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CATEGORY: INNOVATIVE APPROACHES OR TRENDS IN RESOURCE SHARING IN ALL TYPES OF LIBRARIES

BRIEF BIOGRAPHICAL SKETCH:

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ABSTRACT

The University of South Africa (Unisa) is an Open Distance Learning (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 3000 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 RFID transportation system to be implemented as part of a 21st century, newly redesigned Unisa Library. In order 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.

ENHANCING RESOURCE SHARING WITH A STATE-OF-ART TRANSPORTATION SYSTEM IN AN ODL LIBRARY

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Background

A brief introduction to the University of South Africa (Unisa) is provided in order to explain the need for an automated internal transportation system for the delivery of requested information resources at the Unisa Library.

Unisa as an Open Distance Learning (ODL) institution

The University of South Africa is one of the world's top ten mega-universities and the fifth largest Open Distance Learning (ODL) institution. Approximately 400,000 students registered in 2013 which renders it the largest ODL institution in Africa. The Unisa student profile is significantly diverse: of the students registered this year, 386,744 reside in Africa (including South Africa); 893 in Europe, 518 in Asia, 29 in Oceania; 317 in the Americas, and 3216 students are living with a disability (University of South Africa, 2013).

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 takes into consideration the diverse student profile and in practice, seeks to bridge the time, geographical, economic, social, educational and communication distances between students and the institution, between students and academics, between students and courseware and between students and 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 a 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 the province of Gauteng 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 Unisa clients, as a net-lender in South Africa, there is a significant demand for inter-library loans. 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 more than one hundred staff members. It consists of information search librarians, request processors, information resource shelving officers (responsible for the retrieval of information resources) and information resource delivery officers. During peak periods, approximately 2000 requests for information resources are received daily from Library clients. These include requests received from Unisa's authorised interlibrary loan client categories for material not available in the Unisa Library to be obtained via the inter-lending network from national or international participating libraries and from the

clients of libraries worldwide for the holdings of the Unisa Library. A total of 105 000 requests was processed in 2012 of which 8500 were requests for items on inter-library loan (Unisa Library 2013:52).

In support of the Library's vision, the internalisation of the ODL concept, and the needs of the inter-library loan community, rapid delivery of requested materials is important. Over twenty years ago, Swain (1991:169-170) alluded 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 between access and delivery as a significant challenge, particularly from the perspective of bridging the geographical distance between students and the ODL Library. Adherence to the immediacy principle in a global environment with time zone differences is key to this challenge. It is important to deliver requested print material to clients in time for that material to be useful for assignments and research (Raubenheimer 1996:194), and because 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.

In a large library, rapid delivery is only possible if the relevant processes and related activities are automated, that is, those processes and activities supporting the requesting of, and access to, information; the activities pertaining to the processing thereof; the activities pertaining to the retrieval of items from the shelves and the transportation of those items to be issued; the activities pertaining to the issuing of requested material, the marking back and sorting of returned material and the transportation and re-shelving of the returned material; and the delivery activities to transport the requested material to the requestor.

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 has applied information technology to the Library's resource delivery processes.

However, rapid delivery of requested material depends much on their actual availability at the time of request. The Library therefore continuously implements measures to ensure the improved availability of material. These include measures pertaining to lending rules to ensure the availability of issued material by the due date, but also the alignment of request service activities with technologies which ensure the prompt and accurate marking back of returned material and the removal of delay from the shelving thereof to ensure availability should the item be required by a client. This is taken into consideration during any assessment of the Library's request services to determine their effectiveness.

Assessment of the Unisa Library's request processes and related activities in its workflow system

Butters (2006: 1) states that the strategy to separate people from repetitive manual tasks is generally accepted in all industries, including libraries, and that process automation technology has therefore been implemented for years to assist in achieving this goal. He alludes to the fact that typical activities to be automated are those associated with issuing of books, retrieving them and returning them to the shelves (Butters 2006:2)).In order to assess the process to be automated, it is useful to consider the activities within the process that can be automated due to their repetitive nature. An assessment of the Unisa Library's request process and related activities in its workflow system reveals that there is a focus on the alignment of the request activities with information communication technologies and that much has been achieved in this regard.

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 are internally transported with a Swisslog Unicar system from the delivery office for processing. Upon 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 on the part of staff who might misread the handwriting of the requestor and the

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 for information. 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.

Within the workflow system, the request flows from the processing team (where the request is authorised, the location details of the available item captured from the online catalogue, and an automated message is sent to the client to acknowledge receipt of the request or to explain why it is not possible to fill the request), to the retrieving team (where material is retrieved from the shelves, placed on library trolleys and manually pushed to the delivery office near the exit level of the eight storey Library building) in order for delivery officers to issue print material with the aid of RFID lending equipment and despatch it in accordance with the client's preferred mode of delivery. Upon return of the material, the material is marked back by the delivery officers with the aid of RFID equipment which automatically removes 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 to be manually pushed to the relevant shelving area in the eight storey Library. 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 twelve activities in the request process are automated. The four manual activities pertain to the retrieval of information resources from the shelf and the pushing of trolleys to the area where the requested material is issued.

Based on the above 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 by aligning the activities with information communication technologies. However, the question arises as to what can be done internally on the operations side to speed up the workflow to make information resources available in a large library where a significant number of requested information resources needs to be retrieved from the shelves and delivered daily? In particular, the transportation of retrieved information resources from the respective levels of such a large library to the Delivery Office from where the material is despatched and the transportation of the same material when it must be returned to the shelves to ensure availability for the next client both need to be considered.

An investigation into automated transportation systems in libraries was subsequently done to consider whether libraries apply transportation systems as a solution to eliminate the manual transportation of material.

The literature reflects that this has been a solution implemented by many libraries since the early 20th century and the solution is still viewed as an option in contemporary libraries. The successful implementation of different models of automated transportation systems at various libraries is noted as a solution to replace the manual transportation tasks pertaining to book deliveries to and from shelves. This includes installations not only at renowned libraries, such as the Library of Congress and the British Library, but also installations such as the electro-pneumatic conveyor system at the Sterling Memorial Library and other automated book transportation systems (French and Hubbard 1928:15-20; *Book deliveries* 1931:214; Mohrhardt 1965:829-833; *Transport installations for library* 1965:361-362; Becker 1966:15-19; Dickinson 1971:422; McConkey 1976:491; Ohio State University 1973:182; Herman and Nester 1986:1).

More recently, for example, national and academic libraries such as the German National Library, Leipzig, The Grimm Library, Berlin, the Berlin State Library and the National Library in South Africa implemented light transport technologies (*Automation* 2011:217; Malan 2009:57-58); the Seattle Public Library implemented the Tech Logic System (*Seattle Public Library* 2013:1; *New Product*

news:70); and the British Library awarded contracts to FATA automation for the refurbishment of six Paternoster type elevators that form part of the mechanical book handling system at the St Pancreas site (FATA 2013:1). It becomes clear that libraries have started to recognise the value of conveyor systems linked to RFID systems for automated material handling (AMH) as it increases efficiency and has the benefit of being fitted to each library's space dimensions, workflow, timeline and budget.

It was noted that the need to use automated transportation systems has been questioned by some libraries, particularly in the light of the shift to electronic collections (Library of Congress 2010:1-4).

Since the Unisa Library is a hybrid library that uses RFID technology to issue and return library material in print, automated material handling 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, to speed up the delivery of returned material to the shelves to ensure prompt availability to clients upon return of borrowed material. This forms part of the Bibliotheca Automated Material Handling (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
- Fire doors with interface to AMH and building management technology

This AMH technological solution can be applied to large libraries to combine self-service with regard to the issue and return of material, central sorting of material and the in-house transportation of material. The main aim of the application is to manage high volumes of materials which need to be delivered rapidly, either to their locations on 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 Radio Frequency Identification (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 (Bibliotheca 2013:1).

In light of the need to speed up the delivery of requests for information resources received from clients and requests from libraries worldwide for printed material, the Unisa 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 this automated delivery system had been implemented and information gained from relevant service suppliers.

Literature was selected in view of the problem statement. In order to obtain the most relevant literature on the subject of electronic transportation systems, 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 & Mass Media Complete, Library & Information Science Source, Library, Information Science & Technology Abstracts* and *MasterFILE Premier databases* and ProQuest's *Library and Information Science Abstracts (LISA)* as well as a search on Google provided information on electronic delivery systems and the use of automated transportation systems in libraries since the 20th century, 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. The criteria offered a basis for the evaluation of an automated transportation system applicable to this study.

Since the Library uses RFID technology to issue and return library material, 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. Since a shift from a manual system to an automated system was considered, the suppliers alluded not only to the features of the system, but also to important aspects to be considered such as interface requirements and the building requirements that pertain to an automated transportation system.

A study visit was undertaken in May 2011 to a library in Germany, known as the City Library, Hamm, where the library's automated system had been integrated with RFID technology (*Zentralbibliothek in Hamm* 2010:1). The aim was to establish whether requested information resources can be transported in a library through an automated system which eliminates the need to manually transport material on library trolleys. 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 terms of the current workflow of the Unisa Library's activities within the Library's request processes, that is, the information resources processing process, the information resources retrieval process and the information resources delivery process.

Each activity within the processes to deliver information resources internally was considered to ascertain the impact of the execution thereof on the speed of delivery of information resources to be delivered to clients and on the speed of returning these resources to the shelves to ensure prompt availability. Once the manual activities to be improved were identified, it needed to be considered to what extent an automated system could speed up the procedure that delays the internal delivery of information resources. 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 used throughout the investigation pertained to criteria identified as part of the literature study. Additional criteria were added to the list of criteria identified by Jackson (1993:612-613) in order to consider practical aspects such as ease of use.

Evaluation criteria

The first evaluation criterion was stipulated by the Unisa Library, that is, automated transportation systems in libraries.

Other useful evaluation criteria identified were taken from Jackson's (1993:612-613) list of evaluation criteria for document delivery technologies and these were applied to the evaluation of an automated transportation system. All these criteria, with the exception of two criteria applicable to the electronic transmission of documents, were applied for this purpose.

Jackson (1993:612-613) lists evaluation criteria for the evaluation of document delivery technologies which can be applied to the evaluation of an automated transportation system. All these criteria, with the exception of two criteria applicable to the electronic transmission of documents, were applied for this purpose:

- 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
    - Installation base

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

- Security of information resources while in transit

- Building requirements for installation of the equipment

- Reliability of the system

- Comparison with other internal transportation systems

Evaluation of an automated transportation system by the Unisa Library

Evaluation results in terms of identified criteria are as follows.

Automated transportation systems in libraries

As explained in the earlier background, an investigation into the use of automated transportation systems in libraries was considered in order to establish the viability of this application in libraries and the benefits flowing from such an implementation. It was revealed 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 is viable to replace the manual activity pertaining to the in-house transportation of information resources 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 in the future as the Library operates as a hybrid library, which implies that there will still be a demand for the delivery of requested print collections. Although trolleys may still be used on each floor to move books from the shelf to the conveyor belt, and from the conveyor belt to the shelf, 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. Currently trolleys are heavily loaded to move the maximum number of items per trip. There is also the benefit of improved health and safety for the staff as the risks of injuries on duty, although rare, are mitigated.

Costs

The Paternoster system is an automated transportation system between the different floors in a large size library. Costs are determined in accordance with the size of the Library and number of routes to be installed. Approximate cost from a book drop point to the sorting machine is R7 000 000 (approximately US $700,000).

The capital expenditure pertaining to set up costs should be weighed against capital expenditure involved in transporting books manually from drop off points to the shelves. These costs should offset each other. The life span of the transportation system should be considered against the cost of manual labour over that period.
In this regard the investigation revealed that books are regularly transported from nine areas in the Unisa 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 on the respective levels. This includes time delays when the service lift, which serves eight floors, stops to pick up passengers and other trolleys. Per day, a total of 46 trolley trips take place between the different levels of the Library. This means that approximately nine hours (552 minutes) per day is spent on the transport of material. The time utilised for pushing 230 trolleys per week/920 trips per month relates to the time spent in the workplace by at least one staff member.

Ongoing operational costs to maintain the system include the maintenance thereof. These were not calculated as it 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.
From the point of view of cost, the decision was taken to abandon the use of the Library's current Unicar system as a separate system for the delivery of mail and to incorporate the delivery of internal mail with the delivery of Library material by the automated transportation system.

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 will be integrated into the new layout.

Hardware

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

- 2 interior media return terminals with input capacity of approx. 600 media / hour
- Belt conveyor system to connect media return terminals to the sorter and to the vertical circulating lift
- 1 vertical circulating lift transportation system with automatic loading and unloading and automated landing doors with transport capacity of max. 1800 media / hour
- 1 media sorting machine with 9 bins and maximum sorting capacity of 2400 media / hour
- 1 staff induction in sorting room to feed media from circulation desk and interlibrary loan returns
- Fire doors for lift and belt conveyors
- Integrated control system based on PLC technology

Software

- Software to operate the lift, belt conveyors, sorter and fire doors

- Software to align with other RFID equipment (Bibliotheca:2013:1)

Flexibility

The Paternoster system can be used with other RFID equipment, for example, returned library material can be sorted with an RFID sorter and then be conveyed with the aid of the by the Paternoster system to the relevant level where it needs to be shelved.

Advantages and disadvantages

Ease in use of technology

The AMH system is a user-friendly system and has user-friendly interfaces. After loading of the material is completed, the system will commence its operation automatically. Service and support can either be offered by the supplier or can be provided by staff members, with the proviso that staff are trained and have passed the relevant evaluation test.

Integration of the technology

The integration of the technology in the Unisa Library workflow pertains to the activity of requested material to be delivered from the shelves to an area from where it is despatched; and returned material to be transported from the point where it was returned to the shelves for clients to use. Since the Library has more than one material return point, the system must also link two or more return points into a single system.

According to the manual procedure, once material is returned and sorted by the RFID sorter, it is collected by staff members who push the material on a trolley from one level to another to be shelved. This procedure is repeated approximately 46 times daily, depending on the number of books returned. This number is, however, often very high as approximately 5000 clients visit the Library during peak periods and these persons are likely to return material; as well as material returned by clients via the South African Post Office, courier services which return material from eight Unisa regional libraries, and inter-library loans returned from libraries. 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 in the transportation activities will result in the automatic transportation of material from one point to another in the Library. This will eliminate the exhausting and sometimes hazardous manual labour involved in pushing heavy trolleys that can carry up 350 items and will serve to speed up the transportation as the periods of waiting for the single service lift are eliminated.

Monitoring of technology

The status of the AMH solution and the individual components can be monitored from a central Personal Computer used for this purpose. In the case of breakages, 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. More public and academic libraries in Europe, America, Australia, Middle East as well as Asia, are investigating the system at present with a view to implement it (Bibliotheca 2013:1).

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 and media delivery system which meets four main requirements:

- High speed automated book return with high security and 24 hour functionality. The lift can transport up to 1800 items per hour
- Automated sorting of returned items immediately after return
- Fully automated transportation of material directly to relevant shelf areas on various levels in a large library
- 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 (Bibliotheca 2013:2).

The 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. Material is 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 books for re-shelving.

Building requirements for installation of equipment

Since the Unisa Library building has an existing vertical shaft, it was required that the transportation system be installed in this shaft to avoid minimum 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 1850 mm x 1150 mm.

Reliability of the system

It was indicated during the visit to the City Library, Hamm, that the system is reliable as it has not broken since its installation in 2006. Pro-active maintenance is, however, done by the supplier. FATA (2013 :1) reported that Paternoster systems at the British library has been operational since 1997 without major overhaul. In 2013 certain units will be inspected for wear and be replaced if necessary.

Conclusion

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.

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