Enhancing resource sharing with a state-of-the-art transportation system in a large open distance learning (ODL) institution in South Africa

Jenny Raubenheimer
Library, University of South Africa, Pretoria, South Africa

Abstract
Purpose – The purpose of the paper is to investigate the enhancement of resource sharing with a state-of-the-art transportation system in a large open distance learning (ODL) institution in South Africa. The University of South Africa (UNISA) is an ODL institution, and it has the largest academic library of its kind in Africa. The University is acknowledged as one of the mega-universities of the world with a student body approaching 400 000. In addition to providing an inter-lending service to this large student body and to 3,000 staff, the UNISA Library is a net-lender within South Africa’s inter-lending and resource sharing network. The Library’s inter-lending service forms part of the request services available to all its clients and to the wider community of participating libraries. Daily, an average of 2000 requests is received for processing, retrieval and delivery. This paper provides a brief overview of how the Library’s request service is managed and will discuss the technologies used to speed up the request process. It focuses on an automated radio frequency identification (RFID) transportation system to be implemented as part of the 21st century, newly redesigned UNISA Library. To ensure the speedy availability of material on the shelves after return, this system automatically transports materials via a Paternoster book lift to the respective levels within the Library.

Design/methodology/approach – The methodology used in this investigation encompassed a literature study and a study visit to a library where this automated delivery system had been implemented and information was gained from relevant service suppliers.

Findings – The UNISA Library found that it is feasible to use the system in terms of the large number of books to be transported from drop-off points to the respective levels. In accordance with the investigation of the number of trolleys to be pushed daily by staff from one point to another, the installation of an automated system will allow more time for shelf maintenance staff to attend to the processing of requests for material and other important but less urgent duties. This will impact positively on the speed of delivery of requests submitted by ODL clients who cannot visit the libraries together with those submitted by local and international inter-library loan partners who depend on the UNISA Library as a net-lender for material not available in their own collections. This will impact positively on availability of material on the shelves and the speed of delivery of requests for information resources submitted by ODL clients who cannot visit the ODL libraries and inter-library loan partners, nationally and internationally, who depend on the UNISA Library as a net-lender for material not available in their own collections.

Originality/value – Because rapid delivery of requested information resources has become very important to ensure just in time information, it is important to implement an internal delivery system to support the inter-lending process. This study is useful for libraries that need to deliver many physical items to a large client body.

Keywords South Africa, Inter-library loans, Transportation systems, UNISA

Paper type Conceptual paper

Background
The University of South Africa (UNISA) is one of the world’s top ten mega-universities and the fifth largest open distance learning (ODL) institution. In total, 433,342 students registered in 2013 which makes it the largest ODL institution in Africa. The UNISA student profile is diverse in terms of where they reside, age and gender: of the students registered in 2013, 431,475 reside in Africa (including South Africa); 916 in Europe, 538 in Asia, 30 in Oceania; 325 in the Americas, 58 in other parts of the world. Of these students, 3,216 students are living with a disability. The age distribution of the students in Africa is as follows: 1 per cent aged under 20 years, 47 per cent between 20 and 29 years; 34 per cent between 30 and 39 years; 14 per cent between 40 and 49 years; 3 per cent
between 50 and 59 years and about 1 per cent over 60 years. A similar diversity is noted in students residing in Asia, Europe, Oceania and the Americas. The gender of the students is 62 per cent female and 38 per cent male (Africa); 59 per cent female and 41 per cent male (Asia); 62 per cent female and 38 per cent male (Europe); 63 per cent female and 37 per cent male (Oceania) (UNISA Institutional and Analysis Portal, 2014).

The University’s vision is to become “the African University in the service of humanity” (University of South Africa, 2005). Flowing from this vision is a drive to educate Africa to be of global service, and this informs the importance of the ODL model as a means to realise that vision. In accordance with the University’s ODL Policy (University of South Africa, 2008), ODL is defined as a multi-dimensional concept that considers the diverse student profile in seeking to bridge the time, geographic, economic, social, educational and communication distances and differences between students; and within the institution, between students and academics, students and courseware and between students and their peers. The institution’s Library likewise endeavours to bridge the distance between students and the Library, to use information technology to promote learning for remote learners and researchers and to provide equal access to its resources for this diverse student body.

The vision of the UNISA Library is: “towards the leading ODL Library in Africa” (UNISA Library, 2013). In support of its vision, the Library has several branch libraries and access points at partner libraries both in South Africa and in other African countries to support students who cannot visit the main library in person. The Library also has mobile libraries to support students in rural areas in South Africa. Furthermore, those clients who cannot visit any of the libraries receive a dedicated and centralised request service which operates from the Muckleneuk Main Library where the bulk of the print collections are housed. In addition to serving the university’s staff and students, UNISA is also a net lender in South Africa, as there is a significant demand for inter-library loans from other libraries in South Africa. These are supplied via the library’s request services of which the inter-library loan service forms a part.

The request services of the UNISA Library

The Library’s request services are provided by a dedicated service team with >100 staff. It consists of information search librarians, request processors, shelving officers and information resource delivery officers. During peak periods, approximately 2000 requests are received daily from Library clients. These include requests received from UNISA’s authorised inter-library loan clients for material not available in the UNISA Library and to be obtained via the inter-lending network from national or international participating libraries and also from the clients of libraries worldwide for the holdings of the UNISA Library. In total, 1,050 requests were processed in 2012, of which 8,500 were for inter-library loan (UNISA Library, 2012).

Support for the Library’s vision, the ODL concept and the needs of the inter-library loan community requires the rapid delivery of requested materials. Over 20 years ago, Swain and Cleveland (1992) referred to the importance of balancing rapid access to information via the online catalogue with rapid delivery of information. The UNISA Library has always viewed the imbalance as a significant challenge, particularly when bridging the geographical distance between students and the ODL Library. It is important to deliver requested print material to clients in time for that material to be useful for assignments and research (Raubenheimer, 1996); the client of the 21st century library has an expectation of immediacy even when the requested material is not immediately available in the library’s own collection and must be obtained from another library via the inter-library loan service.

The UNISA Library, therefore, has focused not only on the application of information technology to the organisation, storage and retrieval of information to improve access to information but also to the Library’s resource delivery processes.

However, rapid delivery of requested material depends on their availability at the time of request; the Library, therefore, implements measures to ensure the improved availability of material. These include lending rules to ensure the return of issued material by the due date and also the alignment of request service activities with technologies which ensure the prompt and accurate recording of returned material and speedy shelving to ensure availability should the item be required by a client.

Assessment of the UNISA Library’s request processes and related activities in its workflow system

Alan Butters notes that automating repetitive manual tasks is generally accepted in all industries, including libraries. Typical activities to be automated are those associated with issuing of books, retrieving of print material and returning them to the shelves (Butters, 2006). The UNISA Library has achieved much in this area, as it has an online lending system, but some activities such as requests for books in print needed to be addressed, as the process includes retrieving and despatch of items only available in print. The focus of the assessment was, therefore, on activities to speed up the delivery of requested material available in print. In the new millennium, the first step taken was to eliminate the manual request system, whereby Library clients submitted handwritten request cards which could be hand delivered, posted or faxed to the Library. These cards were transported internally with a Swissslog Unicar system from the delivery office for processing. On arrival, they had to be scanned or captured into the workflow system. Moving to an online request system contributed positively toward the speedy receipt and processing of the request and eliminated human error in misreading the handwriting of the requestor and subsequent delays in the capturing of requests. The request mechanism is linked to the UNISA Library’s online catalogue which is accessible on computers, tablets or mobile phones from where requests can be placed at the time when the client accesses the Library Catalogue. Requests are, thus, immediately captured in an automated workflow system, as it flows directly from this online request mechanism to the system and can be attended to by the processing staff without delay. The Library implemented this system for the capturing and processing of
library requests on LibFlow which was part of the UNISA in-house developed workflow system in 2003. UNISA upgraded this system and the Library started to use the new version of the system, UniFlow, in 2009.

Within the workflow system, a request is first dealt with by the processing team where the request is authorised, the location details of the item captured from the online catalogue and an automated message are sent to the client to acknowledge receipt of the request or to explain why it is not possible to fill it. It then goes to the retrieving team where the item is retrieved from the shelves and taken by trolley to the delivery office near the exit level of the eight-storey library building. The delivery officers then issue print material with the aid of radio frequency identification (RFID) lending equipment and despatch it in accordance with the client’s preferred mode of delivery. On return, the item is also recorded by the delivery officers who automatically remove the material from the client’s lending record. Returned material is then sorted with the aid of the RFID sorting machine from where it is packed onto trolleys and returned to the relevant shelving area. The status of the requests within this workflow is indicated at any given time by the automated track and trace system, and the time from when the request was captured until it was delivered to the requestor is captured automatically. Eight of the 12 activities in the request process are automated; the four manual activities include the retrieval of information resources from the shelf, taking it to where it is issued and the return process.

Based on the background information, it is evident that much has been done on the service side in recent years to speed up both access to information and the delivery of requests for information resources. However, the question arises as to what more can be done operationally to speed up the workflow? In particular, the transportation of retrieved items from such a large library to the delivery office and the transportation of items back to the shelves.

An investigation into automated transportation systems in libraries was subsequently carried out. The literature identifies many libraries that have installed systems over the years, and the solution is still viewed as an option in contemporary libraries. These include installations not only at renowned libraries, such as the Library of Congress and the British Library but also the electro-pneumatic conveyor system at the St. Pancras site, the light of the shift to electronic collections (Library of Congress, Office of the Inspector General, 2010).

Because the UNISA Library uses RFID technology to issue and return library material in print, AMH systems that could be integrated with the Library's RFID practices were considered, in particular. It was further noted that some large libraries have implemented an automated transportation system, which can be integrated with RFID technologies, known as the Paternoster system. This forms part of the Bibliotheca (www.bibliotecainc.com/products-and-services.html) (AMH) solution, comprising:

- book return/check-in machines type smartreturn 400;
- belt and roller conveyors for horizontal and inclined media transportation;
- sorting system type smartsort 400;
- vertical transportation and sorting system based on Paternoster technology; and
- fire doors with interface to AMH and building management technology.

This AMH technology can be applied to large libraries to combine self-service of the issue and return of items, central sorting and in-house transportation. The main aim of the application is to manage high volumes which need to be delivered rapidly, either to the shelf or to an office from where they need to be despatched to the requestor. The system includes hardware and software which is commercially available and can be integrated with other RFID technology. Manual input to the operation of the system is restricted to switching on the system and loading the material to be sorted and transported. The Library undertook to investigate the following questions:

- Could the Paternoster automated delivery system, as an alternative internal document delivery method, be used to meet the increasing demand for timely delivery of printed material to clients and other libraries?
- How could the UNISA Library benefit from the implementation of an internal automated delivery system?

**Methodology**

The methodology used in this investigation encompassed a literature study and a study visit to a library where an automated delivery system had been implemented and information gained from relevant service suppliers.

A literature search was conducted to find books or journal articles on the subject. A search on EBSCOHost’s Academic Search Premier, Business Source Complete, Communication and Mass Media Complete, Library & Information Science Source, Library, Information Science & Technology Abstracts, MasterFILE Premier databases, ProQuest’s Library and Information Science Abstracts (LISA) and a search on Google provided information on electronic delivery systems, and the use of automated transportation systems in libraries as well as details of a Library that uses a system which is integrated with RFID technology and useful criteria to be applied for the testing of an electronic delivery system. These criteria offered...
a basis for the evaluation of an automated transportation system applicable to this study.

Automated transportation systems that can be integrated with the Library’s RFID practices were preferred for investigation. Suppliers in this field provided useful information on systems already in use in libraries. Because a shift from a manual system to an automated system was considered, the suppliers referred not only to the features of the system but also to important aspects to be considered such as interface requirements and the building requirements for an automated transportation system.

A study visit was undertaken in May 2011 to the City Library, Hamm, in Germany where the library’s automated system had been integrated with RFID technology (Pirsich, 2010). The aim was to establish whether requested information resources can be transported effectively and efficiently in a library through an automated system. A visit to a site where the system was implemented was particularly useful to obtain a general overview of the system’s features and to consider its ease of use. It was necessary to benchmark the viability of the system in terms of the problem statement and to consider the practical operation of the system in relation to the current workflow of the UNISA Library. The study visit also provided an opportunity to discuss additional matters such as the security of the information resources while in transit and details pertaining to the capabilities of the system.

Evaluation criteria

Evaluation criteria used throughout the investigation reflected those identified from the literature review and, in particular, the viability of automated transportation systems in libraries. Additional criteria, including those for document delivery, were identified from Jackson’s, 1992 study (Jackson, 1992).

The following criteria, with the exception of two criteria applicable to the electronic transmission of documents, were used:

- Costs.
- Equipment requirements.
- Flexibility of technology.
- Advantages and disadvantages with regard to:
  - ease in the use of technology;
  - integration of the technology;
  - monitoring of the technology; and
  - installation base.

The following four criteria were added to Jackson’s list:

- security of items while in transit;
- building requirements for installation of the equipment;
- reliability of the system; and
- comparison with other internal transportation systems.

Automated transportation systems in libraries

As explained earlier, an investigation into the use of automated transportation systems in libraries was considered to establish their viability and benefit to the library. It was concluded that the solution has been applied successfully in large libraries with an in-house transportation need, similar to that of the UNISA Library.

Based on the above assessment of the Library’s request process, it was considered viable to replace the manual in-house transportation of items with an automated transportation system. The identified transportation system can be integrated with the Library’s existing RFID technology which already supports its request process. The benefits of the automated system will add value for many years, as the Library operates as a library with both print and electronic collections which implies that there will still be a demand for the delivery of print collections. Although trolleys may still be used on each floor to move books to and from the shelf to the conveyor belt, the automated system still remains a tremendous improvement, as trolleys would remain on the relevant floor (rather than going up and down eight floors in the lift), they would travel much shorter distances and probably would not need to be so heavily laden. There is also the benefit of improved health and safety for the staff as the risks of injuries on duty, although rare, will be reduced.

Costs

Costs are determined by the size of the Library and a number of routes to be installed. The approximate cost of the Paternoster system from one book-drop point to the sorting machine in the Library is R7,000,000 (approximately USD700,000). Should a second book-drop point be installed, the costs will double.

Although this initial capital cost is high, it can be weighed against the long-term running costs of transporting books manually from drop-off points to the shelves, taking into consideration staff time. The investigation revealed that books are regularly transported from nine areas in the Library. It takes approximately 12 minutes per trip for a person to deliver material by trolley from any level in the Library to the delivery office for issue and from the delivery office to the shelves. This includes time delays when the service lift, which serves eight floors, stops to pick up passengers and other trolleys. Forty-six trolley trips take place daily between the different levels of the Library, amounting to nine hours a day which equates to about one staff member.

The costs pertaining to the maintenance of the Paternoster system were not calculated, as these would be balanced by savings in maintenance costs of the Library’s service lifts used in the manual procedure. The maintenance costs of the new system could also be balanced against savings on the maintenance costs of the Unicar system which will no longer be required.

Equipment requirements

The specific equipment requirements were provided by the service supplier. Should a Library already have RFID equipment, parts of the existing sorting technology could be integrated into the new layout.

Hardware

A vertical transportation system for the Library with sorting includes the following hardware requirements:

- two interior item return terminals with input capacity of approximately 600 items/hour;
- belt conveyor system to connect item return terminals to the sorter and to the vertical circulating lift;
- one vertical circulating lift transportation system with automatic loading and unloading and automated landing
doors with transport capacity of maximum 1,800 items/hour;
- one item sorting machine with nine bins and maximum sorting capacity of 2,400 items/hour;
- one staff induction in sorting room to feed items from the circulation desk and inter-library loan returns;
- fire doors for lift and belt conveyors; and
- integrated control system based on programmable logic controller (PLC) technology.

Software
- software to operate the lift, belt conveyors, sorter and fire doors; and
- software to align with other RFID equipment.

Flexibility
The Paternoster system can be used with other RFID equipment, for example, returned library material can be sorted by RFID and then conveyed by the Paternoster system to the relevant shelving level.

Benefits of the system
Ease in use of technology
The AMH system is a user-friendly system and has user-friendly interfaces. After loading of the material, the system commences operation automatically. Service and support can either be offered by the supplier or can be provided by trained staff.

Integration of the technology
The technology of the UNISA Library workflow requires the integration of requested items to be delivered from the shelves to an area from where they are despatched and returned material to be delivered back to the shelves. Because the Library has more than one return point, the system must also link two or more return points into a single system.

In the manual procedure, once material is returned and sorted by the RFID sorter, it is shelved by staff about 46 times a day, depending on the number of books returned. This number is often very high, as about 5,000 clients visit the Library during peak periods, and they are likely to return items; in addition, clients return items via the South African Post Office, courier services which return material from eight UNISA regional libraries and returned inter-library loans. As part of this procedure, the availability of the material on the shelf is further hampered when staff members have to wait for the busy service lift. The integration of the technology with the transportation activities will result in the automatic transportation of material. This will eliminate the exhausting and sometimes hazardous manual labour involved in pushing heavy trolleys that can carry up to 350 items and will serve to speed up the transportation, as the periods of waiting for the single service lift will be eliminated.

Monitoring of technology
The status of the AMH solution and the individual components can be monitored from a dedicated central Personal Computer. In the case of breakdowns, this will allow staff to determine the type of problem experienced by the system.

Installation base
Similar systems have been successfully implemented at the City Library of Hamm, the University Library of Lithuania and the University Library of Freiburg. A number of public and academic libraries in Europe, America, Australia, Middle East and Asia are investigating the system at present.

Comparison with other internal transportation systems
Although the capabilities of other transportation systems were considered, it was not possible to compare the systems fairly due to the uniqueness of each product. It was, however, noted that the Bibliotheca AMH solution is a document delivery system which meets four main requirements:
1. High-speed automated book return with high security and 24-hour functionality. The lift can transport up to 1,800 items per hour.
2. Automated sorting of returned items immediately after return.
3. Fully automated transportation of material directly to relevant shelf areas on various levels in a large library.
4. Improvement of the availability of material through an improved shelving process and the separation of reserved items in the sorting procedure to ensure that requested material can be despatched without delay.

The actual shelving of the books remains the responsibility of library staff as the system does not transport the item to its location on the shelf.

Security of information resources while in transit
As the book arrives at the Library, it is placed on the receiving sorter and then into the correct bin for re-shelving. Items are then transported to the lift to be conveyed to the relevant levels in the Library. Lift doors open and close automatically at the required level where staff collect the items for re-shelving.

Building requirements for installation of equipment
Because the UNISA Library building has an existing vertical shaft, it was required that the transportation system be installed here to minimise disruption in terms of dust emission, noise and additional costs to modify the building. The space requirement of a vertical lift is a minimum of 1,850 × 1,150 mm².

Reliability of the system
It was noted during the visit to the City Library that Hamm the system has not broken down since its installation in 2006. Pro-active maintenance is, however, carried out by the supplier. FATA Automation (2013) reported that the Paternoster system at the British Library has been operational since 1997 without major overhaul. In 2013, certain units were inspected for wear and will be replaced if necessary.
Conclusion
The Library found that the system could deal with the large number of books to be transported. The installation of an automated system will allow more time for shelf maintenance staff to attend to the processing of requests for material and other important but less urgent duties. This will improve the speed of delivery of requests submitted by ODL clients who cannot visit the libraries together with those submitted by local and international inter-library loan partners who depend on the UNISA Library as a net lender for material not available in their own collections.

References
University of South Africa (2005), 2015 Strategic Plan, UNISA Press, Pretoria.

About the author
Jenny Raubenheimer is the Director of Information Resources Distribution of the Library at the UNISA. Since the early 1990s, Raubenheimer has been actively involved in resource sharing activities, particularly in South Africa but also internationally. Raubenheimer’s research interests are within this topic. She has subsequently delivered papers on this topic at conferences worldwide and has published in this field of interest. In addition to her role at UNISA, Raubenheimer is currently serving within the International Federation of Library Associations (IFLA) Document Delivery and Resource sharing section as a member of the Standing Committee for Resource sharing and Document supply. Raubenheimer holds a master’s degree in Information Science from the UNISA and is currently registered for a doctoral study at the same University. Jenny Raubenheimer can be contacted at: raubej@unisa.ac.za