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# A Model for the Effective Management of Reusable Learning Objects (RLO's): Lessons from a Case Study

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## Abstract

*The management and reuse of digital learning resources has become a major business. Repositories of reusable learning objects (RLO's) are increasingly popular, but pose serious management challenges. In this paper, we report the findings of a case study with a leading distance education provider currently engaged in an RLO strategy. We find that our case organisation has effective strategies for addressing many of the challenges. Based on these strategies, we identify lessons that are generalisable to other organisations, and propose the "zone model" for effective management of RLO's. The zone model balances the degree of control applied and the re-use potential of an RLO. Implementation of the zone model, supported by appropriate organisational culture, processes, technologies and design considerations can provide a means for organisations to pursue an RLO strategy for business benefit.*

**Keywords:** Reusable learning objects, digital learning resources, education technology management

## 1.0 Introduction

There has been a massive increase in popularity of on-line and flexible learning. This use of digital media to support on-line learning is ubiquitous, from the most basic, to the advanced, and in subjects ranging from basket weaving to nuclear medicine. In the US alone, figures for the forecast of internet-based training for the year 2003 in both 'soft skills training' and 'IT training', approach \$US12 billion, a growth of almost 100% from the previous year (Clarke & Hermens, 2001; R. W. Taylor, 2002). Traditional educational institutions are extending beyond their classroom walls, using on-line and flexible learning to meet market demand for anywhere, anytime education.

The management and reuse of these digital learning resources has become a major business. Organisations are seeking shorter production times, better use of resources, reduced costs, and improved quality of content for developing and maintaining educational resources, by developing reusable learning resources, known as Reusable Learning Objects (RLO's) (Kostur, 2002).

RLO's are units of content and educational structure divided into reusable objects and modules. The IEEE Learning Technology Standards Committee defines smaller objects linked together to form learning materials as Learning Objects. Their definition of a Learning Object is: "as any entity, digital or non-digital, that may be used for learning, education or training." (IEEE\_Learning\_Technology\_Standards\_Committee, 2002).

While a RLO strategy promises potential advantages, there are many potential pitfalls. Although there have not been many studies on existing RLO implementations, due to the newness of the concept, cautionary tales already exist (Parish, 2004). Previous experience with planned reuse in other fields, for example knowledge repositories, also offers insights into likely challenges (Weiss *et al.*, 2004). In this study, we focus on organisational and management issues. Issues associated with the technologies of reuse, for example, XML, have been extensively discussed in other contexts.

For our study, we have chosen a large, mature distance education organisation with 50 years of experience in the structured production and reuse of educational material and a history of successful adoption of new media. In the last three years, our case organisation has adopted a RLO strategy. The aim of this research was to study an exemplar organisation to extend existing understanding of effective management practices for RLO's. The research questions are: "How can organisations develop and maintain reusable online educational materials to maximise speed and cost of development, and improve the reliability of the completed content", and further, "How can lessons from an exemplar organisation increase our understanding of effective management practices for RLO's.

First we review potential issues with managing RLO's, from educational technology, content management and knowledge management literature. Next we present the research method, and describe the case organisation and the results. The paper concludes with a model for effective RLO management, and a conclusion.

## 2.0 Literature Review

In this section briefly examine other disciplines that have contributed insights into issues associated with managing repositories. We then review previous studies on the management of RLO's, informed where relevant by content management and knowledge management literature to derive a list of management challenges associated with RLO implementation.

### 2.1 Insights from reference disciplines

*Content Management:* Content management systems were created to deal with the ever-increasing complexity of business websites. Content management systems allowed organisational control of the content displayed on an organisation's website, and provided a facility for employees to update the organisation's website without losing consistency or the ability to reuse the content (Sprague, 1995). A significant component of RLO's is "content". Therefore, common CMS features such as **versioning**, and **security and authorisation**, are potentially relevant to managing RLOs.

The **security**, especially the **authorisation**, in a learning repository is very important to keeping a high quality assurance of learning materials. "Given the variety of users and systems that work with the content management system – as well as the importance of the content – good security is mandatory" (AberdeenGroup, 2001).

If materials are modified, this also raises potential issues with **versioning**. Content management systems provide control of versioning, to track "What the current version is and what previous versions are still needed" (Sprague, 1995).

*Knowledge Management:* Problems with implementation of knowledge repositories also offer some potential insights. Expensive knowledge repositories are frequently not used. This can be because knowledge repositories that do not provide a standard knowledge structure (also

known as **metadata** structure) that enables users with different perspectives to share knowledge (Kwan & Balasubramanian, 2003), or do not provide enough **context** for the user to evaluate the quality of the knowledge (Weiss et al). Organisational **culture** and attitudes with regard to sharing knowledge have also been identified as an issue for knowledge repositories (Weiss et al., 2004)

## **2.2 Challenges with managing RLO's**

In this section we identify challenges with managing RLO's from previous academic and industry studies of RLO initiatives.

**Granularity:** The component-based approach to developing learning materials raises many questions. How big should those components be? Is a learning object an image, text, sound? Does it have to contain a learning objective to be a learning object? Does it need to incorporate some sort of test of the knowledge acquired? IEEE's (2002) definition of a learning object is very broad and covers the whole area of items that could possibly be called a learning object from an image or bit of text through to and interactive CDROMs or a book. Smaller learning objects can be combined together to create larger, more comprehensive units. This raises issues of genericity and contextuality.

**Genericity and Contextuality:** For the concept of reusable learning objects to be effective the objects need to be generic, so that many people can use them in many different situations. The genericity of a learning object is affected by the number of references it contains to the context in which it is used (Hiddink, 2001). To make learning materials generic the designer should avoid using references to local institutions, people, and topics. (Hiddink, 2001).

The issue of how generic to make a learning object has been the source of much debate. Some detractors argue that RLO initiatives are doomed to failure because education is highly contextualised. Basing their arguments on those found in computer programming they observe that only trivial amounts of code can be reused without considerable time and effort being used to transfer the content from one context to another (Kinshuk & Russell, 2001). It has also been suggested that the size of the ideal RLO varies among disciplines, and in some fields a series of small, granular, generic Learning Objects may not be as useful as a few tailored items (Geissinger, 2001). For example advanced level physical sciences may require a large RLO to describe the steps of a complex experiment. Many commercial Learning Content Management Systems (LCMS) for managing RLO's, offer the user nested layers of context, with element as the smallest item, elements can be built up into competencies, competencies can be built up to units, units to modules, and courses form the largest outer layer of context (Mortimer, 2002). Smaller and more granular objects (elements and competencies) can be "recontextualised" by being included in more than one higher-level object to provide flexibility and reuse.

**Central repository:** Both content management literature and online educational literature stress the need for a central repository that stores all the Learning Objects. (Kostur, 2002). A vital aspect of central repositories is the employment of effective metadata so that learners can access content in focused ways (Fleming, 2001).

**Metadata:** Metadata is searchable information stored about an object to identify or explain it. If the learning object cannot be found, it cannot be reused. Metadata for learning objects typically describe such things as what objectives it satisfies, who the intended audience is and the type of learning it supports (Kostur, 2002).

Many RLO projects have devoted a significant effort to setting metadata standards. A key problem with metadata is with interpretation of the words used. Different content developers interpret words differently and assign different descriptors. The labels and tags used to describe content needs to correspond to the way the teachers and content developers think, and also to be clear and standardised (Hiddink, 2001; Rada, 1995; Rada, 2001).

**Versioning:** A potential risk with a reusable learning object approach occurs when changes are made to an object. This can affect all the other people that were using that same object. Particularly where a very granular approach is taken, with small, generic, relatively context independent objects being combined in numerous ways, there is enormous potential for a change in one object to affect many others.

In content management systems, this problem is managed by creating differing versions of the materials. For versioning to be useful it needs to keep track of “What the current version is and what previous versions are still needed” (Sprague, 1995). This means that within the learning repository, the metadata, most likely, will need to keep track of the versions, and also whether they are being used, and by who they are being used.

**Workflow management:** There is frequently a tension when producing online educational material between pressure to reduce time to market, and the quality of the final product (AberdeenGroup, 2001). Contemporary content management systems that incorporate workflow capability are often used to support the tasks and processes associated with creating and managing web-based content in a collaborative, dynamic and high-volume environment (Wu & Liu, 2001; Morgan, 2000; MSI\_Systems\_Integrators, 2002).

In summary, we identified seven management challenges that we considered likely to be important when managing an RLO implementation. These were derived from previous academic and industry studies of RLOs, and knowledge management and content management literature. Some of these issues relate mainly to the organisational culture and process, while others relate more to repository and RLO design and standards. Issues primarily related to organisational culture and process included organisational attitude to reuse, and workflow management, process and authorisation. Issues primarily relating to repository standards and design features include central repository, granularity, genericity, metadata and versioning.

### **3.0 Research Methodology**

This research uses a case study methodology in which theoretical propositions, presented in the form of potential issues, are compared with empirical materials collected from the field. This creates a link between theory and empirical data “providing a template against which to compare the results of the study” s in place. (Yin, 1993). This approach allows the strategies employed by the case organisation to be easily related to existing literature, and allows us to extract lessons learned that will be of potential relevance for other RLO initiatives.

Data were collected by holding semi-structured interviews with five existing staff members and one former staff member. These six people were chosen because they covered all aspects of creation and management of RLO’s, and represented a variety of stakeholders, including management, teachers, and technology support. Interviews sought to gain insight into the participants’ understanding of how the organisation’s processes influence the effective development and maintenance of RLO’s. Interviewing six stakeholders contributed to reliability by acting as verification on organisational memory and establishing a common

understanding (Earl, 1993). The inclusion of a former teacher provides insights into organisational capability and readiness before the current initiative started.

Interviews were transcribed in full and analysed using pattern matching with a list of categories based on the issues identified from the literature. Additional issues, not identified from literature, were created as required. Following that, the transcripts were reviewed for organisational responses to the issues identified, and the lessons that could potentially be generalised to other organisations were derived.

#### **4.0 Case Description**

The case organisation, The Correspondence School, is New Zealand's main provider of distance education for early childhood through to secondary, including special needs. The school has approximately 19,000 students, consisting of full-time, dual enrolled (with existing secondary schools), and specialist services students (Education\_Review\_Office, 2003). Approximately 10,000 of the enrolments are secondary students, the majority of which are dual enrolled, as well as another 4,000 adult students (Education\_Review\_Office, 2003). As a result of the dual enrolled students the correspondence school has needed close communications with schools throughout New Zealand. As an evolution of the schools dealings with dual enrolled students and use of technology, it has taken an advisory role in the setting up of "clusters" of smaller schools that share resources and teaching materials.

Prior to the widespread use of the Internet, the school has extensive experience over many years in the production and management of learning materials utilising a variety of media, including paper, radio, video and television, which were reused for different offerings of the same course for up to eight years. The school has sophisticated and mature processes covering the planning, development and quality assurance processes for learning materials. Over the last three to four years the school has conducted research and development into the delivery of online learning to students.

In the last year the school has been developing a learning content repository. This is being set up in two systems. The first "official" system is being developed and implemented to hold fully Quality Assure Learning Objects that, in the future, could be shared outside of the school, for example, by schools involved in "clusters". The second, which is based on Lotus Notes, is an internal system for teachers to share, within the school, non-quality assured learning materials, and to help encourage the production of reusable materials. As a result of the research and the development of the learning object repository the correspondence school has been recognised as a leading organisation in the use of the online learning environment.

The participants in this research were:

- The Media Services Manager, responsible for the management and strategy of the primary groups within the school group that develops online and multi-media RLOs.
- A retired teacher and manager of the Distance Technology Advisory Group, responsible for advising teachers on the production of learning objects prior to the current development of the online repository.
- A member of the multimedia development team, which is a part of the media services group, with a primary focus on technical aspects of development. .
- The blackboard system administrator as well as a member of the e-learning professional development team, responsible for technical support, advice and consultancy about the technology infrastructure used for managing RLO's.

- A project manager for the development of secondary school courses and resources, responsible for leading all aspects of the development and maintenance of RLOs and other educational resources used by the school.

## 5.0 Analysis

### 5.1 NZCS approach to RLO management challenges

The projects the Correspondence school have undertaken, over the last three to four years, have given the school the opportunity to identify and address many of the challenges associated with the effective management of RLOs. All the issues identified in our literature review were present in the NZCS to some degree. The school is migrating to a central repository approach for managing its learning objects. Issues of granularity, genericity, and contextuality have been identified as a major difference between the NZCS's emerging RLO strategy and the school's traditional approach to managing leaning objects. A homegrown metadata standard has been developed, informed by international developments in this area. Workflow processes, including management of security and version control, already existed. In this section, we look at the strategies employed by the NZCS to address the challenges. These strategies fall into two broad areas, those associated with repository standards and design features, and those associated with organisational processes and culture.

### 5.2 Repository standards and design features

**Central repository:** The NZCS have implemented not one but two repository systems. The school decided upon the two-repository set-up for a number of reasons. As the Media Services Manager mentioned the unofficial repository was “essential for getting buy-in and getting the teaching areas involved.” But also they are using the staff repository “as the catalyst for getting the whole concept of reusable learning objects rolling”, with a further advantage that they “don't lose all that intellectual property when teachers go.”

The Media Services Manager mentioned that the aim was for the “official” school repository in the future to be shared externally. At present, there are a number of obstacles to moving material into the public domain. Currently with the contract between the NZCS and the New Zealand Ministry of Education does not permit sharing of RLO's beyond the school. Sharing the content externally increases the importance of copyright issues.

“There is debate. ..[within the school] we look at it as a closed classroom. And we stick stuff on our classroom wall... I mean, regardless of what happens teachers or facilitators are going to do it anyway. But once you go through the official process...then it has to go through a really rigorous copyright protection”

The Project Manager that copyright can affect the longevity of learning materials.

“The shelf life maybe ten years but our copyright is limited in the secondary area to five years and primary to eight years, and that tends to say, ‘right the five years it up we have to now renew the resource.’”

**Granularity:** A major focus of the new repository is to make learning objects as open as possible. Staff want to be able to get access to the learning object and make changes within the actual object itself, for example change the text, or the image. This is motivated partly by feedback from colleagues about other international repository initiatives.

When talking about the materials coming from an Australian repository ER mentions the problems he sees are involved with the materials

The stuff that's coming out of [repository A] it's all done in Flash or Director, and so, one it's all locked up. One of the last ones looked at was a little bird sitting by a billabong, which has no context for us, and it's an Australian bird and an Australian billabong, and an Australian gum tree, and Australian talkers...the problem with that, is it's not granular. I can't get in there and take the picture out.

Partly based on this experience, the NZCS has taken a different approach. The school repository is set-up with 5 levels of nesting; The Media Services Manager gave a short description of the structure of the learning repository.

“From the smallest level which is your individual component, or your file, through to your chunks, to your RLO, through to a topic, then there’s a program of learning which is a series of topics for a student. If we look at a topic, say the topic was, seasons and within that topic you have; winter, summer, or spring. So there’s another topic. And then below that you have another topic which is what do I wear in the winter, what do I wear in the summer, so then it becomes more granular down to eventually you can’t get any more, it’s just a bit of text or a bit of an image. So we’ll call that an RIO (reusable interactive object), and an RLO is the next step up”

This nested approach allows teachers to create materials that are a combination of several documents, and images and text. A multimedia developer supports this argument through his description of the approach that the developers take to creating the interactive objects; they are creating much smaller modules that can be joined together (contextualised) rather than creating large interactive objects that cover a whole course.

**Genericity:** The issue of genericity is tightly interwoven with that of granularity. The schools approach is to remove the context, or the ‘glue’, from the learning objects and components. Higher up in the hierarchy of nesting, from the topic through to programmes of study the glue is included to give the course context and meaning.

“The plan is for our content management system to treat all those as searchable objects, so the teachers can actually grab those and put them together if they want. Or they can work at the level of the RLO, or even further up the line. They can group a whole lot of RLOs together into a topic, and put some context around it.”

The Correspondence School is developing the lower hierarchical components generically, but once getting to the level of the topic, staff are adding context into the materials to make them more useable to the students. A retired teacher noted that part of the skill of a distance educator is to construct learning materials in a way that is open enough for students to add their own context, in a dialogue with the teacher.

One of the methods the correspondence school uses to make the learning materials more generic is to remove all indication of topic. The Media Services Manager describes the schools approach to making learning materials generic as follows,

“We try to be as vanilla as we can. ...What we’ve been working to is actually been removing any indication of the subject areas. Everything used to say science, or economics, or chemistry or whatever...So we’ve started to take that off, and only have it on your splash pages so it is easier removed.”



With the removal of indications to the subject area it allows for the use of theme-based teaching. Theme based teaching is not about a given subject area, but may include many subject areas.

Despite the current RLO initiative, the pedagogical debate over levels of granularity, genericity and context continues within the NZCS, reflecting unresolved issues that also exist within the current research literature.

**Metadata:** The images, text, and sounds and learning objects in the repository need to be searchable. The school has created a metadata schema for the school repository, which is homegrown but informed by international experience, and is having a significant role in the development of a New Zealand-wide metadata schema.

“That metadata schema is based on international standards, so it completely covers Dublin core, NZGLS, the tikiti oporangi standard, it also covers the learning federation standard which is an Australian & New Zealand consortium for digital objects.”

The Blackboard Administrator in describing the searching system that the school repository is going to use, based on the metadata, cautions that they need to be able to communicate with other systems.

“We also have to be cautious as to how far we, or how deep we go, because if we can't interact with our Australian friends or English, then we've got problems further on down the track.”

The Media Services Manager describes two approaches taken by other repositories; the weaknesses inherent in them and the problems that the lack of a strong coherent metadata standard brings.

There is [a repository] in Catalonia in Spain, where it is very much a free for all, teachers can put whatever they like on there. They can develop stuff, they can change stuff, and they can reuse stuff. There are not a lot of controls at all....The Catalan approach; they can't find anything on there. They've got 20,000 objects in there, but because they do not have the structure on their metadata...it is difficult for them to find stuff.

**Versioning:** The NZCS has implemented a flexible approach to version management that allows RLO's to grow and change over time in response to demand, while protecting the integrity of existing objects for their users. The Media Services Manager describes these capabilities in the following way.

“What we do, rather than update existing ones, is actually create a new one and say okay, this is version one, and all these topics are happy with version one. This is version two and these people are using version two. And it may be that version one is no longer needed after three years, so we throw it away.”

### **5.3 Organisational process and culture**

**Organisational Culture:** Organisational culture issues associated with the production of materials for reuse are largely absent at the NZCS. This can be attributed to the school's history. The core business of the school for decades has been the production of distance learning materials for pupils ranging from pre-school to secondary school. For many years,

courses were developed and reviewed on an eight-year cycle, so each course (effectively a large RLO) would be reused approximately eight times. As a retired teacher noted

“One of the things that many people found difficult moving into the NZCS environment was teaching from material produced by someone else”

**Workflow Management, Process and Authorisation:** The management of copyright for the official repository emphasises the need for a quality assured process when creating or transferring materials. The NZCS have existing processes to work from, and these have proved robust and adaptive to the challenges of new media. The school is adapting their existing processes to manage the development and maintenance of learning objects for the “official” repository.

“Currently we have a revisions process, and basically only the... it’s only the level of curriculum leader or faculty leader who can authorise those changes.”

Our interviewees noted that there is significant potential for tension between achieving appropriate levels of control and authorisation, and achieving the desired degree of agility and flexibility. This had been observed in the experiences of other RLO repository initiatives around the world. One Australian repository is very tightly controlled, as the Media Services Manager noted

“If you look at the learning materials repositories around the world, there are a number of different approaches to it. There’s approaches like the learning federation in Australia, where everything is totally controlled. Everything that goes into that repository is locked down, that certain criteria. It is very difficult to get stuff on there; they have a long birthing process. “

In summary, the NZCS has extensive organisational knowledge and existing processes relating to developing and managing learning objects. Despite this, some tension remains between appropriate controls and agility. The two-repository model, with minimal controls on the unofficial repository, is allowing experimentation with the workflow management, processes and authorisations required for RLO’s.

**Timeliness:** A key theme from the majority of interviewees was the need for speeding up the content development process. This is sometimes noted as an issue in marketing material provided by RLO system vendors, but it has not been a major issue in the research studies we were able to identify. The Media Services Manager noted that the time taken to develop material in some overseas repositories was perceived by the NZCS as a major weakness, because by the time the materials are out, the lifetime of the learning object is shortened considerably.

The [Australian repository] approach is great, because you know you have Quality Assured materials, but the bad thing is they only produce a very small number of them, and it takes a long time for them to come, and if you want something that is relevant at a certain stage, then you may be out of luck.”

The project manager and the multi-media developer noted that development time for a set of multi-media objects, which previously took a year on average, had dropped to approximately three months. In describing their roles both the Project Manager and the Media Services Manager mention that one of the major tasks they have is focusing on keeping everything on time. A summary of the organisational challenges we identified from previous studies, and the NZCS response to them, is included as Table 1.

**Table 1**

Anchor challenge	Sources	Challenge for NZCS?	Organisational Strategies employed by the NZCS
<b>RLO repository standards and design features</b>			
Granularity	AberdeenGroup, 2001; Hiddink, 2001; Sprague, 1995	Yes	Offer support within the RLO repository for multiple layers of granularity from small, generic items of content (for example, a single image), to larger modules and courses.
Genericity and layered contextuality	Geissinger, 2001; Hiddink, 2001; Kinshuk & Russell, 2001	Yes	Develop individual components to be as generic as possible, allow context to be added by individual teachers when combining small RLO's into larger RLO's.
Version control	AberdeenGroup, 2001; Sprague, 1995	Yes	Create new versions rather than modifying existing objects to preserve the integrity of existing objects for their users. Retire old versions as they become redundant.
Metadata	Fleming, 2001; Hiddink, 2001; Rada, 2001	Yes	Follow international standards, and allow metadata to be applied to multiple layers of RLO's as they are grouped together to add context.
Central repository	Hiddink, 2001	Yes	NZCS have adopted a two-repository solution. One repository is tightly controlled and contains larger RLO's intended for formal, planned reuse, within the NZCS and externally.  The other repository is unofficial and loosely controlled. Teachers need to follow metadata standards when storing RLO's, but otherwise can create, store and reuse materials freely and flexibly.
<b>Organisational culture and processes</b>			
Organisational Culture	Weiss et al, 2004	No	Creating and managing reusable learning content, incorporating new media, is already a core organisational competency
Workflow and process Management	AberdeenGroup, 2001; Morgan, 2000; MSI_Systems_Integrators, 2002; Wu & Liu, 2001	Yes	Finding an appropriate balance between control and agility is an issue, but this is facilitated by the two-repository approach.  The NZCS has existing expertise in the development and management of reusable learning materials, and these form the basis of new processes to support the RLO strategy.  The RLO strategy has not changed the core business model of the organisation, although it has had a significant impact on the Design, Development, and Deployment of materials.  At a detailed level, some processes for digital and multi-media RLO's are still a "work in progress"
Security & authorisation	AberdeenGroup, 2001; MSI_Systems_Integrators, 2002; Sprague, 1995	Yes	Apply controls only where appropriate and where legal issues (e.g. copyright) or pedagogical issues (e.g. quality assurance of modules intended for extensive reuse) require it.  Otherwise foster agility, flexibility and experimentation to promote learning, develop buy-in to the RLO approach, and allow time and cost effective production of RLO's.
Timeliness	No	Yes	Remove obstacles and controls on experimentation. Only introduce controls as processes mature, or for learning materials intended for the public domain.

#### **5.4 A Model for effective RLO Management**

Based on the lessons learned from the NZCS, we developed the "zone model" for RLO management (Figure 1). This models the tension between control and flexibility, and between low and high reuse.

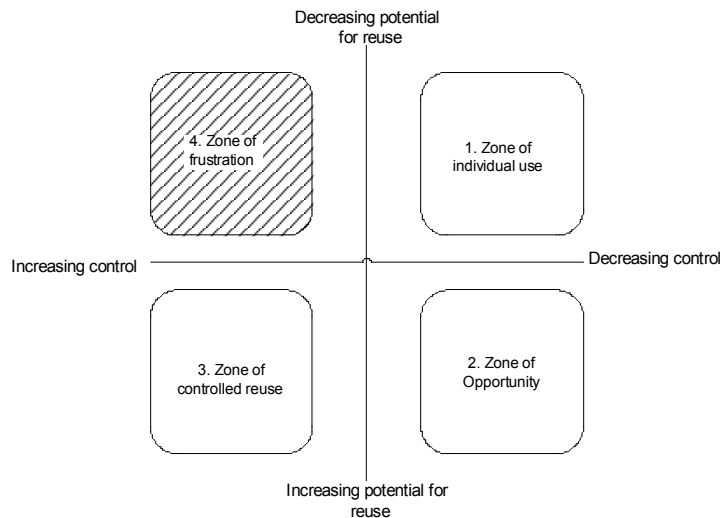


Figure 1: The “Zone Model” for effective RLO management

**Zone 1:** the zone of individual use, is relatively uncontrolled, with low potential for reuse. This zone describes the real or virtual classroom of an individual teacher running a course. So long as teachers follow the curriculum they are largely free to select examples, illustrations and images, set exercises, and develop informal assessments and concept checks. These might vary from one day to the next. The potential for reuse is low because it is ephemeral, and determined by the style and day-to-day choices of the individual instructor.

**Zone 2:** the zone of opportunity, is relatively uncontrolled, with high potential for reuse. This zone describes the permanent digital materials developed and used by individual teachers. This could include images, text objects, exercises, quizzes, assessments, or other learning materials. If these materials are stored in a repository as RIOs and RLOs, they are available for “discovered” reuse by other staff members. If a strategy of nested layers of context is followed, the reuse opportunities are increased, as the objects can be reused in different contexts than those for which they were originally created.

**Zone 3:** the zone of controlled reuse, is highly controlled, for objects known to have a high level of reuse (for example course materials that sold commercially or provided to other institutions, or that form part of a core curriculum with large student numbers). Objects in this zone will be extensively quality assured, and conform fully to all applicable standards. As these processes can require extensive time and resources, they are reserved for situations where they are really necessary, and not applied to the informal development and sharing of materials.

**Zone 4:** the zone of frustration, is highly controlled, with low potential for reuse. This zone occurs when excessive controls are applied to the development of objects with low reuse potential, or when objects are too large and cannot easily be de-contextualised and re-contextualised, limiting the reuse potential. RLO strategies should try to avoid having objects in this zone.

### 5.5 Implementing the zone model at the NZCS

The challenge for organisations is to implement the zone model effectively to address the management challenges posed by their RLO strategy, and in particular, to avoid the frustrations of over-large and highly contextualised objects, which limit the opportunities for

reuse, or of overly long development cycles with excessive management controls, that increase costs and risks, and may produce objects that quickly become dated.

The NZCS implementation of the zone model is shown in Figure 2. At the NZCS, Zone 1 is implemented by the Blackboard distance teaching and flexible learning product. Teachers chose what objects will be used in this environment and change them on a regular basis based on the dynamics of each class.

The “unofficial” Lotus Notes repository provides the NZCS with an effective implementation of zone 2. Staff can store RLO’s and RLO’s in the repository at will, and can add, remove and alter context flexibly and with minimal control (so long as metadata standards are followed). This has resulted in rapid, agile, and flexible population of the unofficial repository so it has become a significant resource of potential RIO’s and RLO’s in a short period of time. These objects become a source of opportunity for the organisation. The NZCS implementation is supported by an existing organisational culture and history of reuse.

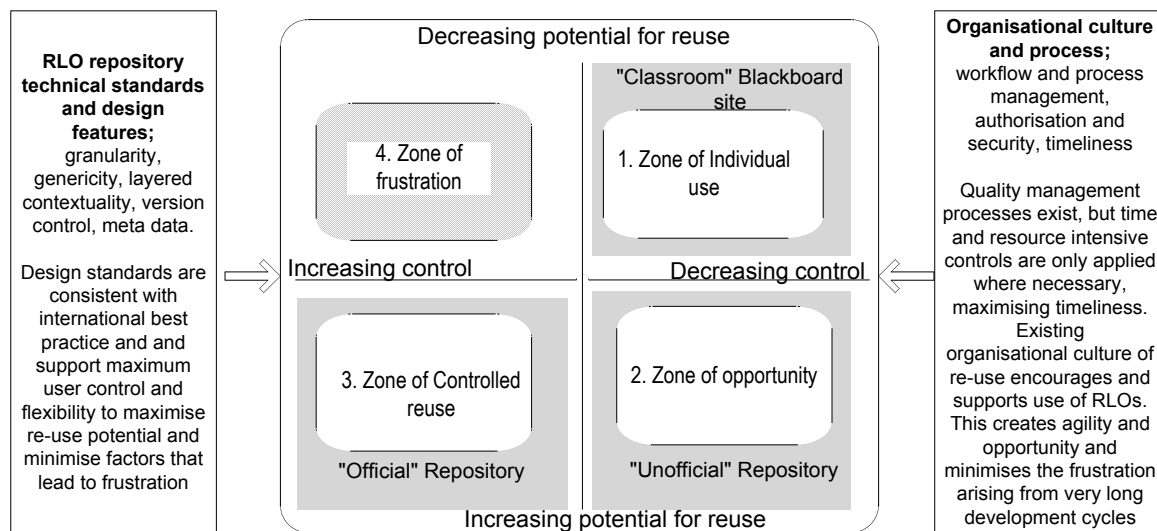


Figure 2: The NZCS implementation of the “Zone Model”

The official, fully quality assured repository provides the NZCS with an implementation of zone 3. Rigorous quality engineering processes are applied to populating the official repository. These can be time and resource intensive, and are only applied when the level and nature of the reuse (for example, materials planned for wide distribution to other schools) justify the time and expense. Furthermore, the quality assurance time is reduced by the fact that a prototype of all or some of the material has already been tested in the unofficial repository. Materials in the unofficial repository that are proven to be popular and effective can be re-engineered to meet the quality standards for the official repository, reducing the risk of failure. At the NZCS existing organisational competencies and quality assurance processes have been adapted to enable the population of zone three with fully quality assured RLO’s.

This implementation also means that the NZCS can largely avoid having objects in zone 4. Unnecessary and frustrating controls are minimised by the use of the unofficial repository. Larger, more highly controlled and more highly contextualised objects from the official repository can be reused where appropriate. For example a school with no Spanish teacher might chose to use modules from the official repository for students to self-study, confident

that the material is quality assured and covers the syllabus. In other situations, larger objects from either the official or unofficial repository can be broken down into smaller, more context-independent objects. Version control also allows people reusing an object to modify it and create a new version without affecting the integrity of the original. This greatly extends the reuse potential of objects in the official repository.

## 6.0 Conclusion

A cornerstone of the NZCS approach is the two-repository concept. The unofficial repository is a Lotus notes environment that staff members can store RIO's and RLO's in, and select materials from in an uncontrolled fashion. Metadata standards must be used when depositing materials in the repository, and version control is embedded in the repository environment, but otherwise, little control is exercised over what is placed there and how it is used.

This experience suggests that organisations seeking to implement an RLO repository should support an informal, prototyping environment. This allows experimentation, creativity, relatively rapid development by non-specialists, and fosters "discovered reuse", where staff browsing the repository find materials of interest and value in other contexts than those for which they were originally developed. A formal, highly disciplined environment with extensive controls should be reserved for materials where the reuse requirement is well established, and where the controls are necessary for legal, commercial or copyright reasons.

In both cases, the application by the NZCS of international best practice in terms of repository technical standards and design features has been essential to success. Appropriate levels of granularity, nested layers of context, consistent use of internationally based metadata standards, and implementation of sophisticated and flexible version control are all essential if the RLO approach is to be successful.

The study was based on a single case study of an exemplar organisation. The applicability of the RLO management issues, the lessons learned, the zone model, and the two-repository implementation to other organisations need to be evaluated further by considering additional RLO implementation initiatives.

Despite the limitations of a single case study, we consider the experiences of the NZCS are of considerable interest and value for both research and practice. Based in insights from the NZCS, we offer a way out of the "zone of frustration" for organisations. This opens the way for organisations to achieve the benefits promised for RLO's; lower costs, faster production time, and higher quality.

## 7.0 References

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