dublin Core, de-duplication and authority control.	

SCOPE	Describes and links to ***full text*** Australian research theses only		Move from URL to URI (Universal resource identifier). Permanent internet address for each document. Still only access to full-text, not abstracts. (don't want to annoy people looking for the full text).		Proposes moving to the addition of metadata only (including abstract) for non-digital theses. Database will become repository for information about all Australian research theses, even if the full text is not available online. Proposes sourcing print and electronic abstracts and bringing them together in the ADT.	
INDIVIDUAL SUBMISSION	Submission by author. Submission possible from anywhere.				Extraction of MARC records from the NBD, conversion to Dublin Core metadata and importation of records for retrospective population of the database.	

SUBMISSION BY 'OTHER'	Submission by institution - but very time consuming, one at a time. Submission possible from anywhere.	Deposit software not necessarily suited for retrospective submission. Time consuming. Scanned files are much bigger than electronic files converted to PDF.	Bulk retrospective scanning available from University of Melbourne, but libraries reluctant to risk losing their only paper copy by sending it off site.	Beefing up retrospective conversion of pre-digital theses. Beginning to plan for hosting of metadata for ALL Australian research theses, regardless of availability of full text.	Propose working with Proquest to compare its online submission process with the current ADT model to see which is more efficient. Flags possibility of outsourcing submission process to Proquest.	
DATABASE CONFIGURATION	Same database configuration for each institution. Australian-developed proprietary database for metadata.					

STANDARDS	Same standards as Virginia Tech and UMI: PDF documents for all full text as this has become a publishing standard. Possible to submit the same document to UMI, commercial thesis supplier, as to ADT. Uses tools and technologies students are already using to create their theses. Relies on member institutions adhering to standards - voluntary. Acrobat reader free for those wishing to access the full text.	Positive qualities of PDF: ease of use, quality, flexibility, rapidly becoming standard worldwide format. Reader is free. Problems with PDF acknowledged: size of file, if scanned (16-20mb) compared to born digital (2-4mb). Scanned document an image; born digital converted to PDF allows greater accessibility, searchable. Problems with document integrity - especially pagination, fonts and styles.	Agreed on Acrobat 4 as the tool for converting theses to PDF.	Planning begins to make ADT Open Archives Initiative (OAI) compatible.	Proposes moving to Open Archives Initiative compliance. Particularly OAI Protocol for metadata harvesting (OAI-PMH). ADT predates OAI, but based on same principles of sharing. OAI-PMH will allow better harvesting by other harvesting engines, resulting in greater exposure of Australian theses internationally.	

SOURCE OF DATA	Online submission, one thesis at a time	Online submission, one thesis at a time	Online submission, one thesis at a time	Online submission, one thesis at a time	National Bibliographic Database will be mined for information about theses, the data converted to Dublin Core and used to populate the ADT with descriptive metadata.	
SOFTWARE	Software is free to participating institutions. Members get 3 hours of free technical support.		Update to software flagged, to enable gathering of statistics and better management. Old and new will run side by side.		Proposes improvements to management and reporting tools. Plan to develop new software using Open Source tools.	New software is being implemented and debugged. It is more unforgiving. Metadata has to be of higher quality. ADT has been checking log files for errors and fixing them. New test site available.
ACCESS CONTROL	Access to document can be restricted by the author or institution			No rights management software. Limiting access up to individual and institution. ADT does not want to limit access		
FEATURES	Easily searchable. Read and print only.					

PRESERVATION	Preservation not resolved. National Library of Australia advising	Long term archiving still not addressed. Expectation that there will be a migration from PDF to a 'final' standard.		Still working with National Library of Australia on preservation		
GOALS	Access to digitised versions of all Australian research theses.	To establish standard for electronic thesis creation, storage and access. To establish process for submission as part of condition of awarding of degree.				