

Manuscript version: Preprint

Title: Planning and implementing an automated storage and retrieval system at the University of Limerick

Author: Ms Ciara McCaffrey, MLIS, BA

Author's Institution: University of Limerick

Article Type: Case study in book chapter

Keywords: automated storage; automated storage and retrieval; ASRS; change management; academic libraries; high density storage

Full reference: McCaffrey, C. (2021) 'Planning and implementing an automated storage and retrieval system at the University of Limerick', in Atkinson, J. ed. *Technology, Change and the Academic Library*. Hull, UK: Chandos Publishing.

Planning and implementing an automated storage and retrieval system at the University of Limerick

Ciara McCaffrey

Abstract

This case study will introduce the Automated Storage and Retrieval System (ASRS) implemented in the new library at the University of Limerick (UL), Ireland. A quarter of the library's print collections were moved into this robotic system that has capacity for 500,000 books and takes up one ninth the space of conventional shelving. This is the first on-site automated storage system located within a university library in Europe. The technology provides an opportunity for a radical and game-changing shift away from providing space for collections to providing new and innovative learning spaces for library users. This case study outlines the drivers that influenced the decision to include an ASRS in the building and describes and reflects on the significant change management challenges of implementing a complex storage solution that affected all staff and had a transformative impact on library services.

Introduction

The decision to include an automated storage and retrieval system (ASRS) as part of the new library building in the University of Limerick (UL) was made to meet two seemingly irreconcilable demands - more seats for students and more storage for books. The tension between how much floor space to give to shelving and how many study seats to give to users is one that almost all academic libraries face. Libraries wishing to provide individual, collaborative, social, flexible and technology-enhanced spaces are faced with difficult decisions around what to do with their print collections. It is becoming increasingly difficult to justify large floor space devoted to storing print materials at a time when use of print collections is universally declining and use of electronic collections continues to increase. That being said, low use print collections must still be retained, stored and managed. Libraries look to solutions like major weeding projects, off-site storage and collaborative storage agreements to cope with this major challenge. For libraries in the fortunate position of planning new buildings, as was the

case at UL, the solution of an automated storage and retrieval system is one that merits serious consideration.

What is an automated storage and retrieval system?

The most common ways to store library print collections is via conventional open shelving or compact shelving. An automated storage and retrieval system presents a third option and has a much higher storage capacity, while occupying a much smaller footprint than the first two options. Instead of shelving, books are stored in large metal trays or bins. The bins are stacked vertically in a high vault and the depth of the bins vary to accommodate small, medium, large and oversized books. Material is therefore stored based on its size rather than a classification system and is identified by its barcode.

When a user requests an item in the catalogue, a mechanical crane kicks into action, finds the right bin and brings it to the staff workstation at the base of the vault. The staff member then retrieves the correct book, sends the bin back, leaves the book at the reserve shelf and the user gets an email to say the book is ready for collection. Figures 1 and 2 provide visuals of the crane and bins in UL's ASRS and readers can see the system in action by searching for the UL Library ASRS video on YouTube or from the website at www.ul.ie/library.

Automated storage and retrieval systems are commonly used in manufacturing, can be easily visualized in product supply companies such as Amazon and have appeared in pioneering university libraries in North America, Australia and Asia since the 1990's. Some American and Australian literature providing individual case study experiences of ASRS's in libraries exist, for example Bullard and Wrosch (2009), Burton and Kattau (2013), Haslam et al (2002) and Heinrich and Willis (2014). There are a small few examples of automated storage in European libraries, which are in off-site stores used for very large collections as is the case in the Boston Spa site of the British Library, the National Library in Norway (O'Connor and Mathisen, 2005) and in the case of Switzerland, for collaborate storage among a number of libraries.

The system at UL, supplied by Dematic, is the first of its kind in Europe, built within a library and allowing users to directly request books stored on-site. After some deliberation about how to refer to it – Automated Storage and Retrieval System or ASRS meaning little to anyone – we

emulated Macquarie University's approach and named our system 'the ARC', short for Automated Reserve Collection. By comparison with libraries internationally, our single crane system is small and can store up to 500,000 books. Some systems have up to five cranes and 10 stacks, accommodating c.2million books. In UL, the ASRS is contained in a high narrow vault which runs from the basement to the second floor of the new library. Like a piece of contemporary art, a window on the ground floor gives users an opportunity to see the ARC at work, with the crane swinging high and low retrieving bins. Since the opening of the new library, the ARC has been a source of fascination for the university community and never fails to impress visitors.

The decision-making process

The new library at UL had been in the planning stages since 2006, but had been delayed by loss of funding during an international recession. The construction re-emerged in 2015 and Dublin-based architects RKD won the tender to develop the design which had been approved with planning permission almost a decade earlier. It was a major extension to the original library building, doubling it in size, and was completed in 2018. The dramatic re-imagining of the new library at UL, together with its many technology-infused features and spaces, are outlined by O'Riordan (2019).

UL is a 45 year old university located in the southwest of Ireland. Library collections are still growing as new disciplines of study are added and the student population continues to grow. The original library opened in 1997 and was built for a population of 7,000 students. In a decade that population had more than doubled, we had an overcrowded library with insufficient study seats, shelving crammed into every conceivable corner and in recent years had to move low demand material to off-site storage at considerable cost to the university. By 2015 our collections included c.400,000 monograph volumes. An ASRS was not part of the original plan, which was to provide capacity for 260,000 volumes, by putting conventional and compact shelving on all five floors of the new wing.

A visit by the architects, together with senior university personnel, to US university libraries in 2015, including the award-winning Hunt Library in North Carolina State University, was the

catalyst for considering an ASRS. The primary purpose of the visit, organised by the Library Director, Gobnait O’Riordan, was to look at highly innovative approaches taken to delivering a variety of innovative, flexible, technology-enhanced, learning spaces. When the architects saw the ASRS they immediately understood the potential that such a high-density storage solution would have on their capacity to deliver user-centred, flexible and varied learning spaces. Following the visit they presented a proposal for an ASRS at UL which provided some compelling figures. Instead of capacity for 260,000 volumes stored on shelving across every floor, the ASRS would provide capacity for 500,000 volumes on a footprint one ninth that of conventional shelving, allowing for a 25% increase in student space. So in essence, the ASRS would provide more storage, more seats and more space than the original plan.

The decision to include an ASRS was not one that was taken lightly. As a young Irish university, UL has a record of being pioneering and innovative, and the system certainly appealed from that perspective. On the other hand, installing the first system of its kind in Europe came with some risk to UL. There was no system like it in any European university. It would require resourcing from more than the library, with high-level expertise and support required from Buildings & Estates engineers and maintenance crews. A further concern was the impact that the system costs might have on the overall budget, however additional funding was identified so that the inclusion of the system was not at the cost of other aspects of the design.

From the library’s perspective, the prospect of an ASRS was initially received with some concern. There was no library in Europe that we could look to for help and advice on implementation. Integrating the library system with the ASRS system was another unknown and a critical factor to its success. If the library system could not integrate with the ASRS then the technology might work mechanically, but the system would fail as a library retrieval service. A further reservation was around our capacity to take on a major change project in addition to that of planning and preparing for the new library. The system required substantial changes in collection management, systems, services and staffing across all departments. With a library staff FTE of 46, the staff time and effort required to operationalise the system while also managing a refurbishment and building project was hugely concerning to library management. Finally, the staffing required to operate the system once it was implemented and where it should

be positioned within our structures was very difficult to plan – who would operate it, which department, which roles, which grades?

However, the library at UL has for many years been following a clear change agenda driven by innovation, automation and the use of technology to improve processes and services. New technologies implemented over the last decade included an array of self-service options, a book sorter, entry gates, laptop loans and a digital library. From a collections perspective, book acquisition processes were re-engineered through the implementation of RFID, EDI, shelf-ready and book sorter technologies, so that the majority of books ordered by the library are received, added to stock and available on the open shelves on the day they arrive into the library. The library's journey of both incremental and transformational change over a decade is outlined by McCaffrey (2019).

The consequence of this journey has been that librarians at UL have developed a great deal of experience in the change management required to automate processes, implement technologies, introduce new services and transform library spaces. Library leadership has a strong understanding of the change cycle, which occurs with all the predictable pain points and challenges in UL as elsewhere, but staff have developed sufficient experience to understand and navigate the process effectively. In many ways, change has been normalised for library staff over the years. One critical learning has been that all technological changes seem daunting when first proposed, yet through careful planning, all have been successful and hugely beneficial to the improvement of library services in UL. Armed with this experience, staff had some confidence when the decision was made that an ASRS would indeed be a feature of the new library.

Preparation phase: getting ready for the ARC

The Library Director and Deputy Librarian were both on the new building design team and worked closely with the architects, the Buildings & Estates team, the contractor and a supply chain consultant to develop the specifications for the ASRS at UL, before tendering for the system. The tendering process came with its own challenges. Only two suppliers of automated storage systems made it to the final stages of the process – the more expensive option had experience of working in a library setting and integrating with a library system, while the more

cost effective option did not. The university embarked on a period of investigation and consideration, hiring a leading consultancy firm to perform in-depth assessments of the both options. After a prolonged and thorough procurement exercise, the Dematic system was selected. Dematic had 20 library customers worldwide at the time, although none in Europe. EU laws presented challenges at the final stages of agreement, as all specifications had to be adapted to comply with EU health and safety requirements around the machinery and who could interact with it.

Following the tendering decision, the library commenced a change management programme to prepare for the ASRS. As we did for other technologies we have implemented over the years, we made contact with libraries that had automated storage and retrieval systems. Successful implementation at UL would not have been possible without the generous information sharing and advice from the libraries at North Carolina State University, University of Chicago, Grand Valley State University, Eastern Michigan University, Georgia Southern University and Macquarie University.

The first step was to begin the process of changing the library management system, specifying within the tender that bidders must have previous experience of integration with an ASRS. This resulted in our migration to a cloud-based library services platform provided by Ex Libris (Alma and Primo). Migrating to a new library system is a substantial undertaking for any library and required a project team and change management plan entirely separate from the ASRS project and the new building project. Migration occurred successfully at the beginning of 2017, after which the Head of Technical and Digital Services made contact with the very small number of customers of both Ex Libris and Dematic, to plan the technical integration aspects.

Within the library, the ARC Project Team was set up in 2017, and its purpose was to plan and implement the automated storage and retrieval system as a library service. The Deputy Librarian, and author of this case study, led the project and the team consisted of managers, librarians and senior library assistants from Technical & Digital Services, Reader Services and Information Services. As with the majority of UL library projects, the team included representation from across departments, a team member was nominated as the project administrator, to manage the meeting schedule and project documentation, and both staff training and communications were standing items on the agenda. The team, while still being formed,

began with a visit to the Mansueto Library at the University of Chicago and then met fortnightly for the period of a year.

A project plan was put in place which outlined the main objectives of the project and worked towards a timeline based on the Dematic project plan, which set March 2018 as the date when the ARC would be handed over to UL. The main objectives were to review the library's print collection to determine what books would be stored in the ARC, to prepare this material for loading into the ARC, to establish a service model for users, to train library staff and communicate with the university community as required.

From planning to reality: operationalising the ARC

Some libraries use their automated storage and retrieval systems to store their entire print collection. This allows them to dramatically repurpose their learning spaces. UL Library made a decision early on not to take this approach. In the first instance, the new library would already double the amount of seating available so there was not an urgent need to create more space. Secondly, while the concept of the system was met with a degree of curiosity in the university, we felt that a dramatic culling of our print collections from the open shelves was not in the best interests of learning and research at the university.

A decision was made to use the ARC for low-demand material and to bring back all collections from off-site and stores so that monographs are located in one of two places - on the open shelves or in the ARC. We defined 'low-demand' through collection analysis as books that had never been borrowed or been borrowed once and had been in the library for five, ten or fifteen years. Different subjects had different criteria applied to them. In the year prior to the ARC handover, in excess of 100,000 books were prepared for loading – each book was cleaned, measured against a template of bin heights, colour-coded and the last two digits of the barcode were written on the top of the book. This work was done by a team of library attendants and students, managed by the Senior Library Assistant in Reader Services who had responsibility for operations, shelving and space maintenance, and overseen by the Head of Reader Services.

In addition to extracting low use material from the open shelves, we also prepared material that had been in store and off-site. Most libraries have one or two uncatalogued collections that are in storage awaiting a time when staff and resources will be available to work on them. For UL, it was the Hammersmith Collection, a labour history collection of 15,000 items acquired some years previously, uncatalogued and unavailable in off-site storage. A separate team of students, supervised by the Cataloguing and Metadata Librarian, worked on this collection for over a year to add it to stock with basic bibliographic records and barcodes. Because books are contained in the ARC by barcode, Dewey numbers did not need to be added to this material.

The system took 9 months to build and was handed over to the library in March 2018. There followed a period of what can be described as organised chaos! Thousands of books were loaded by students while library and Buildings & Estates teams familiarised themselves with the technology. In the background, systems staff worked with Dematic and Ex Libris to iron out many integration issues and at the same time the cataloguing team dealt with an unexpectedly high volume of rejections – material that the ASRS did not accept for reasons such as problem barcodes, old records, material not appearing on the system, etc. Very quickly a ‘Rejections Sub-team’ was created to work through this material so that it could be re-loaded into the ARC. Loading took two months, after which all-staff training commenced, process documentation was written and a service was put in place for library users.

The ARC receives between 8 and 10 requests per day and is in operation during the serviced hours of the library, from 9am to 9pm during semester. One disadvantage of the system is that it cannot operate without staff, so the service is not available late at night and at weekends when the building is open to users. However, because of the low-demand nature of the collections stored in the ARC, this has not been an issue for users thus far.

The small number of daily requests also meant that the technology, though sizeable in itself, did not require additional posts or major changes to existing roles. The role most affected was that of the Senior Library Assistant, Operations, within the Reader Services Department, who now manages the ARC as part of her wider management of library storage, shelving and spaces. Through fortunate timing this role became vacant one year prior to the commencement of ARC project and the new appointee brought an enthusiasm and flexibility that greatly contributed to successful implementation. The library attendant shelving team interact most with the ARC,

switching it on and off in the morning and evening, returning items to it over the course of the day and performing audits of bins on a regular basis for quality control. However, the main work of the library attendants is still stock maintenance on the open shelves, and adoption of the ARC was helped by their many years of experience working with the book sorter technology. Both library attendants and assistants bring material to the Information Desk when a request is made and the time from request to supply is between 10 and 20 minutes depending on staff availability. All staff are trained on the basics of the ARC, so that any staff member can retrieve a book from the ARC if needed. In the event that there is a crane stoppage, the Buildings & Estates maintenance team respond within an hour and they maintain and service the machinery regularly throughout the year, with scheduled visits from Dematic twice yearly.

In communicating the ARC as a new service to library staff, we focused on the fact that it is essentially a staff-mediated shelving system, not that different from our existing theses collection, which students request and staff retrieve many times throughout the day. This helped staff understand the change before it became a reality. In many ways, the ARC technology was one of the most easily accepted changes by staff. This was due to a combination of things that came together – a well-managed project, an enthusiastic project team, good in-house technical knowledge, strong support from the Buildings and Estates Department, a flexible staff that were well used to new technologies and the undeniable coolness of this particular technology.

Conclusion

Because of the ARC, UL Library now has all its collections on-site and available to users. It has allowed us to provide much more relevant material on the open shelves, providing users with a better browsing experience, and the process of reviewing material for the ARC allowed us to clean up thousands of records on our system. Previously unavailable collections are now available to library users. A quarter of our collections are now stored in the ARC. Critically, the ARC gives us a storage solution for our print collections for many years to come. Future plans to evaluate the service include reviewing what material has been requested from the ARC to ensure that it is low demand, identifying more open shelf material to be moved to the ARC and, eventually, making evidence-based decisions about material that might never be requested in the decades to come.

The greatest benefits with the ARC, however, are in what it has allowed us to deliver to library users in the new building. UL Library now has 2,200 seats, 23 bookable group study rooms and a further 12 specialised spaces including a data visualisation lab, a practice presentation room, a media production room, PC training rooms and faculty meeting rooms. There are hugely popular collaborate booths, break out spaces, a new special collections and archives reading room, an exhibition space, a digital scholarship centre and a Moot Appellate Court which doubles up as a presentation space. In the first year library use increased by 31%, group rooms are in constant use and the ARC is one of the highlights of the building, in and of itself.

Overall, the project has been a remarkable success. The implementation of the automated storage and retrieval system, together with the opening of the new library, has been an incredible adventure for staff at UL, filled with many potential pitfalls and viewed with some trepidation during the planning phase, but has worked out more successfully than we could have ever imagined.

References

- Bullard, R. and Wrosch, J. (2009) 'Eastern Michigan University's Automated Storage and Retrieval System: 10 Years Later', *Journal of Access Services*, 6(3), 388-395, available: <http://dx.doi.org/10.1080/15367960902894187>.
- Burton, F. and Kattau, M. (2013) 'Out of Sight but not Lost to View: Macquarie University Library's Stored Print Collection', *Australian Academic & Research Libraries*, 44(2), 102-113, available: <http://dx.doi.org/10.1080/00048623.2013.795473>.
- Haslam, M., Kwon, M.J., Pearson, M., Vent, M. and White, M. (2002) 'The automated storage and retrieval system (ASRS) in Lied Library', *Library Hi Tech*, 20(1), 71-89, available: <http://dx.doi.org/10.1108/07378830210420708>.
- Heinrich, H. and Willis, E. (2014) 'Automated storage and retrieval system: A time-tested innovation', *Library Management*, 35(6-7), 444-453, available: <http://dx.doi.org/10.1108/LM-09-2013-0086>.
- McCaffrey, C. (2019) 'Transforming the university library one step at a time: a ten year LibQUAL+ review,' *New Review of Academic Librarianship*, 25(1), 59-75, available: <https://doi.org/10.1080/13614533.2018.1511438>
- O'Connor, S. and Mathisen, K. (2005) 'From traditional stacks to an automated storage and retrieval system', *Library Management*, 26(1-2), 97-101, available: <http://dx.doi.org/10.1108/01435120510572923>.
- O'Riordan, G. (2019) 'Re-imagining the university library – a transformative opportunity', in Koen, D. and Engel Lesneski, T., eds., *Library Design for the 21st Century: Collaborative Strategies to Ensure Success*, Berlin: De Gruyter, 221-230, available: <https://doi.org/10.1515/9783110617535-017>