

# Looking towards a brighter future: the potentiality of AI and digital transformations to library spaces



UNIVERSITY OF LEEDS

## **Looking towards a brighter future: the potentiality of AI and digital transformations to library spaces.**

Artificial intelligence (AI) in libraries project

Digital futures research report

University of Leeds Libraries

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## Introduction

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At the University of Leeds, we have developed an ambitious, bold vision for our libraries called **Knowledge for all**. Knowledge for all sets out the libraries' direction for 2030, and digital transformation is critical in making our vision a reality. **The Artificial Intelligence (AI) in Libraries Project** forms the basis of this report and it is one of the steps the library is taking to achieve its bold vision. This vision is fully embraced by the University of Leeds as part of the university's development strategy.

On one hand, general AI technologies provide an interesting platform for robust discussion and innovation, and the University of Leeds has always been a lead voice in the conversation. On the other hand, there are significant opportunities for digital transformation on a practical level through the use of specific AI technologies to improve user experience, process optimisation, collections description and discoverability. General AI can help us plan for long-term strategies in the library. Specific AI changes and develops over time and, through these transformations and growth, broadens technology use and the opportunities AI can afford in a library setting. In both cases, these technologies should be applied where they would benefit the library staff and users best, both in front of and behind the scenes.

An increasing amount of research highlights the potential of AI applications in libraries; often this is linked to general AI theory and discussions. While it is true that some of this research is still not translated into practical approaches that can be undertaken by the libraries, many approaches already exist and would benefit from being placed in the spotlight. Similarly, there are many practical applications of specific AI that work in some but not all contexts, and these must be carefully evaluated in the University of Leeds' specific context.

To this end, this is a project that aims to better understand the potential and the practical implications of AI in libraries. Through a general understanding of the current AI research, theory and practices we hope to find specific recommendations for AI applications in the library setting as well as context-specific recommendations for University of Leeds Libraries' future development plan.

## Methodological considerations

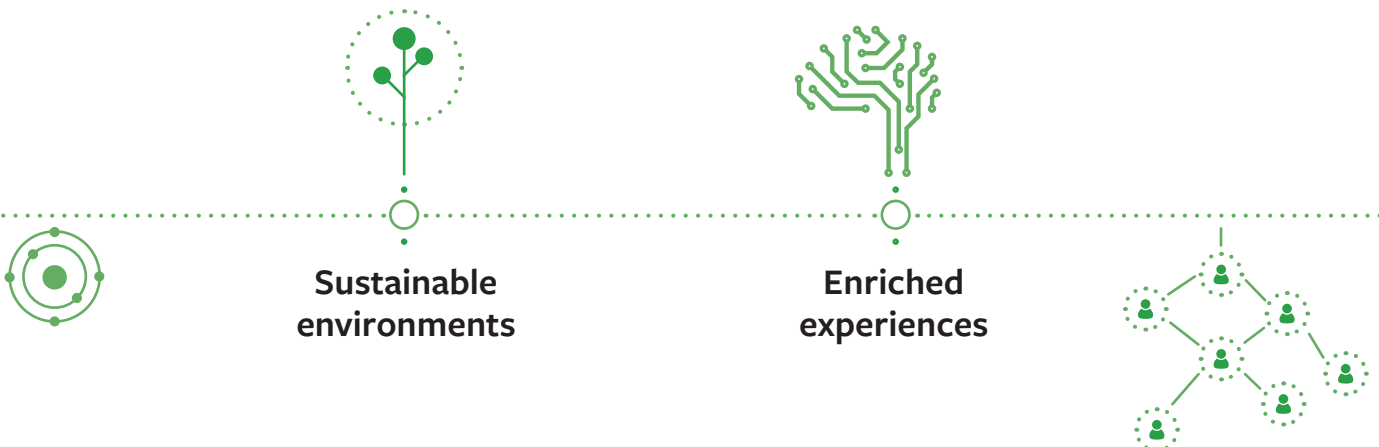
In order to uncover data about the use of AI in libraries and what recommendations should be offered to University of Leeds Libraries, a multi-faceted methodology was conceived. This methodology included a desk-based assessment, a survey and a series of expert interviews with relevant stakeholders.



First, to explore the existing research and practices, a desk-based assessment of relevant materials was conducted, and a literature review developed. The results of this assessment will be presented in detail in Chapter 1 of this report. Second, the analysis of the desk-based assessment was used as the foundation of a university-wide survey that was distributed to both staff and students. The data from the survey will be discussed in depth in [Chapter 4](#). Third, the analysis of the desk-based assessment also showed areas where further expertise was required. The expert interviews, stratified thematically, will be evaluated in [Chapter 2](#) and [Chapter 3](#).

The desk-based assessment provided both context and content for the survey questions as well as the methods for assessing and selecting the expert interviewees. In the survey, the questions were a mixture of open-ended and prompted multiple-choice. Response rate suffered due to the timing of the survey primarily over the summer months. As there were only 60 respondents this became a sample survey, rather than the representative one that was originally intended. This is why the survey data only serves to bring out additional nuances in one of the chapters.

As a way to balance the survey deficiency, the expert interview stage was expanded to cover multiple groups of relevant stakeholders during three separate rounds of interviews. The first round of semi-structured expert interviews was conducted with 10 experts from all over the world. These interviews snowballed a second round of expert interviews. From the second round three additional interviews were completed. Further, as this is a project that has both general and Leeds University-specific applicability, the third round of site-specific expert interviews was also conducted with members of the Leeds library. For these interviews our aim was to learn and develop an understanding about library operations and identify priority areas where AI approaches can help us progress further and at scale. For this stage of the methodology, six more interviews were completed.





The interviews were divided into three sections. The first set of questions were, broadly speaking, about existing perceptions of libraries and the role of technology in the library space. The second were questions related to published work on the topic, and the last were about the current and future directions of AI in libraries research.

The data from the survey and the three stages of expert interviews, which yielded 19 interviews covering more than 30 hours of data, were thematically analysed. The themes formed the basis of Chapters 2, 3, and 4. Chapter 2 focuses on theoretical perspectives and aims to answer what perceptions and images experts have of the ‘library space’ as a concept as well as ‘what is AI?’.

[Chapter 3](#) examines a University of Leeds librarians-centric perspective. This chapter explores the librarians’ perceptions of the library and AI technological initiatives in University of Leeds Libraries and further connections between:

- AI and resilience
- AI and climate awareness
- AI and equality, diversity and inclusion practices.

[Chapter 4](#) then presents the survey data that follows library users’ perspectives. The report will then conclude with a ‘looking ahead’ section that presents the main findings as a series of general and also context-specific recommendations.

This project has a particular importance in general for research purposes, and specifically for the University of Leeds. Our university caters to around 38,000 students and thousands of academic staff who make use of library services daily, so embracing digital approaches in the library can lead to a multitude of efficiencies and augment the support and importance of the library as part of university experience. The data gathered as part of this project will help to move the sector forward, through sharing the findings via a report, further publications and presentations to a wide range of audiences. Thus, the potential impact of this research into the benefits and practical application of AI and other data mining, organisation and analysis technologies is also linked to a contribution to the whole library services sector. The project has been reviewed and it will adhere to the appropriate university research ethical guidelines.





## Chapter 1

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### A comprehensive review of existing studies of AI and AI in the library space





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**In modern terms, AI technologies are ‘retro’.** As much as we keep hearing AI defined as innovative and emerging, this report will break away from these traditional AI perspectives. AI is not new, AI is not emerging, AI is not innovative. What is new, emerging and innovative is understanding of the affordances and limitations of AI technologies and the history of AI applications in different contexts – both successes and failures. This positionality is important when the main aims of this report are to assess how, where and by what means AI could be a useful tool for library services. In this perspective AI is not a mysterious white-winged horse, but rather a series of opportunities with pre-defined characteristics already steeped in rigorous research, trial and error.

## What is AI?

AI as a term appears both in fact and in fiction. Representations of AI technology, in fact, can be seen with voice assistants like Siri or viewing recommendations on Netflix while representations in film span from a robotic takeover in *The Terminator* to lines of code running through the screen in *The Matrix*. The wide range of representations points to the difficulty in defining AI as a single concept. According to McNeal and Newyear (2013), that is because “AI is a wide and diverse field with many subfields, ranging from the creation of machine intelligence that equals or surpasses human intelligence to problem solving, natural language processing, machine perception and learning, robotics, etc”. Gundakanal and Kaddipujar (2020) further define AI as a “bundle of technologies” that can be described as an “extension of human intelligence”. In other words, AI is a series of technologies that can mimic certain aspects of human or animal behaviour, comprehension and sense-making thought processes via the performance of human-attributed actions.

**> [AI refers to] the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. <**

*The Encyclopedia Britannica*

However, AI is not seen as an independent entity that can think on its own. Rather, it is “the science of getting machines, or computer systems, to perform tasks that require intelligence if done by humans, or perhaps animals” (ibid). According to Stanford University, in 1955 John McCarthy, who is generally recognised as one of the first to pen an AI working definition, also argued that AI is a concept firmly embedded in the science and engineering that humans use to teach and mould intelligent machines, making them into “intelligent computer programs”.

Indeed, the history of AI can be viewed to begin even earlier than 1955, when in 1943 Warren McCulloch and Walter Pitts projected a model of artificial neurons. Following on in 1948, Alan Turing published the report ‘Intelligent machinery’, in which he suggested a prototype of the ‘imitation game’ or what would later be known as the Turing test. Turing, as one of the pioneers of AI, would set the Turing test as the methodology for evaluating computer intelligence and ability to be indistinguishable from a human that is still used today to test AI technologies.

**> [AI is defined as:] the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. <**

*The Oxford English Living Dictionary*

As a concept that is part of the academic work as well as practical applications, definitions of AI have also grown to encompass both theory and development of AI technologies. One of the main challenges of these definitions is the difficulty in defining ‘human intelligence’. For example, even though Turing published the paper ‘Computing machinery and intelligence’ in 1950 in which he posed the question ‘Can machines think?’, even he argued that ‘intelligence’ is too difficult to define and instead focused on evaluation via the use of the Turing test. The question ‘Can machines think?’ highlights the need to first define both ‘machine’ and ‘thought’. Two concepts that, nearly 75 years on, still lack simple definitions.

With many competing theories of what ‘intelligent’ is, there is still no precise definition (Bailey 1991). We have some ways of measuring intelligence in terms of capacity or in relation to social curves, but even those measurements have come under fire in recent years. With deconstructivist approaches to social definitions of intelligence being paired with emerging methodologies and varied comprehension of human interactions, our perspectives on intelligence have become even more fluid.

In an attempt to pin down at least a structure for ‘intelligent behaviour’ that can underpin expert system research, Cook et al (1988) defined 10 factors or aspects that they argue constitute markers of intelligence. These 10 factors are:

- acquisition
- automation
- comprehension
- memory management
- metacontrol
- numeric ability
- reasoning
- social competence
- verbal perception
- visual perception.

And yet, these 10 factors are still deemed not enough to encompass human intelligence, because what constitutes human intelligence also includes an abstract understanding of our lived realities, of human existence and of social meanings that change over time. The transience of human perceptions and understanding is integral to human intelligence. For instance, as Dreyfus and Dreyfus (1986) explain in their published work ‘Mind over machine: the power of human intuition and expertise in the era of the computer’, there are five stages to human skill acquisition that begin with obedience, pass through expertise and the ability to adapt to various degrees and conclude with intuition. In other words, the concepts of ‘intuition’, ‘the sixth sense’, or ‘feeling’, are also an undeniable component of human intelligence. That is why, until we can solve the conundrum of how to describe and incorporate transient human behaviour in AI technologies, AI will inevitably remain at a level of mimicry rather than fully replicating or emulating human consciousness.

## Where is AI?

Even at a level of mimicry, AI can be a powerful tool.

**> If we are to make progress in the area of intelligent systems, we must have a well-developed understanding of AI technologies, a historical perspective on accomplishments to date, and a realistic perspective of AI as a tool with appropriate and inappropriate uses in light of current constraints. <**

*Bailey, 1991*

For a well-developed understanding of AI technologies, we must consider where and in what way these technologies are being developed. AI technologies, according to Mishkoff (1988), are developed in eight main areas of research. These eight areas are:

- expert systems
- robotics
- automatic programming
- natural language processing (NLP)
- intelligent computer-assisted instruction
- planning and decision support
- speech recognition
- computer vision.

What is common between these areas is the use of non-algorithmic methods to solve daily problems of any systems (Bailey 1991). AI “enables any device to achieve given responsibilities by processing enormous quantities of data, and recognise outlines, predict the data inputs, which allows users to provide feedback for improving accuracy over time” (ibid). Over the last several decades, with the evolution of AI technologies, some of these areas have developed further sub-categories such as machine learning (ML), data visualisation and big data analytics.

As a way to comprehend AI evolution, it is necessary to keep a record of the historical accomplishments of AI development to date. It comes as no surprise, then, that many papers and reports have already focused on developing comprehensive in-depth overviews of AI technologies such as Frenzel (1987), Luger and Stubblefield (1989) and Warwick (2012). There are also specific AI technologies overviews such as Quiroga et al (2020), which focuses on chatbots used in the educational field by evaluating 485 sources and 80 studies on chatbots and their application in the education sector.

Finally, with so many theories and practical developments in the field of AI, there is a need to maintain a realistic perspective of AI's uses with regard to both successes and failures within the current technological context. AI as a technology is not new either as an idea or as a practical tool, and it has been incorporated extensively in various sectors. However, there is a recognised trend for researchers to label AI technologies they develop by other names such as computational intelligence, knowledge-based systems or cognitive systems. McNeal and Newyear (2013) suggest that this trend has come into being as a means to “distinguish their own field from the rest of AI or to avoid being viewed as wild-eyed dreamers.[...] while there are attempts to replicate the human brain and body, most AI has less ambitious goals; it's really about making computers or machines do things that human beings already do, things like recognising speech, driving cars, translating languages, controlling the temperature in houses, or even removing the bone from a ham.” Therefore, in terms of a realistic application of AI it is not likely that AI will take over the world, but rather that AI will be a part of your home appliances such as your digital video recorder, fridge or thermostat. As a matter of fact, AI is already part of many home appliances as well as being used in aviation, industry, customer service or sectors like the financial one. The trend that makes researchers rename AI technologies with different names is the same trend that we see with the everyday AI technologies in our phones and cars, with the only exception being the Roomba, which is still viewed as AI.





## AI use in the library space

With AI being so widespread, it is no surprise that AI technologies also exist in the library space. There are several great overviews of research and development of AI as applicable to librarianship such as Smith (1987), Aluri and Riggs (1988), Anderson (1988), Cavanagh (1989), Holthoff (1989), Alberico and Micco (1990), Gundakanal and Kaddipujar (2020). There are also numerous publications on the perspectives of librarians about technology adoption in the library such as Wood and Evans (2018, academic librarians' perspectives), Wang et al (2020, particularly about the three impacts in libraries: environment, resources, services) Lund et al (2020, diffusion model and early adopter categories), Hervieux and Wheatley (2021, academic librarians' perspectives), Azimi et al (2022, academic librarians' perspectives), CENL Report (2022, national libraries' perspectives), Okunlaya et al (2022, conceptual framework), and Winkler and Kizil (2022, academic library directors' perspectives). It would be impossible to go into depth in this report about the sheer volume of research already completed over the last 75 years about AI technologies and how they can be applied in the library. The following overview is representative of the current state of AI technological use in library spaces.

**> Strikingly, 50% of librarians were unsure if patrons had already been using AI in connection with their library, suggesting that more learning needs to be done to educate librarians on what is powering the technology they expose to their communities. Currently, only 20% of librarians believe that their patrons are interested in interacting with AI. <**

Hervieux and Wheatley, 2021

Gundakanal and Kaddipujar (2020) wrote an amazing overview of the history of AI development as placed in relation to technological advancements as well as specifically within the library space. The overview includes descriptions starting from early developments in AI innovation to current research trends. The authors even highlight both periods where AI was severely under-funded and research froze, otherwise known as the 'AI winters'. The AI winters were a time in AI research where there was no funding or support for AI development, and yet interest in the field remained and research subsequently recovered. Since 2011, the focus in the field of AI development has been on deep learning and big data with applications in four key areas:

- expert systems
- natural language processing (NLP)
- pattern recognition
- robotics.

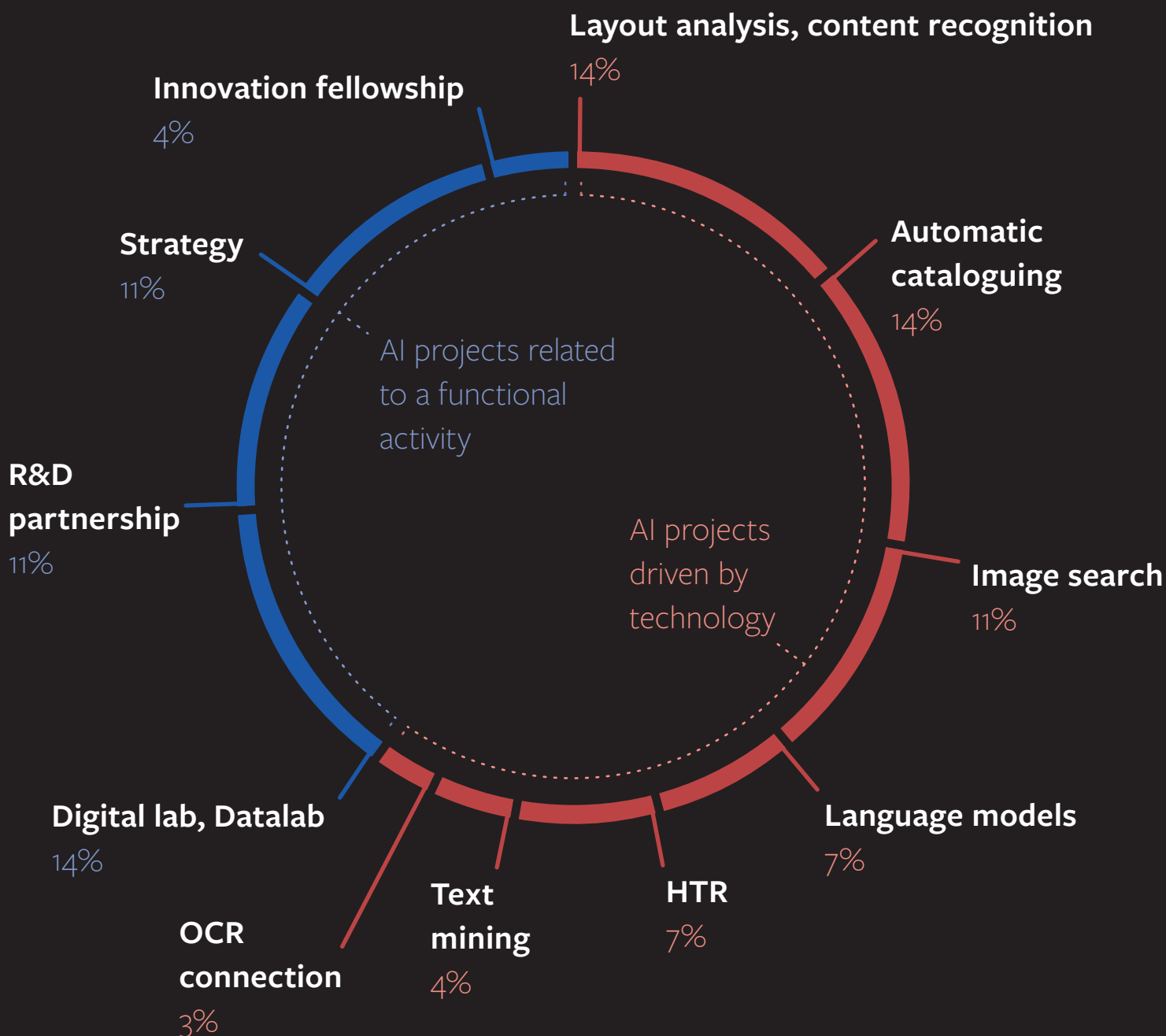
Librarians use intelligent library systems to provide better, smarter and more efficient services to library patrons and staff. Gundakanal and Kaddipujar (2020) match the current areas of focus for AI developments (mentioned above) to their potential applications in library spaces:

- **Expert systems** presents a two-way street that can bring forth an impact on users as well as highlight the impact of users on libraries. AI in expert systems can be seen in relation to the reference service, cataloguing, classification and organisation of knowledge and resources, serial indexing, adapting to user requirements, and user recommendations for collection development.
- **NLP** is linked primarily to search optimisation and improvement of information accuracy. As Gundakanal and Kaddipujar (2020) note, “indexing is the foundation of information retrieval”.
- **Pattern recognition** is primarily linked with two aspects for libraries – machine learning in library services and intelligent interfaces to online databases. Machine learning in library services refers to procurement, acquisition and processing of knowledge and resources. “Machine learning offers an array of potential mechanisms to assist libraries in creating metadata for digital resources [and] allows cataloguing not only to increase the speed of metadata generation but also to expand the depth and breadth of subject terms” (ibid). Intelligent interfaces to online databases helps users overcome the challenges of “language control, search techniques, file structures, and a variety of terminologies”. This help is evident in the process of selecting hosts and databases, presenting search results in an accessible manner, formatting the search query stylistically, linguistically and within the terminological context as well as with regard to scope and volume of response return.
- Robotics in the library spaces are most evident currently in the services and resources for digital libraries, such as robotic scanning systems and text processing. However, there are some developments also with regard to physical robots that users can interact with as part of customer service, such as animated kiosks or library butlers.



## From CENL AI Survey: analysis report >

On the topic of AI activity, the received 23 responses from the CENL network of 49 national libraries representing 45 countries, illustrate “a description of one of your main current AI activities/projects”. The 19 answers from 28 projects are summarised in a graph in the report, reproduced here:



The graph shows two types of AI activity:

- “Related to a functional activity” (shown in blue, including organisation of R&D and partnership with research labs or national AI initiatives, creation and work with in-house digital labs, strategy thinking, etc.)
- “Related to AI projects driven by technology” (shown in red, including OCR, HTR, etc.).

## A theoretical lens on AI in library spaces

The previous section focused on general overviews and the potentiality of AI technology application in library spaces, but this report would run amiss if it were to separate the technology completely from the theoretical context. Here, the focus is on two theories that are specifically about AI technologies in the library space. Those two theories are the ‘library cube’ and the ‘intelligent library’.

The ‘library cube’ is a theoretical approach developed by Cox and Jantti, and published in 2012 in their paper, ‘Capturing business intelligence required for targeted marketing, demonstrating value, and driving process improvement’. The library cube is both a tool that can be used to support teaching and learning and a theoretical approach aimed at new ways of engaging and interacting with the library as a service.

**> The library cube represents a fundamental shift in evaluating the student experience through the integration of discrete systems and data sets [and] has revealed a very strong relationship between student library usage and academic performance. <**

Cox and Jantti, 2012

The purpose of the cube is to maximise resource impact and teaching activities, enhance the student learning experience and academic performance and improve student engagement with library services. On one hand, “the library cube consists of two major components: a back-end system containing a multidimensional data warehouse linking student borrowing and use of electronic resources to students’ academic marks (grades); and a front-end system that allows users to quickly and easily create cross-tabulated data views, such as average student marks by frequency of library resource usage and gender” (ibid). On the other hand, the library cube is not only a tool but also a new lens, a new way to perceive library spaces. The cube is not simply another space that links users with databases and engine providers, it’s also a way to transform the library into an entirely new space.

Academic libraries, in particular, face two major challenges, one being that libraries are under constant pressure to demonstrate their continued value and purpose amid growing competition from other resources and financial constraints. The second is the lack of ongoing access to up-to-date market intelligence. The library cube addresses these challenges by transforming the perceptions of what constitutes the library space and function and redefining the library as a place that has grown beyond an intermediary connecting authors to readers into a space that inspires a way of life, a space that shapes lived realities, encourages intellectual pursuits and moulds dreams. On a practical level, the library cube suggests that marketing should focus on increasing traction and improving library service use as the main ways of student engagement and inspiration.

## > Inspiring a love of reading and learning is a far more rewarding role than showing clients where to click, regardless of how sophisticated such instruction becomes. <

Cox and Jantti, 2012

It is misleading to say that there is only one library cube. The library cube theory comprises three interconnected and balanced cubes. The first is the ‘library value cube’, which is about the uses of the library resources in the way that would make the most impact on the users as well as the users’ impact on library resource development. For example, this cube could focus on academic teaching sessions and the assessment of the impact of student use of the system and available resources on student academic performance and study engagement. This is a cube that would consider frequency of use, demographics, etc. The second is the ‘library marketing cube’, which is the outreach programme of the library. In other words, the ways in which the library links to the users and engages them. For instance, with regard to student use, “the marketing cube will contain student demographic data, and will also identify the type of electronic resources being accessed (e-books, lecturers’ e-readings, and database names)”. The third one is the ‘process improvement cube’, which refers to the evaluation aspect of the system. In the example of student academic performance, this cube could be structured around academic subjects. All three cubes take into consideration other aspects, such as how to overcome privacy and ethical issues and concerns. Additionally, the cubes have helped highlight the relationships between various social variables that impact education such as demographics (age, gender, sex), characteristics (citizenship status) and library usage behaviours. These relationships are analysed and they inform the selection of potential target audiences in library engagement and outreach programmes.

Since its development in 2012 the library cube, both in theory and in practice, has been trialed at universities across the globe. The research project that was used to grow the theory was deemed an innovative and collaborative one, albeit demonstrating limited applicability of the theory and the value that can be provided by academic libraries to users. Klein et al (2019) provides an excellent overview of the library cube’s theoretical development and practical implementation in different universities since 2012 in their paper, ‘Building a “library cube” from scratch’. This paper also serves as a practical blueprint for any academic library that wishes to follow suit and develop their own library cube.

Another theory to consider in relation to library spaces is that of the ‘intelligent library’. The intelligent library theory was developed by Cox et al in 2019 and described in their paper, ‘The intelligent library: thought leaders’ views on the likely impact of artificial intelligence on academic libraries’. The authors develop the paradigm of the intelligent library “to capture the potential impact of AI for libraries” (*ibid*) as a response to the existing expectations surrounding the use and impact of AI on academic libraries.

The paradigm is built on the notion of 11 transformations that AI could bring to library spaces. The following list presents these 11 transformations as listed in the 2019 paper by Cox et al:

1. What a library is, what a collection is and how to search for material. The library may increasingly be seen as data, accessed through AI, the scope of the collection as framed by the AI.
2. How established services are delivered, for example by chatbots and other intelligent agents.
3. What users expect of libraries: through expectations learned in other areas.
4. What information literacy is: the ability to navigate a new space of AI tools and data, and data literacies, including critical awareness of how to protect one's own privacy.
5. Who users are: some users will be AI tools; human access to content will be remediated through content being summarised and partially analysed for them by machines.
6. What libraries know about users and so how the library is managed: because of management decisions based on use data, combined with other learning and research analytics.
7. How the library works with other internal and external partners and competitors, especially IT services and new third-party commercial services.
8. How library services are evaluated: again through wider and deeper data.
9. What skills librarians need: be that for licensing, evaluation of data analysis and visualisation tools or using such tools themselves.
10. Whether the library community can operate effectively at different levels beyond the institution: in order to design and deliver services which will serve international communities of scholars and students.
11. Indeed, whether we need librarians (because of chatbots, automated metadata creation tools etc) or libraries (because of alternative intermediaries) at all, at least as currently conceived.

*Cox et al., 2019*

There are two main challenges that the theory aims to highlight. The first challenge is the ethical considerations of using AI in library spaces and the necessary changes that must take place to address them. An in-depth overview of various ethics scenarios of artificial intelligence in the library spaces was explored by Cox in papers he published in 2021 and 2022. The second challenge

is the required, or perhaps augmented in some areas, skill set for librarians if AI enters the library space. Cox also responds to this challenge of a ‘skills gap’ in the library sector in publications in 2022 as well as with the Chartered Institute of Library and Information Professionals (CILIP) report authored with the support of Health Education England in 2021.

For instance, in a bit more depth, the CILIP report focused on helping healthcare information professionals comprehend the impacts of AI, machine learning, process automation and robotics on their current or future daily work (ibid). The report is a comprehensive study based on rigorous research conducted with information professionals about both the opportunities and the challenges of AI technologies. The detailed and methodological analysis balances the benefits of AI technology for users against emerging risks. The main questions of the report are focused on:

- the skills and knowledge acquisition needed by information professionals in their attempt to support their users
- the ethical implications of these technologies in the library space and considerations of existing publications on data ethics and responsible technology
- the implications for the future, including curriculum development that would match the technological development and enable the future workforce to keep pace.

The report then goes further to highlight the necessary “set of skills and competencies that information professionals will need to develop in order to support their users and organisations through this fourth Industrial Revolution” (ibid). On a practical level, CILIP has also updated its Professional Knowledge and Skills Base (PKSB) to include some of the lessons learned and presented in the report. The PKSB comprises the standard established in the sector for the skills required for people working in knowledge, information and libraries. Some of the impacts of AI technologies already acknowledged in the report are in the fields of search and resource discovery, education and learning, and scholarly publishing. These impacts, in turn, pose challenges for ethics, decision-making, data quality and development. While some interviewees noted that they felt their positions under threat, there was also acknowledgment of additional opportunities related to aiding user navigation and data literacy, data acquisition and curation, and AI tool acquisition and infrastructure building (ibid).

What is interesting is that Cox does not propose an overhaul of the library sector to accommodate AI developments, but rather a symbiotic relationship where librarians could develop an awareness of different techniques and of the potentiality of AI. This awareness would enable librarians to either use the technology themselves, or at least be able to communicate what they wish from the technology to technicians who can enable the actual implementation and practical configurations of the AI. Knowing and understanding the limitations and affordances of AI is what would enable librarians to make the best decisions as to where and how AI could be useful in the library spaces.

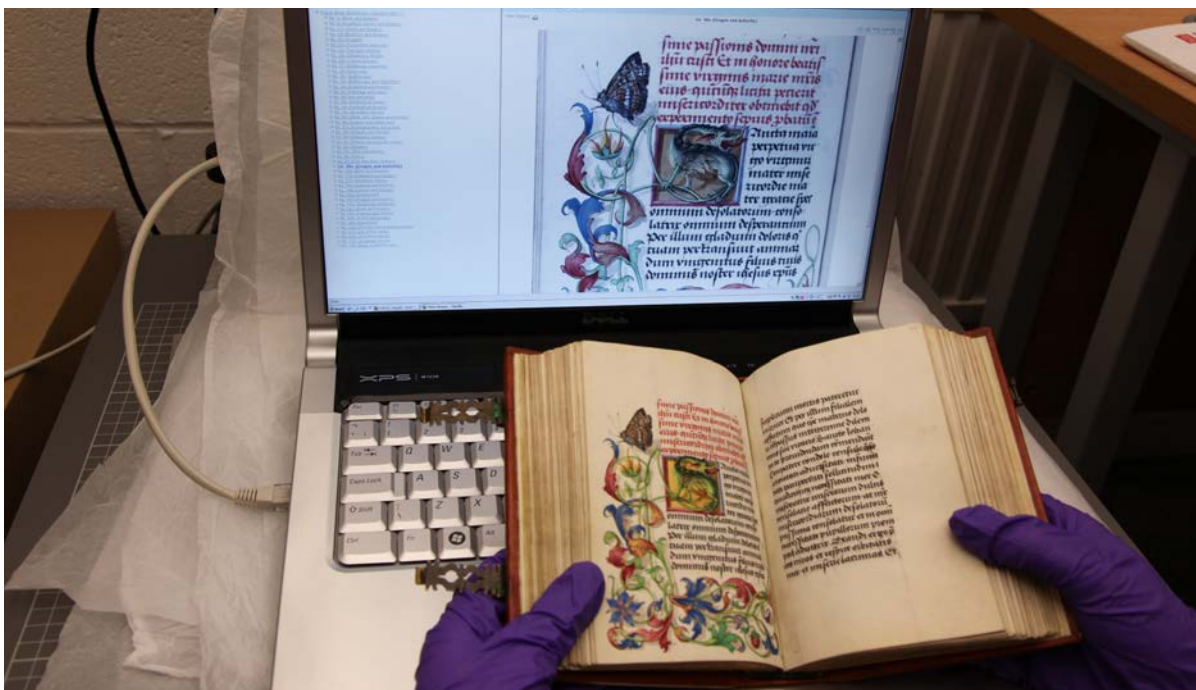


The final aspect highlighted in this report is that, in addition to theories about the role of AI in the library space, there are also theories regarding AI typology. The concepts of ‘general’ and ‘specific’ AI were outlined in the introduction section of this report, but there are other authors who classify AI as ‘strong’ and ‘weak’. (McNeal and Newyear 2013). Strong AI is another way to describe general AI (ibid).

**> Strong AI may be defined as machine intelligence that matches or exceeds human intelligence. A computer with strong AI could perform any intellectual task that a human being could. It’s associated with human traits such as self-awareness and consciousness. <**

McNeal and Newyear, 2013

This definition of strong AI closely aligns with the original definitions of AI that were presented in detail earlier in this review. Currently, this type of AI only exists in science fiction, as technology has a long way to go to reach the required sophistication. Weak AI, on the other hand, is another way to describe specific AI, also known as applied AI and narrow AI (ibid). Weak AI uses software to study or accomplish specific, and often repetitive, tasks. Examples of weak AI are Roombas, self-driving cars, natural language processing, systematisation and optimisation tools, data mining and text analytics as well as interface systems such as chatbots. “In fact, library chatbots can be considered a narrow application of an already narrow application, as their purpose is to assist with the use of library resources and not to chat at length about any possible topic” (ibid). The typology of AI concludes the theoretical discussion for this review, so the next section will focus on a practical example of weak AI, namely chatbots.



## A practical lens on AI in library spaces: chatbots

The history of chatbot development dates back to the 1960s, when computer scientists first began exploring the idea of conversational interfaces. The first chatbot, ELIZA, was developed in 1966 by Joseph Weizenbaum and was designed to mimic the responses of a psychotherapist.

In the 1990s and early 2000s, chatbots became more widely used as a customer service tool, with companies like AOL and Microsoft incorporating chatbots into their instant messaging platforms. However, the technology was limited, and chatbots were often unable to effectively understand and respond to user inputs.

**> At best chatbots would be considered weak AI. They are in no way intended or expected to think, and certainly not to have self-awareness. They are simulators, capable of only appearing to understand questions and comments and giving appropriate responses. Even so, the simulations can be very convincing and useful. <**

Ratledge, 2012

In recent years, the development of artificial intelligence and natural language processing (NLP) has led to significant advancements in chatbot technology. Today, chatbots are being used across a range of industries, including healthcare, finance, and e-commerce, to provide customers with fast, efficient and convenient service (Salihin 2019). Both user experience and collaboration, also for the purpose of maintenance, are necessary for a successful chatbot (Salihin 2019).

ELIZA was programmed to act as a Rogerian therapist. Parry, written in 1972 by Kenneth Colby, was another early chatbot that simulated the thinking of a paranoid individual. Robert Medeksza developed Ultra Hal in 1997 as a program that learns by statistically analysing past conversations to determine the most appropriate response. Jabberwacky, written by Rollo Carpenter in 1988, and A.L.I.C.E., written in 1995 by Dr. Richard Wallace using Artificial Intelligence Markup Language (AIML), are other well-known chatbots alongside Suzette and Rosette, both of which were written by Bruce Wilcox using his own scripting language, ChatScript.

The most prominent chatbot currently is ChatGPT. It is the first chatbot to cause ripples in higher education, especially for student assessments, due to sophistication and capabilities that make its outputs indistinguishable from many student essays. ChatGPT is an AI language model created by OpenAI. It is an advanced natural language processing system designed to generate human-like text. ChatGPT was trained on a diverse range of texts from the internet, including websites, books, articles and more, to help it understand and respond to a wide range of

questions and topics. It is designed to provide helpful, informative and concise answers to users' questions, and to continuously improve through exposure to new data and feedback. The primary function of ChatGPT is to assist users in finding the information and answers they need to the best of its abilities based on the information it has been trained on.

Early in 2023 Google announced the release of Bard, their LaMDA-based intelligent chatbot (Pichai 2023).

In terms of credibility, chatbots have come a long way since their early days. Today, chatbots powered by advanced AI and NLP technologies can understand and respond to a wide range of user inputs, making them a valuable tool for businesses and organisations. For a customer care perspective, a practical review, please see Corea et al 2020. However, it's important to keep in mind that chatbots are only as credible as the data and algorithms they are based on, and there may still be instances where a chatbot's responses are unreliable or incorrect. To ensure the credibility of chatbots, it is important to regularly evaluate and update the algorithms and data sets they are based on (Thorne 2017, troubleshooting chatbots).

Chatbots have several limitations and challenges, linked to how they operate and who operates them:

- NLP limitations, because chatbots often struggle to understand and respond accurately to complex or unconventional language patterns and sarcasm. This can lead to misunderstandings and a poor user experience.
- Often, chatbots have a limited knowledge base. They rely on pre-programmed information and data sets and may not be able to provide answers to unique or specific questions. This can limit their ability to handle unexpected or rare inquiries.
- Chatbots do not have 'intelligence' that includes emotional understanding and context comprehension. They are currently unable to understand or respond to emotions, leading to a lack of empathy and personal connection with users.
- Chatbots are often seen to be biased and discriminatory. They can perpetuate existing biases and discriminatory practices if the data and algorithms they are based on are biased.
- Because chatbots are operated by humans, human as well as technical errors and glitches are still commonplace and these can disrupt the user experience and damage chatbots' credibility.
- There are issues of ethical concerns, especially around privacy and security. The use of chatbots raises concerns about the collection, storage and protection of personal information, which can affect user trust.

Despite these limitations and challenges, chatbots are still a valuable tool for businesses and organisations looking to improve customer service and engagement. To overcome these limitations, it's important for chatbot developers to continually improve and update their technology, and to be transparent about the limitations and potential biases of their chatbots. ChatGPT, which is the most advanced chatbot to date, shares many of the existing chatbot

limitations. When asked to evaluate itself, ChatGPT described its limitations and flaws in the following manner:

As an AI language model, I have a few limitations and flaws that users should be aware of:

1. Lack of context: I don't have a sense of context or the ability to perceive the world outside of the text I have been trained on. This means that I may provide inaccurate or inappropriate answers to questions that are ambiguous, open-ended, or require a deeper understanding of context.
2. Bias: I was trained on a large corpus of text from the internet, which may contain biases and inaccuracies. These biases may be reflected in my answers, and I may perpetuate existing stereotypes, misinformation, or harmful beliefs.
3. Limitations of training data: my knowledge and understanding are limited to the information I was trained on, and I may not have access to the latest information or updates on a given topic.
4. Lack of common sense: I do not have common sense or intuition, and I may provide answers that are illogical or inconsistent.
5. Lack of empathy: I do not have feelings or emotions, and I may not always provide answers that are sensitive to the needs and feelings of users.

While I have been designed to provide helpful and accurate answers, users should be aware of my limitations and should critically evaluate my responses. It is important to verify the information I provide and to consult additional sources for more complete and accurate information.

*ChatGPT. 2023*

Chatbots have been making waves in research practices since their inception. The Alan Turing Institute conducts research into chatbot usefulness, reason, how to build them, and why. Jisc, on the other hand, has focused its research practices into practical chatbot development and initiatives. Jisc provides national infrastructure for IT services across UK universities and colleges, and services such as eduroam. Jisc is the UK digital, data and technology agency focused on tertiary education, research and innovation: “We’re on a mission to improve lives through the digital transformation of education and research. That’s why we exist. It’s what drives us every day.” (Jisc website 2023). A non-profit organisation, Jisc hosts the Janet Network, the UK’s national research and education network (NREN), used by 18 million people. Jisc’s initiatives include examples of AI in automated assessment (semi-automatically marking student coursework, paused over ethical concerns), and looking for commercial products rather than research that could be adapted for higher education institutions with examples such as Bolton College’s chatbot for applicant inquiries (based on the FAQs). Further, Jisc “is taking the lead in helping

universities and colleges understand and leverage the benefits of AI as they focus on their digital strategies and transformations” (ibid). Jisc argues that if risk, cost and complexity are addressed, then AI technologies and chatbots could be introduced across higher education institutions. To facilitate these aims Jisc recently updated its report, ‘AI in tertiary education: a summary of the current state of play’. This report includes real-life examples of existing applications of the technology as well as future plans and strategies (Jisc 2022).

Other notable chatbot-related initiatives include Microsoft Azure, a cloud computing platform with infrastructure for computing that incorporates many widgets and other tools including a chatbot toolkit. Amazon has Lex (an Alexa-like chatbot) and Google has Colab (not a chatbot per se but a data analysis and machine-learning tool with similar principles of operation).

## Chatbots in the library

In relation to use of chatbots in the library spaces, there are many initiatives already underway. Ayu et al (2019) discuss the need information professionals have felt in adapting emerging technologies “such as chatbots to innovate, improve and support library services”. They follow the history of chatbots in literature and practice as well as how librarians engage with the conversational design and capabilities of chatbots in partnership with technology developers “to make it useful, friendly, trustworthy, and customisable for university students”. They describe their library chatbot Lib-bot and evaluate information gathering practices, empathy and usefulness for the library.

Chatbots in libraries are not a recent feature. In many US libraries there have been chatbots for over two decades. From ‘Emma the Chatbot’ in Mentor Public Library, Ohio and ‘Dewey’ in Akron-Summit County Public Library in Akron, Ohio to ‘Pixel’ in the University of Nebraska–Lincoln Libraries, these are chatbots that use artificial intelligence mark-up language (AIML) (DeeAnn 2012 [see for more info on Pixel]; Ratledge 2012 [see for more info on Dewey and Pixel]; McNeal & Newyear 2013; Pandorabots 2019). AIML “uses pattern recognition to process inputs and pre-defined templates to generate outputs” (Pandorabots 2019), and is still used today by developers to create new chatbots (Dekhno 2015). As an alternate to AIML, there is the possibility to use Rasa stack as a method for chatbot building for libraries (Bagchi 2020 [see for more information on this trend as presented specifically for libraries]).

There are also many studies that evaluate student, teacher or librarian perspectives of chatbots and their usefulness. For more information on student perspectives and the theoretical contributions and practical implications of how to successfully employ these assistants, the Al Shamsi et al (2022) study on ‘Understanding key drivers affecting students’ use of artificial intelligence-based voice assistants’ is quite informative as well as the Følstad & Brandtzæg (2017) study titled ‘Chatbots and the new world of HCI’. Følstad & Brandtzæg (2017) conducted an in-depth survey with 166 students at a German university aiming to uncover the requirements that underpin a chatbot and the topics and questions the chatbot should be able to address. This is a study that both showcases student perspectives and provides a practical approach that is student-focused regarding technical and content-related requirements and usefulness assessment (also see Hien et al 2018; Meyer von Wolff et al 2020). Further, there are studies that specifically focus on using chat and

chatbots to enhance mature student engagement in higher education (Abbas et al 2022). Teachers' attitudes towards chatbots for teaching and learning purposes show they consider chatbots a useful but still emerging technology, plagued by limitations and shortfalls, according to Bii et al (2018) within developing countries, including Kenya. However, they can be used in a practical capacity in areas such as computer science classes via FAQ-building exercises (Shaw 2012) or program development (Shaw 2012b).

Librarians' perspectives on chatbots in the library are covered extensively in literature. From chatbot applications in reference services (Nawaz 2020) to chatbots as a cost-effective way to answer routine questions and to direct users to the appropriate services (Vincze 2017), chatbots are deemed useful in library spaces.

Sanji et al (2022) make the argument that chatbots are rarely used in libraries but should be, and in support they describe practical examples and challenges in their article 'Chatbot: an intelligent tool for libraries'. However, there is a counter-argument to be made that chatbots have been in existence in some shape or form for 50 years and have been used in libraries for more than two decades. German libraries developed a number of chatbots such as Stella at the Bibliothekssystem Universität Hamburg and Askademicus at the Technische Universität Dortmund, both launched in 2004 and still in operation today. Other examples include INA, launched in 2006 on the Bücherhallen Hamburg website and Kornelia in the Kornhaus Bibliotheken in Bern, Germany. Similarly, in the US, Lillian (2006), Emma the Chatbot (2009-2012), and Pixel (2010) are used in libraries.

Chatbots were designed to provide information and support to library patrons in a convenient and user-friendly manner. They offer the advantage of being available 24/7, thus providing instant responses, anonymity, and the ability to personalise the user experience. Chatbots can also ease the burden on library staff by directing users to additional services, providing a cost-effective way to answer basic or routine questions, and giving access to information even when the library is closed. Chatbots can be installed in multiple locations and environments including websites, desk-side kiosks and library computer desktops. Despite not being able to replicate the complexity of a human interaction, chatbots have been shown to provide a useful tool for reference services, as noted by Anne Christensen (2007) in her excellent paper on the history and technical details of library chatbots.





## AI limitations

In addition to chatbot limitations discussed earlier, there are also many limitations and challenges of AI technologies in general. Gundakanal & Kaddipujar (2020) write that, while “library and information professionals are keen to adopt the advanced technologies in library and information centres”, there are many challenges faced by libraries in AI adoption, including internal issues and resistance such as funding, lack of awareness and insufficient knowledge of AI opportunities, resistance to learning or coping with the new technologies, lack of sufficient motivation and skills gaps. There are also significant issues in the implementation of AI in libraries linked to language preparedness, system requirements, privacy concerns and a threat to intellectual freedom.

**> Liebowitz identifies inadequacies in the following areas of expert system technology, leading to what he terms “artificial stupidity” in these systems: (1) common sense reasoning, (2) ‘deep’ reasoning about the underlying principles of an area of knowledge, (3) explanation features, (4) ability to learn, (5) support for distributed expert systems, and (6) knowledge acquisition and maintenance. <**

Liebowitz (1989) in Bailey, 1991

Other limitations to AI technology development are issues with semantics (meaning) and pragmatics (user to expression relationship) both due to the challenge of context interpretations, practices regarding knowledge acquisition, representation, and maintenance as related to both machine and human input, difficulty in scaling up prototypes to operational systems, level of effort, technical expertise and expense (Bailey 1991).



**> Yen and Tang confirm the difficulty of performing common sense reasoning in expert systems. They point to additional problems, including: (1) difficulties in allowing end-users to tailor expert systems to meet their needs, (2) high system development and maintenance costs, (3) inherent complexity of expert system development, (4) limited natural language capabilities, and (5) inability of expert systems to recognise the limits of their knowledge, deal with problems at those limits and reject problems that exceed those limits. <**

Yen & Tang (1989) in Bailey, 1991

AI technology still has many limitations and challenges that must be overcome. One major limitation is the lack of commonsense understanding, meaning that AI systems cannot process information and make decisions in the same way that a human would. There is a lack of creativity and flexibility in AI systems as they are limited by their programming and data sets and may not be able to handle unexpected or novel situations. AI systems have a limited understanding of context, so the systems struggle to understand the context and subtleties of human language and behaviour, which can result in misinterpretations and mistakes. This is also linked to a lack of natural language processing capabilities as AI systems struggle to understand context and sarcasm in human language. Further, many AI systems are still plagued by technical errors and glitches, which can result in incorrect or harmful outcomes. Another limitation is that AI systems can be biased due to the data they are trained on, leading to inaccuracies and unfair decision-making. This can result in unfair and unjust outcomes. Privacy and security are also major concerns with AI, as the vast amounts of data that AI systems collect and process can lead to potential breaches and misuse of personal information. Therefore, the collection, storage and use of personal information by AI systems raises significant privacy and security concerns. Finally, the development and deployment of AI technology also raises ethical and moral questions, as AI systems can replace human workers and have the potential to perpetuate existing inequalities and power dynamics. The automation of jobs by AI systems raises concerns about job loss and economic displacement. Addressing these limitations and challenges will require ongoing research and development, as well as the development of ethical and legal frameworks to govern the use of AI technology.

Despite these limitations and challenges, AI has the potential to bring about significant benefits and improvements in a variety of fields, including healthcare, finance and transportation. To address these limitations and challenges, it's important for AI developers and organisations to prioritise ethical considerations and work towards creating AI systems that are transparent, fair and accountable.

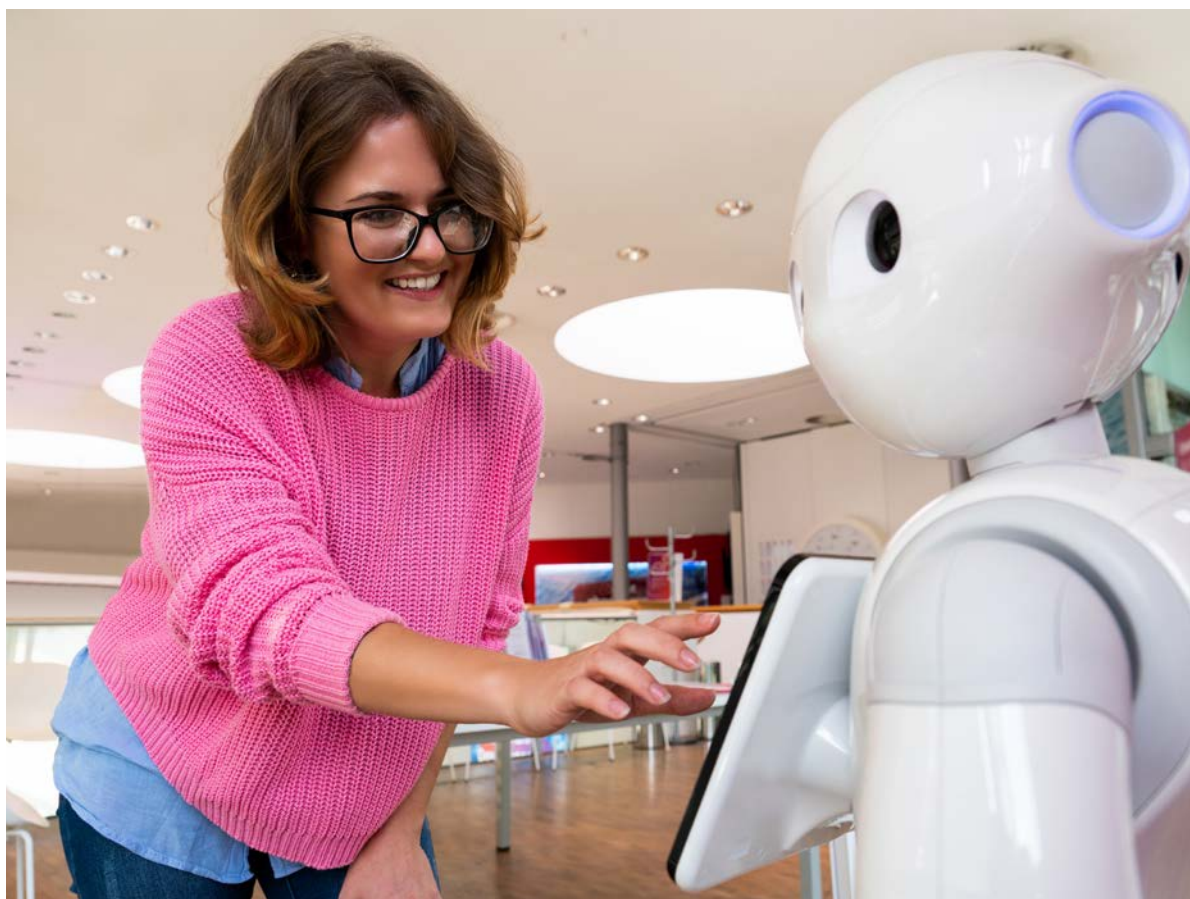
## The future of AI

The future of AI is expected to be shaped by advancements in several key areas. One of these is in the development of more advanced deep learning algorithms and techniques, which will allow AI systems to process and analyse larger and more complex data sets, leading to even greater levels of accuracy and performance. Another area of focus is the development of AI systems that can interact with humans in a more natural and intuitive way, such as through conversational interfaces and human-like voices and expressions.

There is also a growing interest in developing AI systems that are capable of augmenting human intelligence rather than simply replacing it. For example, AI systems that can analyse large amounts of data and present it to humans in a way that is easily digestible and actionable could help humans make more informed decisions. Similarly, AI systems that can automate routine or repetitive tasks could help humans focus their attention on more complex or creative endeavours.

The increasing use of AI in various industries and sectors is also likely to have significant implications for the global economy. While AI has the potential to greatly improve efficiency and productivity, there are also concerns about the potential job displacement that could result from widespread adoption.

As a result, it is important for policymakers and industry leaders to carefully consider the ethical and social implications of AI and to ensure that AI systems are developed and deployed in a responsible and equitable manner.



## The future of AI in library spaces

On a practical note, AI is seen to have major impact in the educational sector, and libraries are key.

### Educating people to live with artificial intelligence

The world is experiencing enormous transformation in the education system. Artificial intelligence will impact labour markets. In this connection, the biggest priority of the library is creating awareness of lifelong learning and enlightening the social presence in educational activities. Libraries can play a vital role in achieving educational goals. Libraries can educate non-digital learners to update themselves with modern technology. On the other side, artificial intelligence helps the libraries to develop learning tools that would be of great use for non-digital learners. Public internet access and digital literacy programmes can help more people enjoy the benefits of AI. The knowledge and information that libraries offer can help people learn new techniques to traverse the altering labour market and improve their livelihoods.

*IFLA blog, (2020) in Gundakanal & Kaddipujar, 2020*

In this regard, some steps have already been taken. Yewno is a company that uses a business model approach to transform “information into knowledge” in the areas of finance, education and publishing. (Yewno 2023). Whether through business or best practice, we need to bring the conversation of AI to the foreground as many of these technologies are already a part of our lives, according to Beth Singler, writing on the Jisc blog. (Singler 2020).

Libraries, as community hubs, have the responsibility to facilitate public discourse on the subject of AI. As AI technology advances, it has the potential to significantly impact society and culture. As a result, libraries, as social gathering places, should serve as a platform for citizens to voice their concerns to the AI Commons initiative, a future-facing non-profit organisation aiming to bring together AI developers and members of society to engage in open communication.

Some library institutions have started to open up the conversation, not just to experts or people in the field but also to the general public. For example, the British Library and the Leeds City Museum cooperated on an initiative to tell the people’s perspectives of adaptation and resistance to industrialisation in 19th century Leeds via the ‘Living with Machines’ exhibition in 2022. Such initiatives could become quite common in the future as the technology enters mainstream use.

Further, using AI can enable libraries to maximise efficiency in service, while also considering ethics. For example, there are ethical considerations with respect to data-gathering and handling. In recent years, libraries have been providing digital literacy training to users, and now it’s time for them to offer algorithmic literacy training as well. This type of literacy involves being aware of one’s interaction with AI, comprehending how AI processes information found online, and knowing how algorithms collect personal data. Libraries, with their expertise in digital literacy

programmes, can arrange activities that assist users in acquiring algorithmic literacy skills. In the UK, in particular, wellbeing and ethics are at the heart of AI discourses (see Halfpenny [2020]; McGregor [2021a]; and McGregor [2021b]).

This is perhaps why using ChatGPT and other AI systems in student assessments raises ethical concerns over potential abuse by students. With the advancement of technology, it is becoming easier for students to obtain access to information and answers through various means, including AI systems. This creates a challenge for higher education institutions, as they must ensure the integrity of their assessments and maintain the credibility of their degrees. One of the ethical implications of AI systems like ChatGPT being used for cheating in student assessments is that it undermines the value of a student's degree. When students cheat on assessments they are not demonstrating their actual knowledge and skills, which devalues the degree they receive. This can have long-term consequences for the student, as employers may question the validity of their credentials. Another ethical implication is that cheating undermines the principles of fair competition and equality in education. When students use AI systems to cheat on assessments, they have an unfair advantage over other students who have not cheated. This creates a level of inequity in the education system, as students who have cheated have an easier time getting good grades and passing exams, which can lead to further opportunities. Moreover, using AI systems to cheat on assessments can have a negative impact on the student's own learning and development. Cheating can prevent students from gaining the knowledge and skills they need to succeed in their careers and personal lives. This can also result in students becoming dependent on cheating and not developing the critical thinking and problem-solving skills necessary for success. It is important for higher education institutions to take steps to prevent cheating, including the use of AI systems, in their assessments. This can include incorporating anti-cheat measures into assessments, such as randomised questions and the use of proctors, as well as educating students about the importance of integrity in assessments and the consequences of cheating. This is why higher education institutions are now planning the necessary steps to address these concerns, and maintaining the integrity of their assessments to ensure the credibility of their degrees and the success of their students.

In conclusion, the future of AI holds great promise and AI is likely to be a major driving force for innovation and progress in the years to come. As AI technologies continue to mature and evolve they will play an increasingly important role in shaping the way we live and work, and in solving some of the world's most pressing challenges. It is important to continue to invest in research and development in this field, while also taking a thoughtful approach to the ethical and social implications of AI and working to ensure that its benefits are widely shared. It is important to note that, while AI has the potential to bring about significant benefits, it poses significant challenges and risks. The future of AI will depend on our ability to manage and regulate these risks effectively, and to develop AI systems that are transparent, fair and accountable.

So far, this report has provided a comprehensive review to show the perspectives of AI in academic literature. The next chapter will explore expert perspectives on the concepts of 'library' and 'AI'.

## Chapter 2

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### Images of libraries and images of AI: expert interview perspectives





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**This chapter is focused on the notion of images, or the perceptions of the library space and AI technologies as divulged by experts in the field.**

**Chapter 2 is divided into two sections. The first section will focus on the concepts of a library and library spaces, while the latter will focus on the images of AI technologies.**

*Annex A has a full list of the experts interviewed for this report and the reasons why they are being classed as expert. Some of those experts revoked their confidentiality, so their qualifications and their names can serve as additional context for the statements they make. On the other hand, some chose to remain anonymous and have the readers focus on the specific words and phrases they selected to portray their perspectives here. In this chapter they are represented as [anon].*

## Section I: The library space

The first, broad question that was used to begin every interview was: “What is your perception of a library or the library space?” Without having a clear idea of what experts imagine as a library, this report could not explore the topic of ‘using AI in the library space’. The aim of this question was to understand the experts’ perspective on the current state of libraries, the images the concept of a library evokes and capture comments on the transformations, preservation or even loss of library spaces and/or functions.

### A historical perspective of libraries

One theme that all experts agreed on in relation to the notion of a library is that, historically, the library had one image but that image has changed over time. The library is not a static thing, but rather a morphing system that evolves, grows and adapts. What the experts differ on, however, is what their image of the library was in the past, and how the library has transformed in current times. Some of those differences stem from the many regions around the world these experts study or live in, or in other words, the context of libraries. Other differences are related to the varying backgrounds of the experts including the stage, type, or years spent in their career, or the context of expertise. Yet other differences connect to the variances that occur due to external stimulation, or the context of variability.

**>If we think historically, we thought of libraries as physical repositories of books and other types of information, materials and so on [but in time] that’s changed a lot, in the last 20 years or so, towards spaces where people learn, or can create knowledge. <**

Andrew Cox

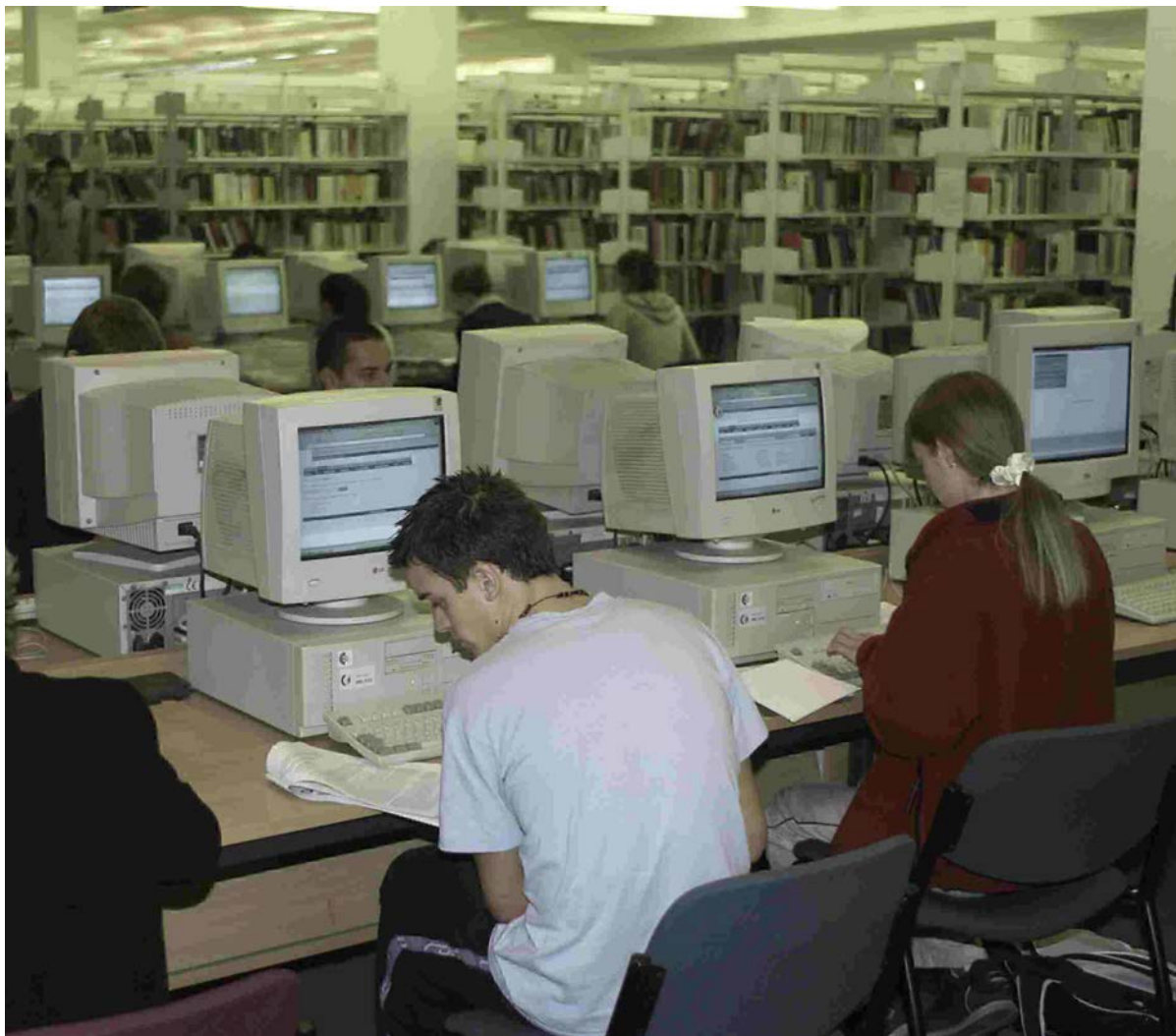
This historical transition was deemed by experts as very interesting. Quite a few were ready to point out that, even though there is a realisation of the historical impacts on libraries as well as the library transformation in time, there has always been an issue of lack of collective memory regarding these changes. For example, in the United States, modern academic libraries do not have the same image as older ones, even if some Midwestern universities could have comparable or better resources than Harvard and Yale. The prevailing view describes older libraries as the standard by relying on information such as size and types of endowments that have been collected through time. Some of these endowments are monetary, but many are also collections, artifacts, or other resources that modern libraries have no access to. This view poses a problem for the library image, because modern academic libraries are built in the image of older ones. Older academic libraries often set the standard as to what a library should look like, because they existed first. Modern academic libraries follow the existing models for library structure, service and strategies. That is why for many years there was a stagnation in modern academic libraries in the United States [David J. Evans].



> A library was expected to be a place with book stacks, a massive amount of book stacks, and study space with a librarian sitting at a desk, waiting passively for you to come in, and answer the students' questions that might be "Where is the bathroom?" "How can I make a photocopy?" "How many books can I check out?" And they really, in so many ways, never contributed towards the students' intellectual growth there [in the library]. <

David J. Evans

However, over time as the image of libraries changed, many libraries began to innovate, to transform into new types of spaces. These transformations challenge the pre-existing images of what a library should be, how it should operate, who, how and why it should serve.

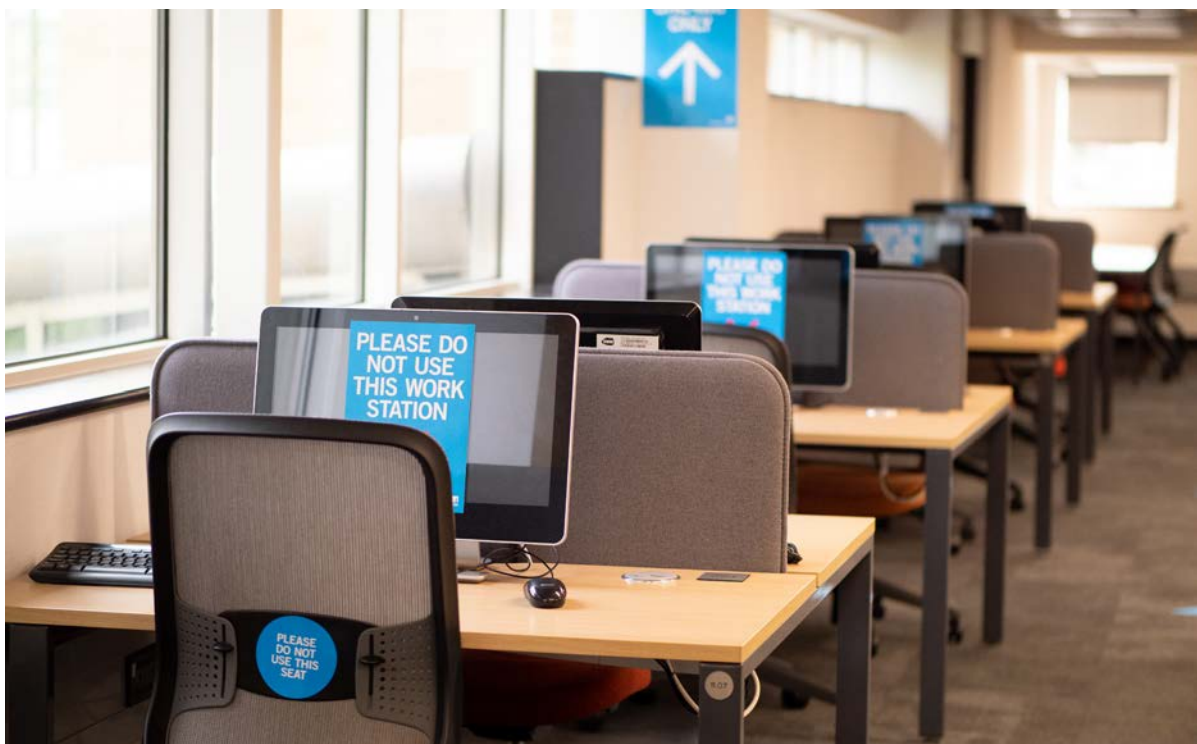


## Transformations to library spaces

The experts' most often cited transformation of the image of the library from the past to the present was that the library physically used to be a room filled with books, but those books are now being converted to eco-friendly, open, online access via resource digitisation. The digitisation of libraries is also known as the 'digital shift' of libraries.

Digital transformations were seen, by some, to have started a long time ago, while for others COVID-19 was seen as a catalyst for migration of resources to virtual spaces. COVID-19 was seen as very nuanced in terms of causing transformations to library spaces. On the one hand, COVID-19 was described as having promoted digital transformations. On the other, the pandemic highlighted that the digitisation of library resources has not achieved the necessary capacity and also highlighted areas of inability or unwillingness to digitise. Experts who came from the library background were often especially opposed to what they called 'pure digitisation' as they want people to come into a physical space. In fact, whether libraries could or should be purely digital is a long and vigorous debate that some participants defined as the 'virtual library debate'.

Experts acknowledged that there is currently a digital transformation component in many new library strategies, but it often is about acknowledging that the digital has already been featured largely in lots of the existing library operations. This has occurred in some libraries for many years and it could even be said that "libraries in particular, have been quite early adopters of technology and digital approaches to help them with their own operational requirements" [Neil Fitzgerald]. Examples included speed and optimisation of library services as well as methods to improve access for library users. Also in terms of access, in the past users had to come down to the library to use the book or resource, but now they can increasingly work remotely and still access a wide range of library services. This is a change to library operations that was afforded through the mechanism of digitisation, which in turn has changed the experts' views of what constitutes library services.



## The hybrid library

In the past a library was more often described as physical spaces and places, while the modern-day version is mostly in the online space [anon]. That is why many experts currently define a library as a ‘hybrid library’ that exists both in the digital and physical spaces. The library remains both physical and digital because “people still very much like to come to ask you questions in person, and consult documents in person, but a lot of the students I work with never actually come into the physical space of the library” [Sandy Hervieux]. Students often use virtual references, electronic books and other digital services that can accommodate the student lifestyle, confidence, ability, or will to engage. The hybridity of the library allows for users to have a balanced access to these two types (physical and digital) of resources.

The types of resources that should exist in each of these two states is something that should be determined as a conversation between the library and the users. What should be accessible virtually and what in-person is defined by this conversation that is ongoing and can re-imagine the library over time and within the conversational context. An example of this type of conversation can be seen via the concept of the ‘living community’.

**> Then there being also concept support, [that a library] should be like hybrid library, a living community. <**

Andrew Cox

The notion of a library as a living community is that the library has slowly been changing from a place with stuff to a community of the people, for the people, and by the people. A juxtaposition of the outside world and knowledge and a library that is comprised of knowledge that is merged within the library space. A bridge between the ‘outside’ and ‘inside’, and yet a bridge that is as a morphing structure that “should disappear into the background and should be almost invisible” [*ibid*].

## **Library as a space**

Hybridisation of the library is seen to have impacted various aspects of what a library is. In terms of transformations to library spaces, there are changes in relation to preservation, loss of spaces and/or library functions over time. Some experts described the newfound importance of the library space as such.

### **> To be honest, nowadays it's much more of the space that's important.<**

Andy McGregor

The importance of the library space is often linked to the familiarity of a library. That is why some will equate a library space as a place that contains books. In one expert's words "still books, yep, books" [anon]. For others, the importance of the library space lies in its permanence. A form of a library space has always existed, from the space around the Rosetta Stone to Alexandria and the image we have of it despite its destruction, to the Bodleian in Oxford. The library space exists in many contexts, varied cultures and across time.

### **> The library is a place for information, it is a place to meet, talk, relax, learn etc. It is important to be able to get accurate and reliable information from the library. <**

anon

COVID-19 has also brought a newfound importance to the physical library spaces. In the view of one expert, the recent pandemic has increased the online function of libraries, but it has also highlighted the importance of the library as a real place. The library space remained open in many places either as a library or as a space to provide other functions related to the COVID-19 situation. Some libraries were spaces for food distribution, others were transformed into shelters, yet others were places where one could get vaccinated. Most importantly, during the pandemic libraries were seen as information hubs with varied added responsibilities where people still gathered, a real place to meet people. That is why experts often mentioned that it is the ability of the library to exist both online and offline, and to provide services in many contexts and throughout time, that remain the most important functions of a library to date.

## Library as value

A library has many values; its spatial existence is merely one of them. A library is a place of safety, of comfort, of familiarity. There is a recurring image of the library as a peaceful environment. This peaceful or calming atmosphere was often depicted by experts as establishing the library as a place of escapism in the physical and imaginary sense. An escape from one's environment, such as home or work, as well as an escape from one's lived reality. There is an expectation of being able to receive support, to find answers, to find "something, anything".

### > When you find yourself in the library, they always have something for you. <

Solomon Tijani

In a library, you can ask for information guidance or literary knowledge in any academic field. There is a certain comfort in the fact that you can do this and find at least something in any library. In the past, queries were answered only through books, but over time this now includes various types of technology. The advent of information technology has really changed the definition of what a library is, what it can provide, and how, and yet the image of a library as 'knowledge' remains.

### > We can say a library can be referred to as knowledge, the knowledge-based environment, or repository, where you can find all manner of knowledge and different views of life. <

Solomon Tijani

Some experts described their image of a library as based on the perception of a library as a place that serves to organise knowledge and an information repository that is targeted and unbiased. Often the contrary example was that of internet services where private opinions could be labelled as facts. A library, on the other hand, was described as a knowledge repository where you acquire knowledge, organise it, process it and disseminate it to satisfy users. This is why, according to the experts, the information contained in a library has immeasurable leverage against technological advances.

In terms of the leverage libraries have over technology, the 'virtual library debate' should not be about the fall of the library or loss of libraries to technological advances or how to save them from the onslaught of AI, but rather about the value of libraries. Libraries have functions that are innovative and can help users beyond technological capabilities. These innovations are related to library use as contained in both the virtual and physical library spaces. Indeed, the image of a library in terms of atmosphere and aesthetics is also related to both the physical and the digital library space.

### **A user-centred view of libraries**

Another image of a library that emerged in the interviews is the perception of the library as being ‘user-centred’. A main library function is to deliver services to users either physically or digitally. These services are individual or group, private or public ones. Therefore, an image of a library is a place to deliver services to user(s). Additionally, in relation to the image of a library, there is the added layer of the library as a space “that can be accessible anytime, and in any way, by any person, irrespective of location; geographically, primarily or environmentally” [anon]. In other words, it’s a service that is always there for users.

**> A library, from a user point of view, is a place [that could be] a digital place, [but] that is most often a physical place where people find and create knowledge, and it also could be a place where library professionals operate, do library professional things, or semi-professional things.<**

Andrew Cox

A librarian’s perspective of the library as a user-centred space portrayed the library as somewhere people can come and find many books, the stacks, and grade reading rooms as well as a space where people can receive help. “As I’ve become a librarian it’s much more a space where I think people should be able to get help with the research, their assignment, pretty much a user-centred space, which [I think] obviously is going to change [...] I don’t think it should be a fixed space of just the current specifics [because] although we love the books and they’re important, I also think there should be a space for growth” [Sandy Hervieux]. This space for growth could be for the development or application of technology and new services as well as simply changing or interrogating the existing approaches of library services and operations, challenging whether the current methodologies are still the right ones within the library spaces, or whether some should be discarded as obsolete. Current practices in some libraries may support concepts or ideologies that we no longer want to support, “so very much a space that should be focused around new users and should not be afraid to change and evolve with them and their needs” [Sandy Hervieux].



## The case of many ‘S’s: a summary of what a library is. An expert perspective

Picture the library as the three ‘S’s: space, stock and services. All three of those occur in both the physical and the digital realms.

**Space** is obviously the building in the physical realm and the environment you create, but also the equivalent of that in the digital and virtual realm.

**Stock** refers to the content, or ‘stuff’, that you manage both physically and digitally. Some of this is the stuff that libraries have traditionally managed as carriers of information, such as publications. These publications tend to be positive, well-understood artifacts like books, journals and so on. So, what is managed is not so much the infrastructure, as libraries are the carriers of information, but rather how the users are guided to the information within those artifacts.

**Services** help users use the content within the context of the environment and within the context of the space the library is creating. Those in a traditional print environment would be services such as being able to reserve a book, borrow a book and so on. In a digital environment services are related to, for example, the discovery and use of electronic resources.

All three of those (space, stock and services) have physical and digital manifestations. These manifestations are also one of the key challenges for libraries today, namely, how to bring those together and create a kind of unified experience for users, in so far as that’s possible. Space, stock and services are also underpinned by systems, staff and strategies.

**Systems** are the processes and the policies the libraries have, and that now often depend on technology.

**Staff** refers to human resources. These resources are the people with expertise, the people who can run the library, the people physically present.

**Strategies** are the planning and reflective processes that libraries go through to work out their position within their parent organisation.

*Stephen Pinfield*

## Different types of libraries

There are many different types of libraries, with different functions. The experts interviewed also come from different backgrounds and define the library context differently. So, it comes as no surprise that there are so many varied images of what a library is.

**> Strategically speaking, [a library is a] wide range of interactions and services, depending on users and depending on the library types. <**

Jean-Philippe Moreux

There is a different context to what a library should be. For example, national libraries are different from other types of libraries. According to Neil Fitzgerald, national libraries “have particular aspects that have to be discharged [as the UK national library has] this federated approach and structure that may be different to other European countries where the national library will take a more leadership position for the overall sector.” The legal requirements that bind national libraries are different from those for university or community libraries. For example, in terms of exchanges between libraries, other libraries can form networks while national libraries have partnership and association-type approaches. National libraries also have their own membership organisations. Public libraries in the UK are managed by local authorities, while other types may be associated with universities or other bodies. “It’s probably most useful just to highlight the differences because there’s very different emphasis and perspectives based in which type of library might you be working” [Neil Fitzgerald]. National libraries can be defined as providing a wide range of services,. Not only is a national library a depository for books, often it is an independent research institution, a place to curate collections and a space where one can work with the public and with other libraries/institutions. “I would probably frame it as that we have different purposes, and we serve different audiences” [Neil Fitzgerald].

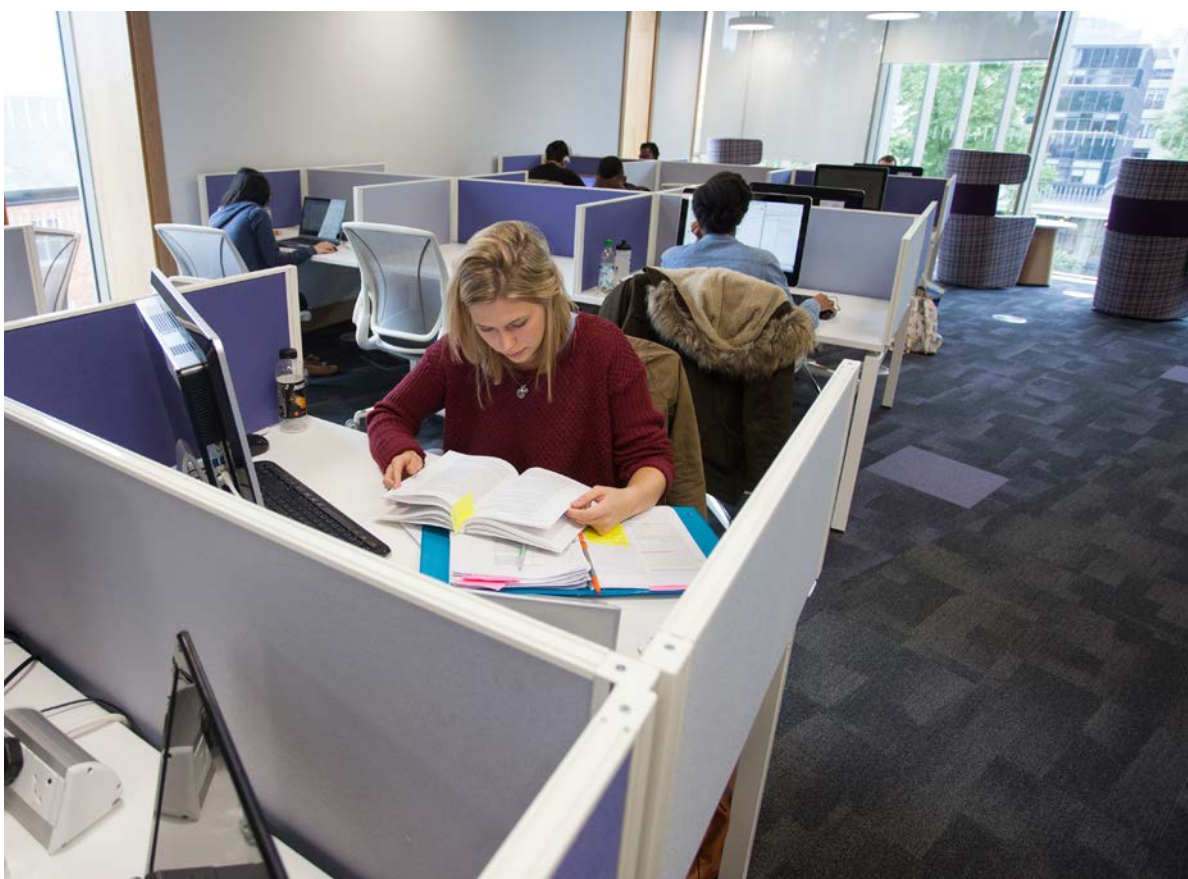


## The special case of university libraries

University libraries are a category, or a type, of library. The University of Leeds Libraries belong to this category. Yet this category is not homogenous as universities differ globally, politically, financially and culturally. Experts do agree, however, that university libraries are all focused on academic excellence and serve the mission of the institution to which they are attached. Universities are, generally speaking, tasked with carrying out research as well as facilitating teaching and learning. The university library helps its affiliated higher education institution by providing information, services and spaces that support those endeavours.

The currency for students is their grade point average. This is what determines if they progress in their studies or not. David J. Evans is an expert who is currently working on quantifying the relationship between use of electronic databases in the university library and student grades and progress. The library cube theory discussed in the previous chapter is the inspiration for this current work. The practical application David J. Evans developed is linked directly to this theory, only he linked it to the university authentication system. Studies such as his, as well as others listed in the literature review chapter, point to the final image of the university library that is highlighted here – the library as an acquirer of knowledge. This image permeated all expert interviews that perceived the library as a collector of knowledge. What makes university libraries different is that the knowledge collector image refers to both primary and secondary knowledge. A library stores and organises information and also generates original and innovative outputs.

Innovation and outputs are also at the heart of how the experts described AI. The next section focuses on the images of AI technologies.





> In universities [a library] is a place where people go, where people study, where people interact, where work happens, where collaboration happens; and that's almost as important now as any of the content it provides [even if] obviously the content the libraries provide is still massively important. <

Andy McGregor



## Section II: What is AI?

The findings for this report show that “what is AI?” is still not an easy question to answer. Experts’ definitions varied, if they were even willing to provide one. Andrew Cox explained this phenomenon by stating that “there are a lot of people who don’t like the term; the more technical people tend not to like the term because it has a lot of cultural meaning and therefore it can’t be reduced to a set of technologies like natural language processing or machine learning”. Most experts agree and say that AI doesn’t have one static definition – it is actually an idea.

**> Artificial intelligence can be explained as the development of machines to accomplish tasks and reproduce thought processes that are normally seen in humans. This simulation of intelligent behaviour is unique from other automations, as it requires the computer to use human reasoning or thinking to perform tasks. <**

Sandy Hervieux

Even Sandy Hervieux’s definition is a working one, developed with a colleague for research and educational purposes. They developed their definition in an attempt to capture the nuances of AI and give a baseline to their collaborators and/or students since there isn’t an established definition of AI in existence. What is classified or recognised as AI keeps shifting and changing and so, inevitably, do the definitions of AI.

### The nuances of AI

One of the reasons behind the morphic properties of the AI definition is the many nuances that exist in relation to the technology. AI covers a broad range of topics. These topics could be from AI described as ‘computers able to do some form of knowledge task’ to AI as ‘a series of divisions’. [Andy McGregor]. Some of these divisions were described as ‘weak’ or ‘specific’ AI such as machine learning, algorithms, neural networks, etc. “Broadly, it’s any kind of software that allows you to analyse and make decisions that analyse and make insights or decisions on a corpus of data” [ibid]. This means that a technology such as Google Maps is not AI, but it uses AI as part of its operations. Specifically, Google Maps is a mapping tool, but behind it there are all sorts of artificial intelligence algorithms that are helping Google Maps be used in interesting ways. Google itself is also not an AI, but it uses AI in the way it analyses and processes data. The same is true for your phone, for image searches, behavioural analyses, and so on. AI, is therefore, embedded in many tools, and the tool is not AI, but the particular application of AI could be helping the tool function [ibid].

**> In fact, there are many cases of AI's micro services plugged into existing technology which is helping make it better, but tools like GPT 3, driver-less technology, and Dall.E that contain pure AI, as in that they are an algorithm optimised for one specific task, are starting to be able to do as well as, or in some cases, better than humans. <**

Sandy Hervieux

Other experts view the nuances of AI as rooted in the properties of the concept itself. AI to actually mean 'a kind of bucket term, so it's not a thing', but rather a 'tool' and an 'idea'. In that context, AI is described as both the set of technologies and as a set of approaches that are unified by specific, commonly held parameters. One of those things in common is the ability of the system to learn without being programmed, ie to learn by itself. In other words, AI technology is viewed to move beyond the initial input of its programmers and to develop and grow of its own accord, including how to respond to certain situations. This is linked to perspectives of AI mimicking human decision-making processes. For example, in the library setting, AI could refer to the different tools that libraries could be using, such as machine learning for discovery and analysis or chatbots learning in relation to answering inquiries. The commonly held parameters are, then, that the machine is learning and growing human decision-making capabilities for the library context in whichever capacity it is focused on. This has the inherent current challenges of algorithmic bias, that by now are very well documented in the field, even if not adequately addressed. However, the same could be said for any tool that is used out of its original context. AI is simply a type of tool, a technology with many different manifestations around learning and decision-making that are projected or linked to a pre-conceptualised, albeit without a specific definition, idea [Stephen Pinfield].

Transformation of the technology over time, and the nuances embedded in the concept, are not the only challenges to defining AI. Another challenge is the very different images people have of what AI is, which has prompted some experts to employ alternative methods in their search for an AI definition.



## Images of AI


The images of AI that experts shared, as well as images that they found in their research with participants, portray the wide range of perspectives in existence. For some, AI is a “type of machine intelligence that could mimic a human’s intelligence”, while for others, AI is a “machine that thinks, but it’s not quite a machine”. Yet there were also many that did not discuss AI specifically but rather referred to subtypes or how AI could manifest, such as in named existing technologies, algorithms, companies and/or prototypes. These were perceptions that were based in some understanding of the technology. However, many images of AI (and what it is) are not based in reality. Participants would often give examples from news, books and movies. Experts commented that, for non-experts, it was often difficult to distinguish or evaluate AI. It was hard to separate fact from fiction. That is why Star Trek, The Terminator, and WALL-E were used as definitions of AI, alongside Boston Dynamics’ robots, the little robots at Incheon Airport in South Korea, and Amazon’s Alexa.

**> The majority of respondents associated the concept of AI with possibilities such as: automatic processing, automated information, anomaly detection in databases, services that learn from user behaviour, digitisation, etc <**

[anon].

The difference between definitions of experts and non-experts is perhaps most evident in the perception of the ability to customise AI. A prominent image of AI by non-experts, which emerged in the data, is to describe AI as ‘customisable’. Something that ‘technical people tend not to like’ according to some experts. By having an image of AI as ‘customisable’ that perception detracts for some experts from the technical components. Others have a concern over the potential idea of people controlling a type of technology that should have ‘free will’ and be ‘able to think for itself’. It would not be a stretch, then, to comment that because expert and non-expert definitions of AI differ, there could be difficulty in implementing AI technologies in non-expert user contexts.

What is interesting, as pointed out by Andrew Cox, is that even if participants could not provide a definition of AI (or did not agree on one) there was a shared feeling about knowing it exists, that it is advanced, and often, having an opinion about it. “We all have an opinion of what [AI] is, whereas most technologies, like quantum computing, many will draw a blank at” [Andrew Cox]. Actually, some experts took this a step further, by stating that they have no interest in AI ever being defined. The lack of agreement about what AI is explains, in part: a) why AI remains so interesting, b) why people want to discuss it, and c) how the technology stays relevant. It is the fluid image of AI that is cherished because, “this way we have some chance to influence what it does mean and what I can relate it to, and we should be able to say what it doesn’t mean as well” [*ibid*].



> The key thing is, if it's just a set of technologies we don't really understand like deep learning, or something cool like neural networks, which I don't understand and can't really say anything about; actually, when I say it's something to do or it's an idea of a computer doing some things that are a bit human-like, like making decisions or something about that, we'll all have a view of that and therefore every citizen can be engaged. <

Andrew Cox

And people are engaged. Different experts describe their engagement with the technology in different ways and by different methods. The ways and methods depend on their individual perception of AI as a technology. The following three cases can serve as illustrations of these differences.

### **Case 1: in search of a definition in a library setting**

We started with service, but without a formal definition of a meaning [of AI]. We were all supposed to understand it. This is a terminology that is a kind of technical device, or a piece of software, or model, which is achieving some kind of treatment to deliver and then service. It might be that workflow produced should be better. It might be a service with a layer or a dimension. It might be an experiment. So it was quite wide as a formal definition, but a very broad range of one of the questions as related to having it in your library.

We derived this idea of AI through a group we formed aimed at understanding how we can use AI in the library space. We formed the group two years ago, so it's something relatively new. [We have thematic groups we organise for many years, but two years ago, the organiser asked the members] "what kind of topic would you like to address in this little group?". We proposed a group for the first time because it was the right time, a technology-rich, right time for us. We think it was a time for us to create our experience, and to share with our colleagues this knowledge, and our experiments, and our achievements.

*Jean-Philippe Moreux*

### **Case 2: stepping on ‘digital humanities’ on the path to define AI**

A few years ago there was a lot of discussion around trying to define digital humanities. One could fast forward to AI. So I think it’s definitely one of those things that you should understand what it may mean for you [...] You have to be quite clear in the context in which you are defining [AI]. Particularly for organisations that have a public good remit, they have to be very clear about what they’re doing, how they’re doing it, and why they’re doing it. It’s more difficult to do this on the [whole library] sector basis, even though we are working in partnership. We are trying to share best practice and lessons between cultural heritage organisations [at meetings with two international library organisations], because collectively, we can move faster if more about the technology is shared among the community.

*Neil Fitzgerald*

### **Case 3: AI literacy as the next stage of understanding**

Librarians are very familiar with the concept of information literacy. They’re familiar with the concept of data literacy. And there is also what we could do: [have] the concept of AI literacy. People are gonna have to be aware, not only [regarding the AI] language, [but also] how AI works to a certain degree. [What] it is good at, and what it’s not good at, but also when we can trust it [and] when we can’t trust it. What we have to be aware of when using it, is that literacy isn’t something that’s generally widespread at the moment. I wouldn’t say I was the most literate. Other people in my team were much more [literate] than me, but I understand the broad scape rather than the specific scape. We are all going to have to be able to do that because [AI literacy] is going to play an interest in it. Increasing part of our lives as knowledge workers is going to change the way medicine works, change the way the law [operates], [change the way] fashion works, change my bank account, and [how we deal with] disease. All of these professions are gonna use AI tools, and often they’re gonna replace human jobs in doing so. So we’re all going to have to get a bit more literate about how we do it in the same way. We’re early in [the development] stage and education is probably behind. Maybe some other areas where it’s been more pressing, but it is definitely what we should consider next [our attitudes to AI literacy].

*Andy McGregor*



## The language of AI

Definitions of AI are often contingent on having a shared language and understanding, be it regarding digital humanities, AI literacy or simply a set of goals within a specific pre-determined context. Depending on the audience, expert and non-experts or context and background, the words used to describe AI should be carefully selected according to the experts. For example, in general conversation, you can use AI and machine learning interchangeably, but to a programmer, you should be more specific about what you want to communicate. So, in essence, there are some accepted definitions of these sub-types or sub-divisions in existence, but the level of specificity has to change depending on the audience [Andy McGregor].

In a library setting, the language of AI is related to the introduction of machines and the use of technologies to do some of the librarians' repetitive work. That is why the language terminology is often linked to the pre-AI functions of the library task. For example, data mining and text analytics are terms that librarians understand from the pre-technological library context. This pre-existing understanding of those terms/labels/language is then only reaffirmed by the introduction of AI in the library space, when AI is used to mimic the pre-technological repetitive and well-established nature of the tasks 'data mining' and 'text analytics' [Solomon Tijani].

**> We can have a knowledge-based system that can help take care of reference services, inquiries and questions on standby to answer those questions and improve the efficiency of the library and of the librarians; and also, make the 'library power' more useful. <**

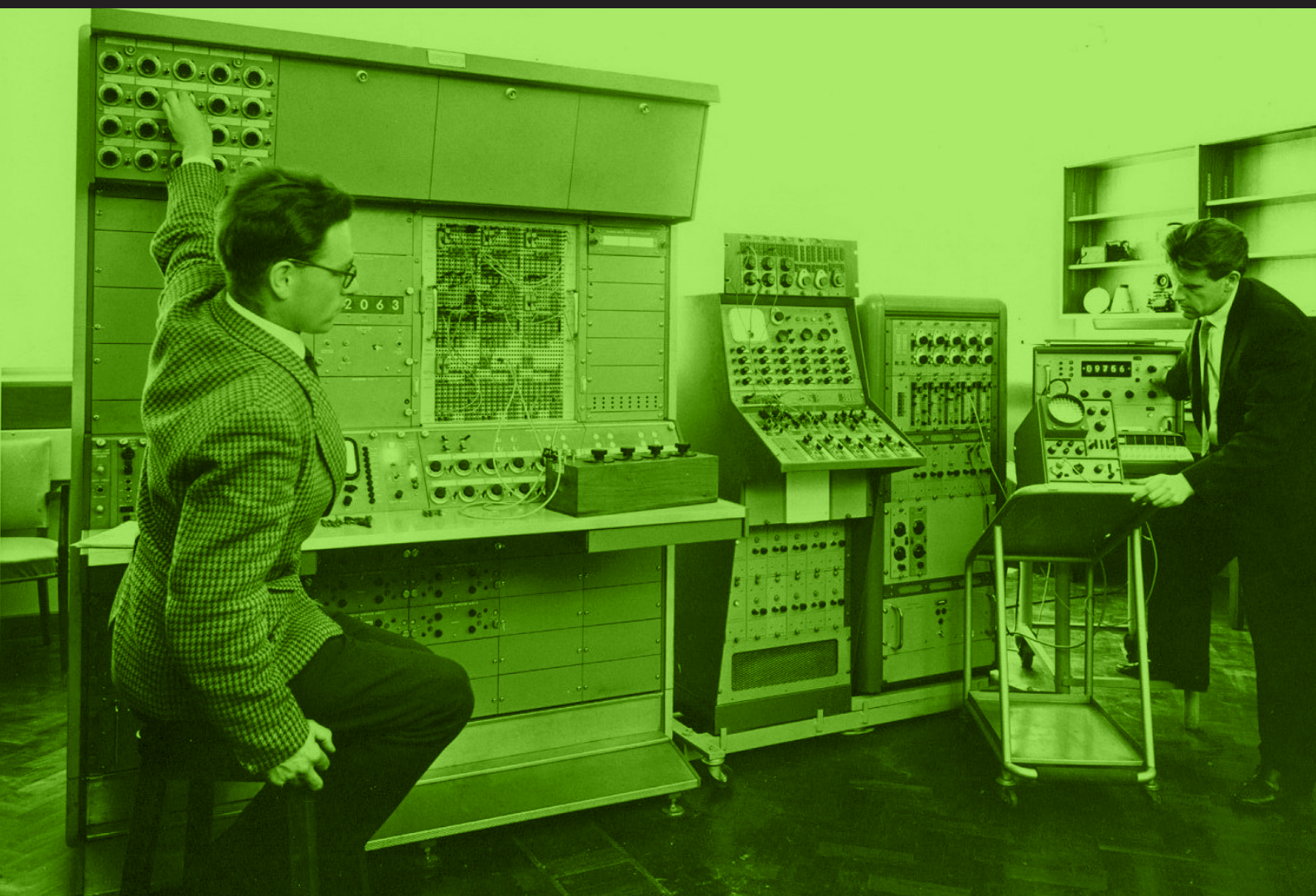
Solomon Tijani

'Library power' is an innovative idea, and it's a power where AI has a role to play.

## Chapter 3

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### University of Leeds librarians' perspectives on technology use in library spaces





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**Chapter 3 represents some of the voices of the staff of the University of Leeds Libraries. Unlike the previous and subsequent chapters of this report, this chapter contains the words from seven library staff members, who have all contributed to the findings we hope to convey.**

**The staff members have asked to remain anonymous, but I must highlight here the immense support and help they gave with producing this chapter. With it, we hope to share the images of 'library' and 'AI' that we hold here at the University of Leeds as well as how we have already begun to use and plan to use AI technologies in our library spaces. spaces, while the latter will focus on the images of AI technologies.**

Together, the **University of Leeds Libraries** are one of the major academic research libraries of the UK, with globally significant collections and a strong service ethos. We play a crucial role in the creation, dissemination, application and preservation of knowledge, critical to the success of the University's strategic ambitions. We are a major cultural hub, enriching the University and the wider community through our unique collections, rich resources, expertise and innovative services.

**The world around us is rapidly transforming.** We continue to act as agents for knowledge, but the form and channels through which this knowledge is created, curated, accessed and preserved has changed. It is time for us to accelerate our journey towards digital, to embrace open education while continuing to enrich the academic and cultural life of the University and our communities. We aim to achieve this through our vision for 2030, Knowledge for all.

**Knowledge for all** consists of four strategic programmes and three underpinning themes to support the University strategy, Universal Values, Global Change. It builds on our past and acts as a compass for navigating our future. It positions us to become one of the greatest libraries in the world.

*Knowledge for all: University of Leeds Libraries Vision for 2030s*



## Images of library

For us at the University of Leeds Libraries, a library is a multifaceted thing. A library is a combination of different elements.

**The library spaces:** There are associations with books but also it's about spaces, it's about the people in those spaces and the expertise available to people in those spaces. There is a wide variety of types of libraries too, and the types of spaces and services they offer. The wider public already has certain perceptions of what a library is, but many members of the profession are trying to expand those perspectives. We have an increasingly diverse range of expectations in terms of what we offer in our physical and digital spaces.

As a working-class person who visited libraries from childhood and commenced study as a mature student, my experience of libraries and librarians throughout my life has been marked by an approach that draws on radical pedagogy, and represents freedom to learn with guidance when needed, with a focus on visitor autonomy and respect for prior knowledge and capacity to learn

**The library as a hub:** libraries are the essential hub of information, learning and knowledge. The library is a community hub, with opportunities for meeting similar others, and for having the experience of co-learning as individuals, which can in itself bring a sense of belonging.

**The library is changing:** libraries used to be mostly shelves full of books. Now, they are more empty bookshelves and lots of laptops everywhere! Libraries also have an inherent value in addressing inequalities through access to knowledge and information, both directly through access to resources and indirectly through the expertise of librarians in passing on skills, techniques and values in terms of information literacy, and the nuances of learning how to learn.

**The library in the future:** as learning becomes more active and dialogic, and digital transformation accelerates, it is interesting to think through how libraries are designed to facilitate these changes through space design, keeping in mind the balance between individual and group learning. Also, it will be interesting to understand more about how visitors will interact with digital artifacts in a way that might be different from working with them in physical form, for example with special collections.

## Challenges facing the library

There are many challenges that face libraries today, and the University of Leeds is no exception. Currently there is a diverse range of expectations of what a library should do, and it can be challenging trying to fulfill all of them. For example, some public libraries in the UK are often taken for granted and not properly resourced, despite an expectation for them to support a wide range of activities. These activities include community activities, working with social services, helping individuals and groups beyond information seeking. Public libraries are often under-appreciated as a resource by central government, and they are frequently the first service to be cut when local government is under financial pressure. Moreover, financing is a major challenge everywhere, especially in the UK at the moment with the inflation that we now have here.

Academic libraries face similar financial pressures. And although academic libraries have to operate within financial restrictions we are still trying to diversify the range of things we do. So, there are lots of challenges in trying to allocate the resources we have available, appropriately, to the expectations of a very diverse range of users. We have galleries and collections that are part of our remit, we have researchers, students and staff as well as our own innovation projects. We have many enthusiastic, innovative people in the University of Leeds Libraries who want to achieve great things and to support our users.

As an academic library, how to keep our students safe and provide an environment in which they feel comfortable and productive is a major component of what we do. We have learning development teams that are very much focused on developing academic and digital literature in support of our users. A challenge in this area has been trying to figure out how to stay relevant to the users that are coming through our doors in a modern world; how to enable our users to be more effective, how to encourage them to contribute to the community of practice, and how to study effectively and to take those skills beyond our University.

'Beyond' actually refers to challenging both the boundaries of the institution and the boundary between the types of learning spaces we can engage our users with and within.

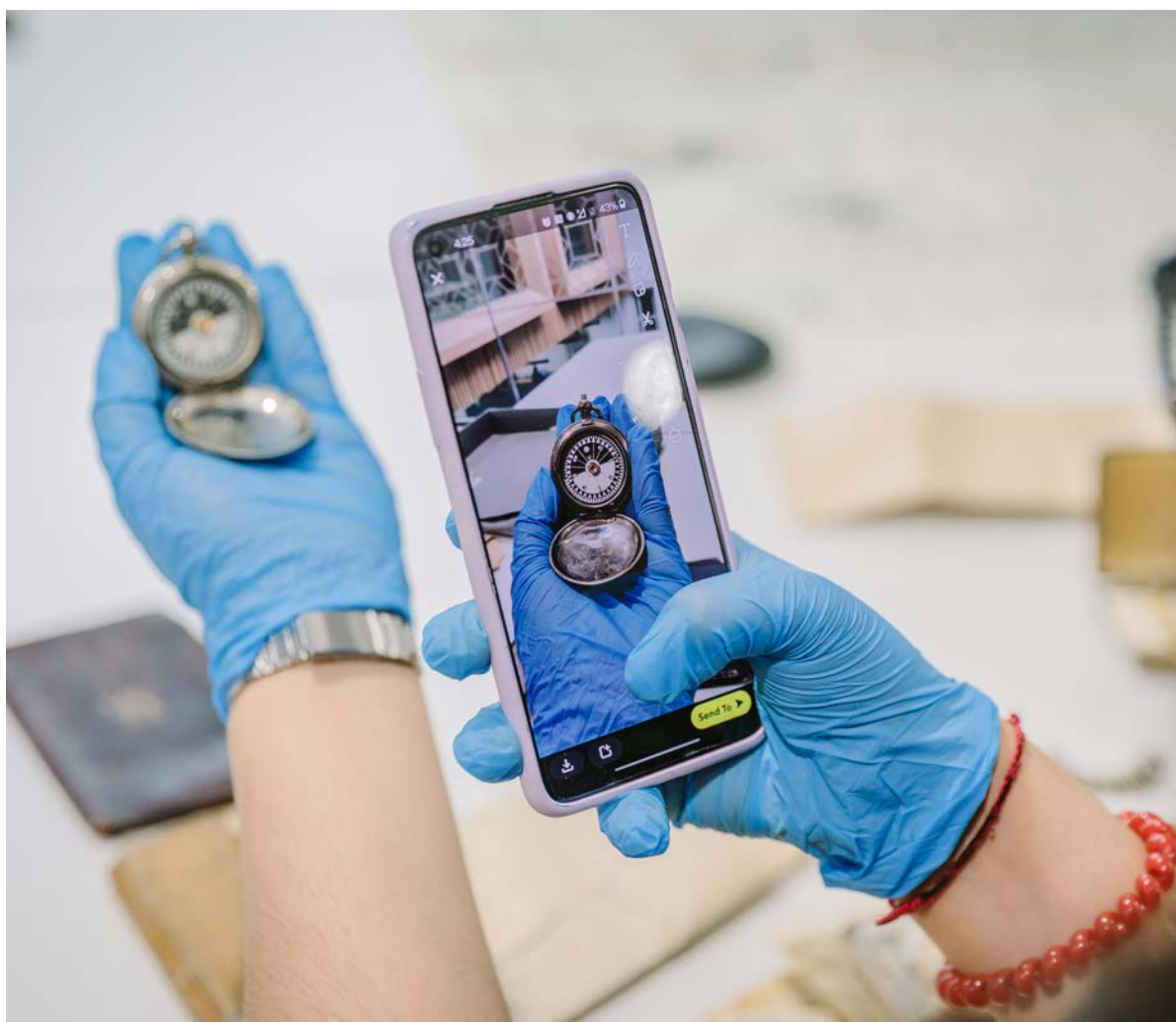
One of the challenges to traditional libraries is the availability of information beyond the boundaries of institutions, and how to deal with the shifts in terms of the democratisation of knowledge, the speed that understanding in a particular field of study may progress, and how to evaluate sources that may not have been published via traditional media.

As librarians, we must understand how to separate noise from valuable information without acting too stringently as a gatekeeper. Libraries play a great role as part of the information landscape. There is an expectation among users that information is readily accessible, especially with the advent of the internet. In this context, people might not understand the library's role in the information landscape or the limitations that we have in terms of subscriptions and access to information. So there lies yet another challenge for us – namely, how to navigate the balance

between the physical space and the community aspect of libraries. People may not be accessing information in the same way, or be physically co-located, but we still want to facilitate conversation and sharing. Also, how do we move away from that perception of the library as a set of collections and towards a perception of the library as the facilitator of access to information? That is not to say that we shouldn't have collections. A library is a place to manage collections as well. But there are some restrictive factors. Space, in particular, is a challenge for us in terms of both physical space as we grow our collections and digital space with the storage and information needs we have to manage. Even though we're not growing the print collections as much, at the University of Leeds Libraries our special collections are growing. We are also currently trying to understand what digital spaces we should make available to our users, and how. The ethics and management both present challenges.

There are competing demands on library resources that must be balanced, for example, creating and managing the spaces required to grow collections, providing the appropriate environmental conditions for preservation and storage, in opposition to responding to user needs for access and longer opening hours. Staying open early and late exposes us to sustainability challenges, particularly when libraries are in old, draughty buildings.

There are so many challenges that we face in the University of Leeds Libraries, and AI could be part of the solution to help us manage them.





## Images of AI

First and foremost, AI could refer to automated technologies that can provide solutions to certain problems. Some of the more straightforward library processes or basic queries could be addressed by AI technologies in the hope of freeing human resources and time. This would mean that AI is not about intelligence per se, but rather about access to a pre-determined knowledge base of information that enables users to obtain quick answers without the need for human intervention.

AI is any tool that aims to create knowledge from information, in whatever form that may take, so would consider geographical renderings and what they aim to expose as AI tools. To highlight a caveat that the intelligence part of AI is important here as considering the usefulness of a particular AI output being dependent on the AI being able to move beyond representation and into usable knowledge and meaning.

Therefore, AI is not only about the keywords that will trigger receiving information, context, or answer, but also about efficiency and speed. It is about trying to make sure that people get the information and the support that works for them in as quick and efficient a way as possible, based on whatever the input is from the user. For example, a functional technology that supports interrogation of data to surface insight/themes/trends and does it faster and more impartially than a person could. This includes areas where there is a flow of data to negate or at least reduce processes that are done manually.

There is also a view that AI is a computer system that simulates human intelligence processes – such as speech recognition, for instance. This intelligence is perhaps better defined as the system's ability to adapt or to have a learning component. However, this learning is not self-sufficient, but a group of pre-programmable parameters within which the system still operates and changes within pre-set variations. In other words, AI may appear to be a machine that can learn, but it is essentially machine learning or users augmenting the data input to receive better outputs. For example, the more information Netflix gathers on what you watch, how many times, and when, the better the AI's recommendations can be.

This logic can be taken an additional step forward, by suggesting that AI is not just a tool that grows as it learns, it is a space that itself can be defined as a learning process. Thus, AI is also a way of thinking, of perceiving technology and what it can be used for. It is about the input of data that, in turn, can produce outputs that re-shape the query and require re-evaluation of the technology application.

Finally, AI is linked to the idea of personalisation, in the context of the ability of a technology to offer users options to personalise their experience. In other words, AI is able to tailor the information users see based on what user preferences are. To balance this view, the authors would also like to acknowledge the risks that are well documented regarding personalisation approaches. Some users may end up in an echo chamber, or a bubble of their own



personalisation choices. The more users input their preferences, the more that narrows down the recommendations they see. The recommendations, or tailoring, for the user thus restrict the information flow. Examples of this phenomenon are rampant online such as with social media outlets like Facebook, Twitter and Instagram. Following certain groups, news or people on social media sites can lead to recommendations based on the same kind of topic. Additionally, in the case of social media sites, often the user inputs are not conscious and not apparent to the naked eye. Even though these inputs can lead to recommendations that may be time-saving, these inputs do not necessarily reflect the richer/deeper insight the technology would need to reflect conscious human choices.

## **Role of AI in the library's future**

AI technologies could, with careful management, play a role in the library's future. This role can be both behind the scenes and in front, interacting with end users.

There is an area of technological development around the digitisation of archives, where co-production methods could be used by students who are conducting research with archives; this approach could speed up the digitisation process while also passing on archiving and digital skills to the next generation. This could work as an apprenticeship model, where students learn tools and techniques as well as principles of designing metadata for use in AI tools and are guided through the process by expert technicians. This could have a positive outcome in sharing technical skills, career development, and tangible outcomes around democratisation of access to, and understanding of, archives.

This is particularly important from the perspective that digital libraries are a part of our future, and therefore so are AI technologies. In the University of Leeds Libraries we have people with expertise in using NLP in automated phone lines, chatbots, machine vision and AI in systems that are designed to absorb and analyse data and book appointments based on availability and geographic location. Chatbots, in particular, could be described as front-line agents, encountered before library staff.

Another area where the role of technology could be useful for our library is related to resource management. We could use AI to explore the relational understanding of texts and artifacts, through metadata and data visualisation techniques.

One of the experiences I had as a student was reading widely in my subject area but feeling like I wanted to be able to map how texts, authors and artifacts related to each other and the development of to help me build a more situated understanding and tell more of a story. I've used a piece of software called ResearchRabbit that works very well in this respect, allowing users to find related texts through AI, and to understand relationships and chronology, and to collaborate with comments on a text.

In terms of opening additional collections and resources, we can use technology with a crowdsourcing approach to help our library colleagues evaluate resources, process information about our collections and our users and understand what users are hoping to achieve and what they want from their library.

The question of supporting our users is paramount as an academic library. This is the end user element as balanced against the efficiencies these types of technologies could bring. Librarians are the custodians of information. So how we keep the information, how we access it, how we order it, are all areas in which AI technologies could help. Users don't need to know the process that goes from getting resources into collections or buying content, which is a huge challenge for us. It's buying and storing content, type of content and file types, and the choice of digital preservation of that content that we could manage with technology to help us deliver a more efficient service for our users.

A library is full of students I don't know. I don't know what they're looking at. I don't know what would be the best things for them, and I think that's both in terms of the uses of the building, but also in terms of what would be useful for them in their learning journey. AI here has a role to play by going beyond the live readers, and to connecting users and needs in new ways.

Furthermore, AI could help us keep up with the needs of users as they become more demanding. It could help us be ahead of the game. For instance, we need a better understanding of what type of content users want, and where. The digital experience seems to have given access to new mediums, and yet information acquisition, type and processing have very much remained the same. We are still very much based in print types; the only shift is from a physical print to an electronic one. Even visual materials follow structures already in existence with regard to visual communication practices. What people want to consume, where we can obtain it, and the teaching styles needed to be given to our users for different types of information, are areas where we need to be focusing our use of technology.

That is not to say that human resources will diminish. In fact, the role of the librarian would increase as not only the custodian of knowledge, but also the custodian for understanding technological implications in information, communication and interpretation of resources. After all, having an AI search through a database is only as useful as the query or parameters put to the AI by the human controlling it. Evaluation by a human of the technology, of the findings, of the outputs, will remain relevant, if not even more so with AI in the library spaces. The AI tools people use can save some legwork during the investigative stage of knowledge acquisition and can bring efficiencies to repetitive or repeatable tasks that could be replaced by a script, or a tool that is intelligent and learning. However, there are aspects of the library, such as collections, where AI tools cannot help during the investigative stage of knowledge acquisition. This is an area where the library staff's authority and expertise cannot be augmented by an AI.

Areas where the library has repetitive tasks that could be supported by AI are in relation to card catalogues, where the technology could improve search functions, and the library software. In terms of access to information, AI could support better aggregation of that information as well as finding tools for quick searching and filtering information to focus in on particular needs. There's also the role of technology more generally in supporting learning through things like making spaces or by making the library experience more personalised. We don't have personalised services in that sense in the library, but we also have ethical issues to consider in that regard. We shouldn't collect personal data, but perhaps we could use the technology for a personalised student experience by telling users, "well, as you've looked at these five things, maybe you want to look at this one, or maybe you need to discover that one, or actually this is a video that seems to be your learning style". This use of AI in the library space could enable us as librarians to augment access for our users, target our service better and support them in their needs.



## Innovative AI-using approaches in Leeds University Libraries

Over time, the line between libraries and research has become more blurred. Some staff perceive this as a positive transition, a return to past practices. Many of the library staff engage in primary research, such as those in special collections who conduct research into collections and curatorial work. This also reflects an underlying difference between academic libraries and others. In a big, research-intensive institution like the University of Leeds the breadth of what we do in the library is immense. In line with our own research practices, the University of Leeds Libraries already employ AI in certain areas to support our staff, students, and resource management. We also have additional plans for digital transformations within a few years at the University of Leeds Libraries.

### Content acquisition and discovery

For the area of content acquisition and discovery we have been looking at the potential for automating elements of metadata and discovery work. We have made some progress with the technical knowledge that we have. We needed to find a way to create/locate sets of records more quickly than searching 1:1. We have developed two different techniques that provide different levels of records but enable discovery of items. We are investigating a crosswalk that would help with classification. In the future, we want to look at the possibilities of text and data mining in relation to linked data and discovery, but this will have to wait as we don't have the time or the skillset (or sufficient IT development support) currently.

### Research support

In research support we are very keen to discover potential applications to support our service, both in terms of internal operations (processes we can do more efficiently within the team) and our offer to researchers (how we can support them to operate more efficiently, gain deeper insight into data etc). Some time ago, one of the research support managers trawled some peer institution websites to try to understand the offer elsewhere, particularly around text mining, but it didn't seem widespread and there was no obvious development for us to consider implementing. That being said, we make use of a limited range of tools for text mining purposes within our services on literature searching and bibliometrics. VOSviewer is one such tool. It can help uncover most frequently occurring keywords in a publication set, which can help shape future search strategies for interrogating the literature. More broadly, and something that we now take for granted but could fall into the domain of AI depending on definition, is the harvesting of publication data from external sources (typically bibliographic databases) based on a match with a Leeds author. That data is then presented to the author for claiming inside the University's research information system (Symplectic) to help populate their list of research outputs, reducing the need for manual data creation.

## Learning development

Within learning development, it's a priority area to adapt and use AI within are our booking systems. An example is that, currently, the process for students booking onto our workshop programmes or other types of appointment still requires quite a bit of human intervention to find the right slot. So, we are looking to bring in a new booking system where the slots available are adaptable to individual student schedules, and open for students to choose from in advance without our intervention. A system where we can upload our availability and the system then matches that availability with the student's timetable and availability, issuing the appointment directly. There could also be a feature for students to choose which option they prefer if a few are available, as well as to cancel appointments automatically without contacting our staff. In other words, we are hoping for a system that enables us to improve our processes through technology, and perhaps uses some AI to make better recommendations for students and to be a bit more explicit about the options.

Additionally, we have a team in the Leeds University Library who are developing a digital learning office. The aim of the office is to provide support to students with learning in a digital context. In that context, our work is about engaging with appropriate software to help students grow on their own, thus making it easier in terms of time management. This is useful in areas such as assignments, grade checking and exam timetable access. We are hoping to use technology to help students learn more effectively. In terms of using AI, the obvious one we are hoping to pursue is of chance functionality or automated responses for queries. We have been exposed to the usefulness of chatbots, so we are considering chatbots as an option.

## Research and digital futures

Further, in the areas of research and Digital Futures we are looking into how we can support digital humanities. We have already completed some work on our workflows and around our special collections. Some of this work focused on text recognition. For instance, when you take things off the camera or scanner you often get dead space around images and/or text. So we looked at how we could automatically cut that dead space, enabling us to bring the words out. We used an optical capture recognition to bring the characters through, by removing the dead spaces out of the text and spotting headers, etc. The idea is that when we are doing big digitisation we can do this automatically by feeding it into a tool.

Additionally, there is a digital learning accelerator project planned at the University of Leeds that is part of the wider digital transformation work. The digital education service is developing the digital learning accelerator, which is effectively a large space within one of the university buildings that will house lots of digital technologies. There will also be an enterprise space and a major open space within it. The idea behind this project is that this would be a space to allow staff and some students to engage with new and innovative technologies, and to be creative with things like AI. It will allow for students who might not necessarily be expected to use these tools on a course to engage with them for their further development. It is an opportunity to explore beyond individual areas of study as well as to develop a bit more fluid thinking. It is still in early development, but it would be interesting to see what kind of innovative practices that will enable in terms of education services and having video editing suites. These are not extra resources for staff and students as people are already using those tools.



There are many questions we still have about which students will have the opportunities to play with the AI tools. We need to be able to work out exactly what that space is for. What kind of equipment do we envisage being there? How will students be able to engage with it? Is it just to turn up and use or do they pre-book? What support will there be? What teams would be needed to support that equipment and to give pedagogical value to it? This is not just for people to play, it is a tool for inspiration so how can we help people to progress with it? How do we help them have some clear outcomes for what they want to do with that equipment? There's quite a lot to think about. There are still lots of questions to deal with.

## **Customer services**

In customer services AI use seems very far into the future for the University of Leeds Libraries. We would love to see a world where we have a chatbot to assist with increased webchat traffic and online inquiries. In the past, we had a live online chat function for a few years. Using this function, colleagues were answering students live, but the service only operated during our work hours. So, we were having some discussions around whether we can partner with other institutions that are based in different time zones, for example in the USA, in the hope they would answer students' queries outside of our working times and so provide better coverage. A partnership with a time difference would enable us to service our students at half past five in the morning or perhaps late at night, simply by offering to do the same for other universities in other countries. However, this idea was declined considering the time and human resource it would take. A more automated approach with no human intervention would be preferable for 24/7 coverage, leaving specific queries for our working hours. One day, we hope to centralise our library customer service functions (galleries, special collections, front of house customer services) and introduce improved scheduling and training software that would enable us to streamline several areas while increasing both our customer interaction and satisfaction.



> In a big, research-intensive institution like the University of Leeds the breadth of what we do in the library is immense. In line with our own research practices, the University of Leeds Libraries already employ AI in certain areas to support our staff, students, and resource management. We also have additional plans for digital transformations within a few years. <



## Further considerations

### Resilience

Technologies could support libraries to become more resilient in the face of pandemics such as COVID-19 or other disasters such as environmental or man-made ones. This was a theme that emerged in most interviews, as librarians viewed technology as one of the main aspects that helped the library to serve students and staff through the pandemic. On one hand, according to some staff, there are pre-existing barriers to accessing online resources from the established gatekeepers of information, which must be overcome. Further, opening up access to collections and libraries can be physically demanding and certain aspects of technology can create an intimidating space. On the other hand, taking down these barriers and making content available online essentially supported libraries to become more resilient in the face of disasters. One of the priorities for the University during the pandemic, for example, was to get those library spaces open and accessible for information. The more we can make our collections online and available the more easily they can be accessed by our users.

Long term, the image of the library will change, irrespective of whether we improve our technology. However, resilience will be linked to technological adoption. First, on a theoretical level, digital technology is revolutionising how we live our lives. The users that pass through our doors will more than likely all be using technology in some form every day for the rest of their lives. It has become an expectation in society. By including technology in our library spaces we can maintain a permanent link with our technology-bound users, thus maintaining the resilience and value of the library. Second, on a practical level, the pandemic has shown the value of hybrid library services. For example, in respect to student-facing activity workshops organised by the University of Leeds Libraries, during the pandemic the library very quickly transferred into an online delivery mode, thanks to technology. We were able to keep supporting our students and avoid them being isolated in terms of the study support they needed. The experiences from running these workshops during the pandemic made us learn some lessons in the library. Even pre-pandemic we had already started to have webinars and some online support. Now that we are post-COVID-19, we certainly retained an element of that and even hope to expand our online appointments, contacts and guidance. In order to be resilient and best serve our users, we hope to have a hybrid model of 50/50 online/offline. This model would enable students to choose whether they want an online or face-to-face appointment. We're also offering online equivalents for most of our workshops. Some of those work better face to face because they are meant to be really interactive but, depending on the topic, some can be covered in an online format. These lessons are why the University of Leeds Libraries currently has no intention of going back to purely face-to-face interactions.

## Librarians' skillsets

To make our library more resilient, we also need to consider the type of skillsets that we would expect of our staff members in the future. These skillsets should ensure that the next generation of information professionals can keep pace with future developments in technology. This is why the skillsets most often cited by staff were:

- the abilities to work with various types of technology
- insight into areas such as data science, complex searching
- expertise with big data
- information and media literacy.

AI is still an unknown but specific area of interest. We are still at the stage of not understanding the full potential of AI within our service area. The more we learn, the more we will need to develop the corresponding skillsets. That is why the University of Leeds Libraries focus on developing diverse skills for our librarians and all staff we're working with. We are focused on developing skills that correspond to the current services that we offer and also planning for future ones. Much of our effort is hidden for users. For example, the people in our reading rooms who perceive the library as an amalgamation of resources may not see everything else that we do to make those resources available, customer services, the management of the buildings or the organisation underpinning projects.

We are a little business within a wider business.

Librarians, nowadays, have developed both soft and more technical skills. Soft skills are skills such as communication, web writing, social media management and use, customer services and inquiry management. Technical skills are skills such as system selection, procurement, maintenance and upgrades. The more we include technologies in the library, the more our colleagues grow their skillset to incorporate new trends such as creating visualisations, designing and building websites, having to understand cloud storage, ethics and security.

About nine years ago, to keep up with skills development in the University of Leeds Libraries, we transitioned our staff structure into functional teams. The purpose of those teams was, rather than being librarians who were trying to be masters of everything, to be more specialised and develop our skills into defined areas. It's the concept of the large and well-oiled machine, where functions depend on each other. That said, when it comes to digital, this is an area relevant to all of our different staff, through learning, development, research, support and access as well as acquisitions and material collections development. However, in terms of the skill development related to digital, we do not develop digital and technology skills for their own sake, but with the aim of moving forward or succeeding at particular tasks and priorities that we have.

Therefore, for us here at the University of Leeds Libraries, it is about developing skills that relate to your own context; a context that is different for our 250+ members of staff.

Even when staff are not directly involved in an area such as digitisation, we still provide a working awareness and an understanding of the types of skills and context that may be needed. Understanding the area and the skills is the only way we have determined so far to decide if we as staff would advocate for one type of technology over another. For instance, there should be an understanding of the value of online learning platforms and the resources required so we can examine whether the platforms would be an effective tool for students and staff. Additionally, there needs to be understanding of the context within which those tools exist. As we work with academic colleagues we expand the context of our tools and skills not only to serve library needs, but also to support academic staff with their needs for student engagement, support and management as well as the primary sources available online for them to engage with research.

### **Generational gap**

Skillset uptake varies across departments and teams in the library, and one aspect of further themes that emerged was whether there was a generational gap in the understanding, acceptance, willingness to implement, and/or use AI technologies and the corresponding skillset required within the University of Leeds Libraries space.

On one hand, some staff expressed concerns over age as a barrier to new technology implementation. Several members of one of the teams, who are close to retirement, have expressed that they do not feel suitably comfortable to use technology in the library. 'The cloud' gets referenced a lot in this context. On the other hand, other staff members imparted that their teams contain people from varying age groups and they are all keen to explore and experiment. 'Lack of time' is the defining factor in not being able to do so, not generational differences. Yet a third approach was between these two perspectives, where some staff suggested that a general gap in technological use would depend entirely on what the AI application was and what need it was able to meet.

There are many ways to encourage staff to get engaged with technology, including AI, in the library spaces. One option is to make training more interactive and complete it in such a way that people are comfortable to speak up if they need more support. It is about helping staff improve their understanding and awareness of the technology. Another option is to be careful not to make any assumptions about the digital capabilities of the staff or the students.

Technological literacy in one area does not necessarily translate to technological literacy in another. For instance, an 18 year-old may be great at using TikTok or other social media channels, but that does not mean they know how to use Microsoft Teams or that they can manage to protect their identity or security in a sensible way. Similarly, some mature students or older members of staff who might have less experience, may adapt faster to new technologies and learn better using those resources. In other words, we need to be mindful that age does not determine willingness or capability to use technology.



## **Ethical implications and considerations**

Being careful about age is only one of many ethical implications and considerations that technological adoption in the library space may bring. AI is often based on limited and generally biased datasets and is heavily influenced by the creators. It's well documented that significant proportions of our key user groups are being ignored, mis-identified or otherwise being made to feel excluded by AI technologies.

AI for some staff is linked to the ability to provide a personalised service to users. In personalisation lies a big ethical challenge for AI technology adoption in library spaces, where the priority is to safeguard our users. Personalisation implies asking for information from students and staff and keeping that information for a set time. Ethical considerations are linked to the maintenance of this personalisation and data storage.

University of Leeds Libraries have a lot of data on students and staff, but according to some staff we're really poor at using that data effectively. We have many service users but we often know very little about them. For example, finding out what percentage of our students study mathematics. We can find out but it takes a bit of digging around, yet this is information that can be valuable for our service development and enable library services to be more effective in helping students.

Additionally, there is an expectation that the library knows certain data provided by students, but often that is not the case. For example, students often declare to the institution if they have a disability when they first register. It is not unreasonable then, for students to believe that since they have made the declaration university services, including the library, would be made aware. However, because of ethical concerns, information of this kind is often not shared. Technology could help with sharing, but we need to make sure students have a really clear understanding of how that data is being used and moved around the institution.

## **Perspectives on the global north and the global south**

Ethics of data storage, personalisation and use are not the only concerns within the University of Leeds Libraries. There are also concerns over types of context and how those influence technology adoption into the library services. An example is the global north-south digital divide.

In the existing publications on the topic of digitisation, the global north is often distinguished from the global south both in positive and negative aspects. On one hand there are many publications about the 'digital divide' where the global south is at a disadvantage. On the other, some researchers are recognising that the rate of adoption and openness to implement new technologies can differ greatly, but surprisingly, if finances are not an obstacle the global south is transforming quicker without pre-existing institutional history and memories as well as social, economic and political environments. This is something that librarians, especially, have highlighted in prior interviews. Leeds University Libraries have also come in contact with the digital divide and themes emerged that supported this pre-existing outlook.



One staff member related this experience of the digital divide to a career before joining the library at Leeds. This staff member imparted that in big companies in India and in South Africa, in particular, the colleagues were always a step ahead of their counterparts in the UK in terms of technology. Another staff member related anecdotally that some universities may be able to be more agile precisely because they are freer from entrenched power dynamics and may be more adaptive to change without heavy bureaucracy.

In terms of a university-wide challenge, within a longstanding institution such as the University of Leeds, there are layers upon layers of developments, initiatives and strategies. There are increasingly complex structures and processes of approval and implementation for any changes that we may wish to make. It is a complicated web of gains, losses, stakeholders. In other words, there is the culture of the institution to consider as well as the technological maturity of the institution. That can mean innovation is very slow to happen because of institutional barriers. Even if we might want to bring in a new system, or just some different or augmented aspects to an existing one, we realise that we must link and provide access to systems, X, Y and Z. There are multiple systems and technologies in operation at the University and trying to fit them together is an enormous task, especially with ones that are no longer fit for purpose or have different ownership. It is a difficult web to untangle. That is why it is easier to adopt technology than to update it. This would explain why in some areas of the global south, where there are no institutional histories to consider, technological adoption may indeed be easier.

Moreover, in the UK many people have to be involved in institutional decisions. There are lots of blocks and barriers and gatekeepers. People are quick to recognise the need for change but getting them implemented can be slow. For example, in the UK, we generally do things per institution, whereas in lots of other countries they do much more collectively technology-wise and system-wise. Where there is overarching governance to projects and innovations it may take longer to accept a technology, but once a decision is made it is implemented immediately. In the UK we are bound by the institutional budget, goals and strategies, making this process of implementation rather slow. However, if there is a clean slate, then it is simply a question of "will this make things better?". The global south often has situations where there is a clean slate, and as long as there is finance there are no other wider external pressures. It is not necessarily about success, but rather technology as a way to address challenges that the global south faces and people willing and able to accept this change. There is much we still don't know or understand about decision-making in the global south, but this is an area that would be interesting to explore further, as there is much we can learn.

## Verdict

This is a complex topic and many aspects need to be considered simultaneously. However, in respect to whether AI technologies in libraries would do more good or more harm, there was a general consensus in support of technological adoption if the consequences are carefully considered first. The consensus was rooted in the belief that the library needs to evolve and stay relevant to the users while also acknowledging that this is a topic that cannot be approached in a broad brush way. It would depend on the specific AI technology in question. Those that enable deeper insight, save time etc, are likely to be viewed positively. Other applications may be viewed as overly invasive where they touch on, or are interpreted as touching on, personal data. AI has the potential to do good, with the caveat that librarians and users must understand what the AI is doing, and why. Even if there are some tasks that can be made easier by technology, there still needs to be an understanding of what that task is, and how it would be done without AI, as it is important to avoid black-box systems that would mean a widespread forgetting of how to do things without AI.

This is what we hope to convey from the University of Leeds Libraries, and the next chapter will tell us if this is what our users also see.

## Chapter 4

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### The University of Leeds perspective: data from the survey of users of the library services and data from library staff interviews



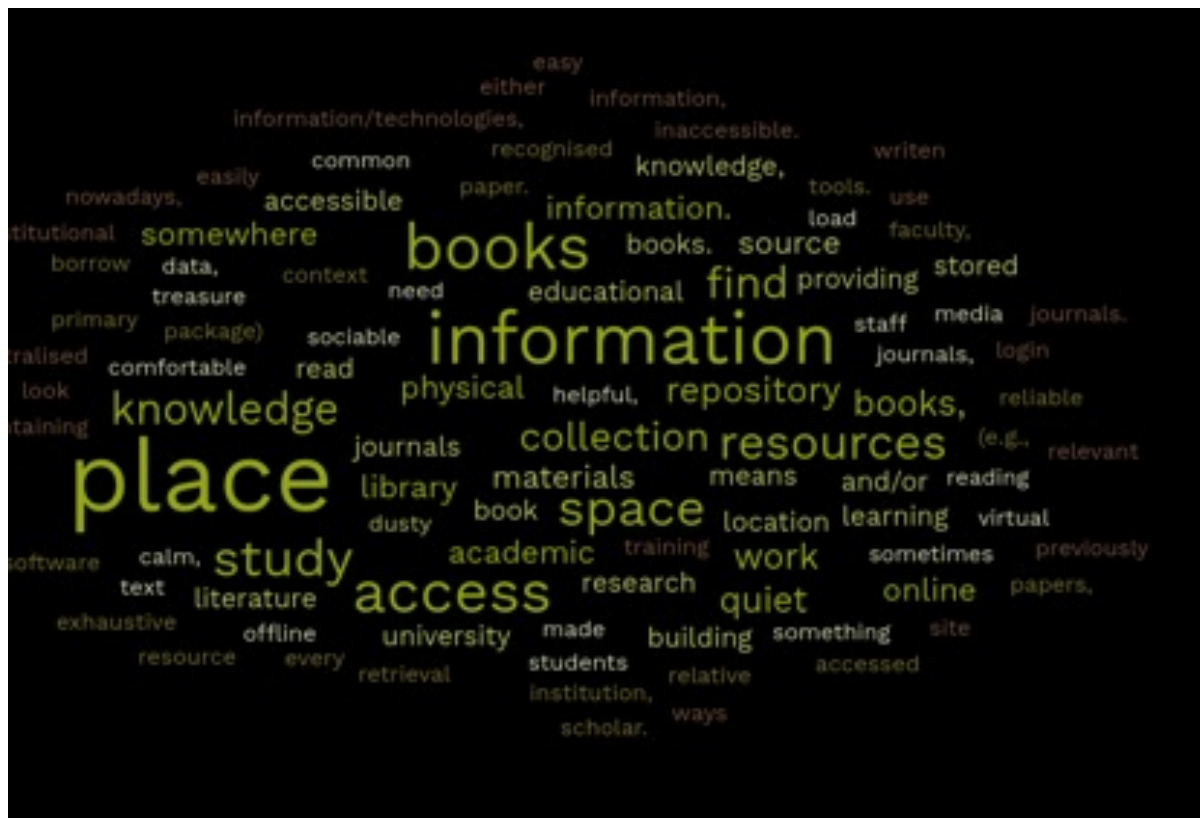
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**This chapter presents the data from a sample survey that was distributed to University of Leeds students and staff. The initial purpose of the survey was to have a representative sample. However, due to the timing of the survey (it was released during the summer months of 2022) there were only 60 responses. Therefore, this is a sample survey only and the data within it should be understood in this context.**

## Demographics

The sample comprised 63.3% responses from students and 36.7% from members of staff. In terms of gender, 31.67% of responses were from females, 51.67% were from males, and the remaining 16.67% of respondents declined to specify. In terms of age range: 38.33% of respondents were in the 18–27 category; in each of the 28–37, the 38–47 and 48–57 categories there were 13.33% of the respondents, and in the 59 and over category there were 6.67%. Further, there were nine (ie 15%) that remained unspecified.

This word cloud illustrates what a library means to our staff and students.



For our users at the University of Leeds Libraries, a library can be both the physical space full of books that you can touch and feel and a virtual space where you can still access information and services. Most respondents (86.7%) were in favour of this hybrid approach. Only 5% perceived the library as physical only and another 5% saw it as virtual only. For most of our users a library can be both physical and virtual, but the physical aspect is essential. One of the reasons for this is related to the purpose of academics and cities where there must be a physical library space first and foremost.

The value of a library in our users' opinions is primarily that 'libraries are core to higher education' (with 91.7% agreeing or strongly agreeing with the statement), that 'libraries are useful for my studies/research' (with 90% agreeing or strongly agreeing with the statement), and that 'libraries

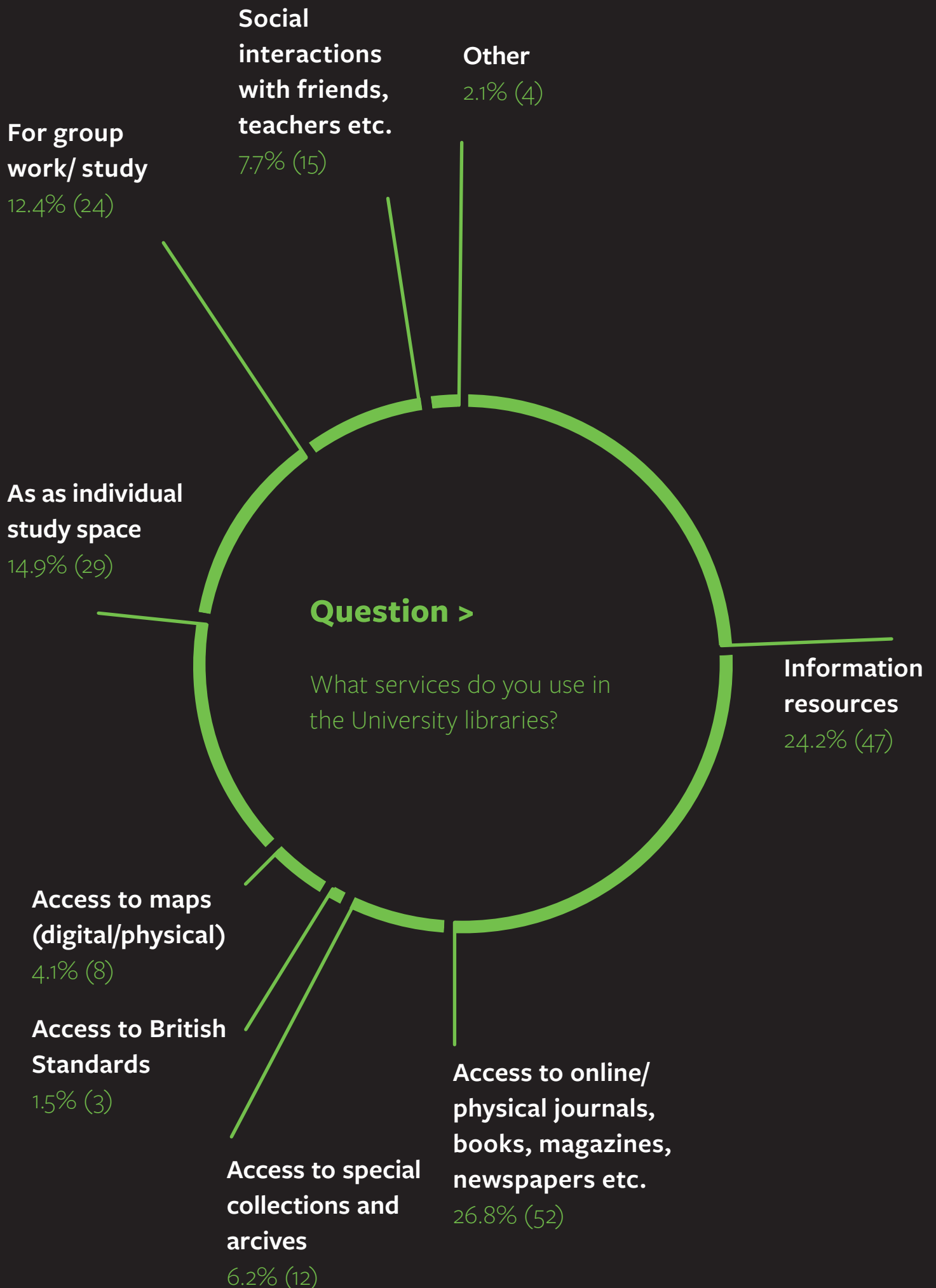


are a trusted space' (with 88.3% agreeing or strongly agreeing with this statement). There was also strong feeling (81.7% agreeing or strongly agreeing) that 'libraries are uniquely positioned to provide learning spaces'. These findings were in line with what we expected to see, considering this is an academic library and the users work or study within the academic institution. What is surprising is that neither libraries' excellence at partnership working outside or inside the institution, nor the ability of libraries to remain highly resilient in the face of change, were as strongly acknowledged. In these questions, at least one third of respondents could not agree or disagree with the statement. This shows that these are the three areas that the University of Leeds Libraries could prioritise in communicating how we can support our users, what we already do in those areas, and what improvements we keep making.

Additionally, 56.7% agree that the libraries have a strong brand, and perhaps we could re-examine how the University of Leeds brand could be further used to better engage with our end users and more strongly position the libraries as space that is core to learning at Leeds. We should find methods of highlighting the relevance of the library to our users because this data shows only 46.6% of users are optimistic and believe that libraries have an exciting future.

In terms of the services the University of Leeds Libraries' patrons use, the graph on the following page shows their answers.

There were also some additional services that users mentioned, such as occasional laptop hire or access to the on-site computers.



## Interactions with the library

In terms of frequency of use of library services, 3.3% use them every day, 28.3% use them most days of the week, 23.3% use them some days of the week and 21.7% use them once a week. So in total, 76.6% of library users use University of Leeds Libraries services at least once a week. However, there are 16.7% who use the library only occasionally, and we recommend a focused study on this group to try to understand why their engagement with our services is infrequent. A starting point in understanding users who opt out of particular services is provided by several respondents, who focused on the transitioning of the library to digital and online available texts as well as the pandemic's impacts. For example:

I used the library a lot as a student for finding books and journals. I don't use it as a staff member, partly because I am not actively involved in research. I still access journals regularly, but I can find everything I need online.

In terms of pandemic impact, one respondent explained that they have opted out of laptop hire because with COVID-19 and possible infections they prefer to bring their own. Similarly, the physical spaces were perceived as more dangerous for project meetings, and room bookings were replaced with Microsoft Teams meetings. Recommendations here could be related to better communication, both of our services and of our pandemic-related safety measures for students and staff.

During the COVID-19 pandemic, frequency of library use changed. While before the pandemic 76.6% of surveyed users were using the library once a week or more, during the pandemic that number dropped to 57.6%. Conversely, before the pandemic 6.7% used the library at least once in six months, while during COVID-19 that number rose to 28.8%. For one out of three users, 'learning to live with COVID-19' has increased frequency of library use, but for others (also about a third) use has decreased. For the remaining third, use of the physical library reduced but both the use of online library archives and library interactions via open research activities increased.

For those who record an increase in the frequency of their library use, the most cited reason is the ability to study in groups in the shared workspaces; the cubicles are valued especially highly. As there are fewer users on site, the library is described as 'a quiet place to study' where you don't have to pre-book seats. Many choose the library study spaces, especially when they feel unproductive at home.

The experience of home learning has taught me that I prefer having separate studying and living spaces. This has greatly increased my use of libraries, as I find them the most comfortable and productive environment to study in.

Another asset of the library is ‘especially when they are open 24/7 at the exam season’. However, this particular asset of 24/7 access to resources via the online medium has brought about some misconceptions that patrons are somehow using fewer library services because they are less in the physical library spaces. . For many library patrons, frequency of library visits has decreased because of the ability to access required resources online. The physical component of the library spaces has been replaced by online accessibility. Access to the academic papers, databases, and other online publications can mostly occur via the internet. It is also in this context that many library users seem unaware of the library’s role in securing their access to said online materials. There is a lack of awareness that the online access they enjoy is also a part of library services. It is recommended, therefore, that this aspect of library services is better highlighted to library patrons in future.

## Technology in the library services

There are many challenges faced by libraries today. Some challenges could be overcome by adopting technologies; for others, technological adoption could be a hindrance. Survey respondents were asked questions around how and where libraries should adopt technologies and for what purpose. The following responses help us understand where users believe technology could be implemented in the library services, and how.

In terms of areas where technology could be used, a series of questions specifically asked if respondents supported technology use, either to enable libraries to process information faster and better, or to help libraries keep up with global technological adoption and use so they can remain relevant. In both cases over 80% of the users support or strongly support use of technologies for library services. Some are undecided and fewer than 15% are unkeen to bring more technology in the libraries.

There were other areas where fewer than 15% did not support technology use. However, a growing number of users are undecided. In providing faster, better user experience (16.7%) and in competing with today’s alternative sources of information (18.3%) fewer than 20% were undecided. However, in showing operational efficacy and effective management tracking and analytics tools (21.7% undecided), attracting new and more diverse audiences (25.4% undecided), emerging skill gaps for library management (27.6% undecided), and emerging skills gaps ‘for library users like yourself’ (28.3% undecided), the number undecided is higher. Finally, in redefining the value proposition in today’s information marketplace (37.9% undecided) and dealing with financial uncertainty (40%), the undecided category represents the largest share of the responses.

As for where technology should be integrated into the library space, 11.9% stated that it should be in services only, 3.4% that it should be in management or organisational capacity only, with 83.1% suggesting technology should be integrated in both services and management/operations. Additionally, 67.8% would like to see technology in both visible interfaces and as a supporting mechanism behind the scenes, 28.8% only want technology they can see and 3.4% only want technology as a hum in the background.

This graph represents what technologies the users thought could be added to the University of Leeds Libraries.

Rank value	Options	Count
1	Voice recognition	21
2	Augmented reality	24
3	Virtual reality	22
4	3D printing	25
5	Fulfilment automation via kiosks / robots	32
6	Technologies that may improve teaching and learning such as gamification or living labs	35
7	Artificial intelligence / Machine learning that may enhance user experience	44
8	Artificial intelligence / Machine learning that may improve library operational efficiency	39
9	I don't understand these technologies	1
10	I don't understand why these technologies should be included in the library	9
11	Other	0

Mean rank	5.25
Variance	5.76
Standard deviation	2.4
Lower quartile	3.0
Upper quartile	7.0

The graph on the following page shows why users thought the library should add advanced technologies.



Rank value	Options	Count
1	To enhance my experience	43
2	To engage larger audiences through better user experience and new services	36
3	To enable cross-disciplinarity	26
4	To improve my productivity	35
5	To better tailor services and/or content for my needs	36
6	To improve library operational efficiency	46
7	To reduce operational costs with process automation, optimised research data management, and digital asset management	36
8	To optimise collection analysis, visualisation, and preservation	38
9	To reduce expenses associated with delivering services	32
10	To make sure the library is keeping up with the latest trends in relation to technology development and the new scholarly information landscape	35
11	None - the library should not add other technologies	2
12	Other	1

Mean rank	5.51
Variance	8.46
Standard deviation	2.91
Lower quartile	3.0
Upper quartile	8.0

The other response submitted was that the technology should be added into the library services to allow for collaboration with University of Leeds research expertise in these technologies.

## Communication practices and digital services

The preferred method of communication with the library and its services is via website search (42.4% of respondents) or email (37.3%). A further 13.6% communicate in person, 5.1% by phone, and only one noted that they do not attempt communication with the library at all. An interesting discovery was that, even though many users might have social media of some type, none use the library social media channels for communication.

When users visit the library in person, 38.3% prefer to speak to a librarian directly, 11.7% prefer an autonomous interface and a third could do either human or human-less. One in six do not visit the library in person at all, and only engage with online services.

Where an autonomous digital interface exists, 58.3% would like that interface to include text, images and video content. Another 35% would at least like text with accompanying images. Almost no responders were in favour of a text-only interface.

Many existing library innovation interfaces use a mascot, or a 'face', to help with user engagement. More than half of our users, however, would like nothing at all, just an information portal. The second largest category of users (28.3%) would like a smart, animated character that learns user preferences over time. Only two users would like the library to have such a 'face' in name only, while four support a picture of a mascot only and another four support an animated character. The clear recommendation here is to either have a smart animated character or nothing at all, but in both situations a large group of patrons would have to be convinced to change their perspective on mascots in the library space.

A character that would learn preferences over time is a nod to the aspect of AI technologies that is linked to the concept of personalisation. The library users were therefore asked if they would be willing to have information about their preferences stored on library servers. This information would be used to allow for an AI or smart assistant to learn about user preferences, to tailor services and to make personalised recommendations related to studies and/or research. With an additional clarification that all stored information will be kept confidential and automatically deleted from servers at the end of the user's time at the university, three out of four supported providing their information for such technological innovation. Yet there was slight scepticism about whether an AI or smart assistant could help to create a personalised library connection that would improve in accuracy the more the individual interacts with it and provides it with information. About one in three did not think this would be the case.

The next question on the survey was aimed at finding out users' preferences regarding the type of digital services they would like, particularly whether those services should be personalised or not. Three in four respondents would prefer to have a library service personalised to their needs. However, 21.7% would prefer that the service is not personalised at all, while 3.3% do not plan to use any type of digital interface or service that the library offers, whether it is personalised or not.

In terms of interface, the following options were presented to the respondents:

- information kiosk
- phone app
- AI robot
- virtual reality (VR) simulator
- interactive floor maps
- Information game accessible either online or by phone
- audio guide
- augmented reality (AR).

In terms of 'might use' or 'likely to use', the ones highlighted by the respondents were information kiosk (78%), phone app (76.3%) and interactive floor maps (83.1%). AI robot, VR simulator and augmented reality were just as likely to be used as not. An information game accessible either online or by phone was rejected by 45.7% with an additional 23.7% undecided, and the audio guide option was rejected by 50.8% with an additional 22% undecided.

In terms of their awareness of any advanced technologies already in place at the University of Leeds Libraries, 86.7% said they weren't aware of any, and 13.3% said they were. Some of the examples they knew about were:

- a self-service kiosk to take out books
- book return scanner
- the automated printer
- Ovid MEDLINE search
- access to advanced search eg Google Scholar, which can highlight text resources available at the University of Leeds
- the Falco AI chatbot from IT Services that can answer questions about library opening times, floor-plan, reading lists, library IT systems, etc.

## **Further considerations: skillsets, smart libraries and ethics**

The skillsets users expect of librarians in the future are as varied as the types of technology that could be used in the library space. These skills were described as both vital and integral to the future of librarians. Respondents often said these are the skills that would ensure the next generation of information professionals can keep pace with future developments in technology.

A summary of the recommendations submitted by the survey respondents highlights that the ideal skillset for a librarian in the current technological era involves a mix of traditional library skills and competency in new technologies such as AI, virtual and augmented reality. This includes computer literacy, data analytics, pattern recognition and knowledge of information retrieval and text analytics. Librarians should be able to use AI technologies and be technically fluent, and offer personalised recommendations based on gathered information. The librarians should be able to use data analysis tools and understand automatic search and recommendations, but also have good computer literacy, programming skills and troubleshooting abilities. They should be able to provide personalised recommendations for information sources and be able to help users with new technologies. Additionally, they should have good communication skills and have a passion for customer care. While some specialists in new technology are desirable, most librarians should simply have a working knowledge of new technologies according to their needs, with a focus on helping users learn and navigate these technologies effectively.

The second topic of interest is linked to whether users would like to see the library take steps to reduce its environmental footprint – for example, lowering the building's heating settings for periods when less human traffic is expected. Most respondents (88.3%) supported the library taking green initiatives, while only 11.7% were against, with no other responses recorded. It must be noted that this survey was conducted prior to the current cost of living crisis in the UK, where the library is currently one of the support systems for both students and staff. In terms of how the library could become more environmentally friendly, there was a question asking users to describe if they would like to see the library become a 'smart library'. A 'smart library' was defined as one that adopts smart technologies to reduce energy use, such as motion sensitive lights and heating that turns off or lowers when the building is less busy. The graph on the following page illustrates their responses.

The graph clearly shows that two in three respondents would love the idea, with 86.7% selecting either 'would like' or 'would love' the idea of a smart library.

The final topic in this survey was the considerations and the ethical implications of including such innovative technologies in the library.

**I think it's a  
terrible idea**

3.3% (2)

**I see some positive  
aspects but generally  
dislike the idea of a  
'smart' library**

5.0% (3)

**I would neither  
like nor dislike a  
'smart' library**

5.0% (3)

### **Question >**

Would you like to see the library become a 'smart library' (defined as a library that adopts 'smart' technologies to reduce energy use)?

**I would like the idea  
of a 'smart' library  
but have some  
uncertainty about  
practical applications  
or how it would  
impact me**

20.0% (12)

**I would love the  
idea of a 'smart'  
library**

66.7% (40)



A summary of the recommendations written in by the survey responders is that there are ethical concerns about the use of AI and robots in the library and their potential impact on privacy, confidentiality, research, teaching and accessibility for students and staff. The users are concerned about personalisation of research, data protection and the potential for technology to exclude certain groups of people. Additionally, there are worries about the concept of smart technology and surveillance, and most users want a way to opt out of personalisation and/or data tracking. They believe that information should always be confidential, so they have ethical concerns about AI systems that analyse behaviour and could lead to information abuse. Particularly, the users are wary of the profit models of tech companies and the potential for abuse of recorded information. The users raised comments about the influence of tech companies on the library and the impact of smart technologies on accessibility and personalisation. At the University of Leeds Libraries, data protection and privacy should be a priority and people should be aware of how their information is being used and stored.

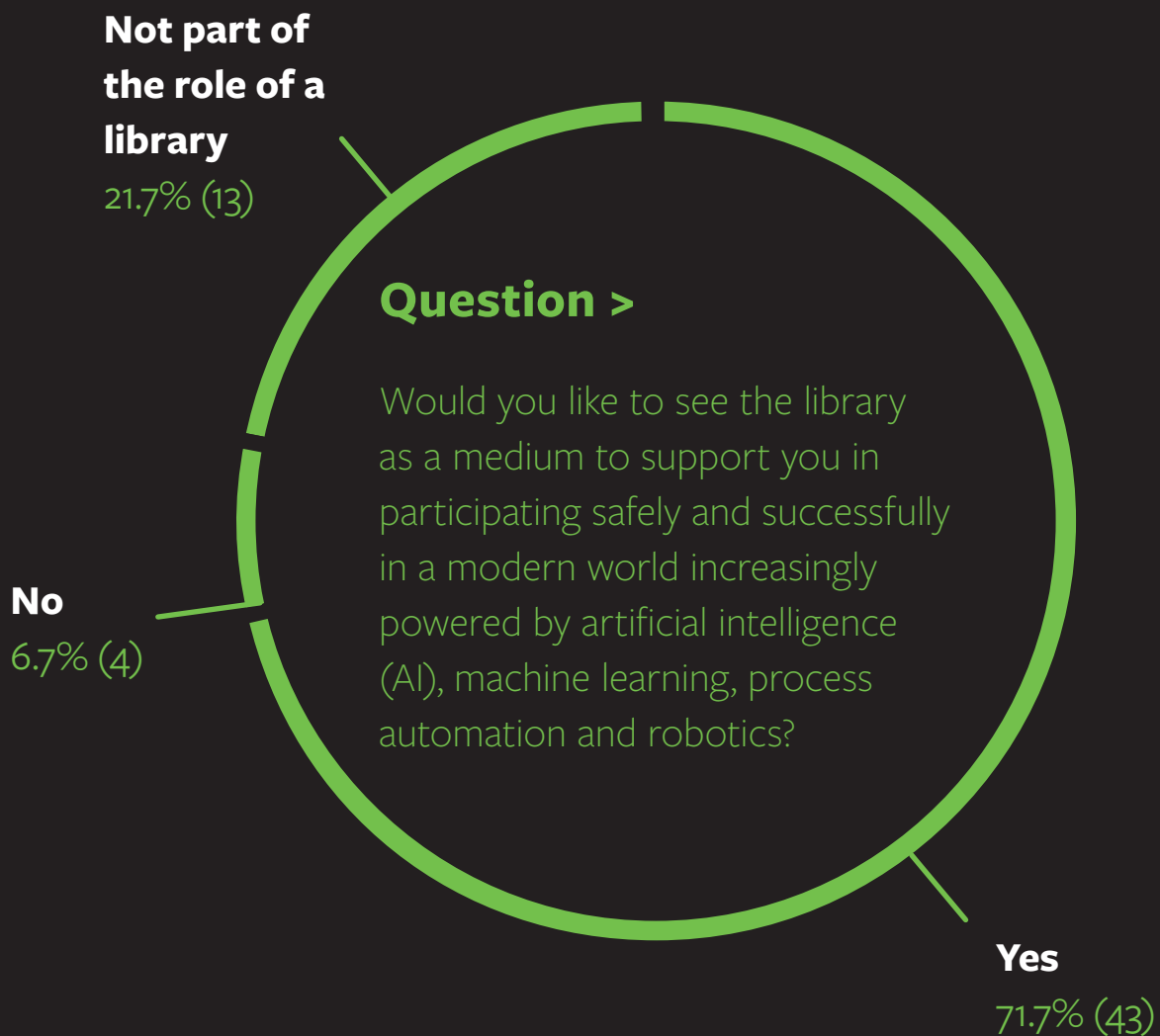
Users also believe that the library should be a safe space for knowledge accessibility and sharing, and that AI technologies should not be used to replace human interactions. In other words, they believe that replacing human staff with AI/robots is not acceptable, but AI should be used to help with workload instead. Many users would prefer not to see AI in the library and are worried that AI-based recommendations could limit access to resources. There were specific concerns raised about the limitations of digital assistance, as related to conflict situations. Users believe that library staff should be trained to handle complaints and be empowered to deliver solutions. After all, the human librarians are seen as the gatekeepers of the interactions between users and technology, and are tasked with ensuring that the technology serves all users.

The final ethical consideration was that the energy used to power new technologies should be sustainable and renewable. Technology is positive only in so far as it does not create a bigger issue, and users who are open to new technologies don't want them to create a substantial additional carbon footprint.

## Concluding question

The last question in the survey asked whether users would like to see the library as a medium to support them in participating safely and successfully in a modern world that is increasingly powered by artificial intelligence (AI), machine learning, process automation and robotics. The following graph serves as their final answer.

The next chapter will provide some more recommendations that arose from the data, both general and specific to the University of Leeds.





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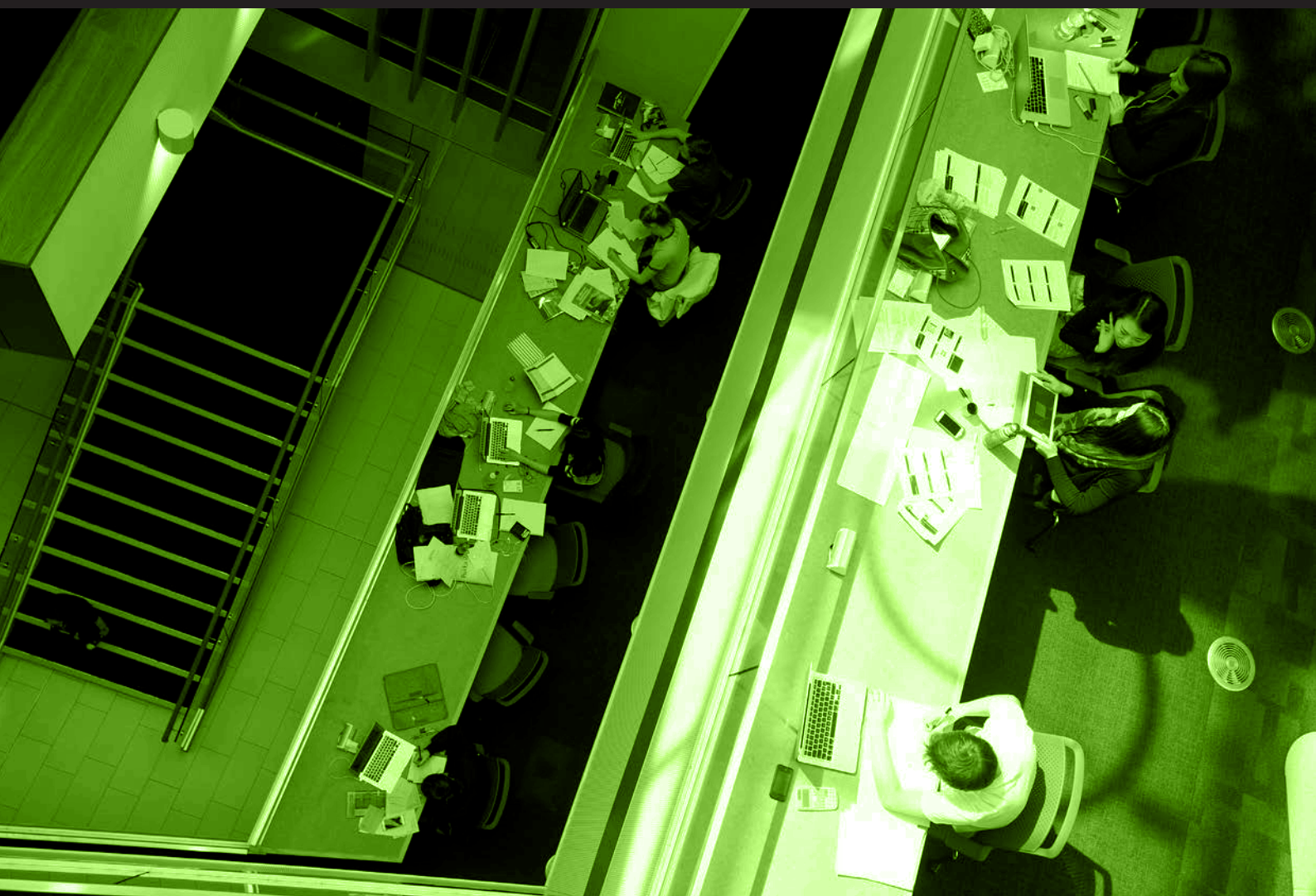
Users believe that the library should be a safe space for knowledge accessibility and sharing, and that AI technologies should not be used to replace human interactions. They believe that replacing human staff with AI/robots is not acceptable. AI should be used to help with workload instead.

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## Looking forward

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This chapter provides more recommendations that emerge from the data. They are specific to the University of Leeds and also have relevance more widely.





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## **General recommendations from literature and from experts' interviews**

**There are many further recommendations or observations that should be recorded in association with AI use in the library space and services. The following are the main highlights from the literature and the interviewed experts. These recommendations are separated into two categories – theoretical considerations and practical approaches.**



## Theoretical considerations

Theoretical recommendations serve primarily for aspirations and future development of the library, library spaces and library services. That is why the first major finding of this research was how little research has been done on what people understand AI to mean. Almost no studies in the comprehensive review asked participants what AI is, or offered them a definition. That is why this report focused a large section on the image of a library and the image of AI, to create a baseline understanding of how individuals and experts perceive libraries and AI. Only by first understanding their perceptions can a study examine their attitudes, behaviours and the value they place on these two concepts.

- Thus, the first recommendation for future studies is to identify what AI is in the library context, before asking for any data.
- The second recommendation is about the technological convergence and synergy between the transformative image of a library and the currently evolving AI technologies. In the text there were two novel theoretical approaches that redefine the library space as either the intelligent library or the library cube. Both theories match the expectations related to AI technologies that are still being developed, evolving, intelligent. Using the technological and spatial convergence makes the library the ideal place for testing out these new technologies. Further, the transformative image of a library is balanced by its stability, its ever-presence. A library is often seen as a national treasure that grows and shrinks to reflect the needs of its users over time. That being said, this 'treasure' is always there for users in some shape or form. That knowledge gives users a sense of security, a quality that makes the library a safe space where one can experiment with new technologies in familiar surroundings. It is therefore recommended to better communicate the changes in interactions between the library image and AI technology image as well as the affordances of the technology within library spaces thereby maintaining the library's image of stability, familiarity, and control. The third recommendation relates to defining libraries in relation to their newfound digital capabilities. On the one hand, a library can be seen as a tool repository, on the other, as a community space for borrowing. The library collects and gives users what they need. Balancing this message in communication with patrons would enable them to partake of everything a library can offer.

- The final theoretical recommendation is about the library's strategies for future progress and development, in terms of how to target development efforts as well as how to evaluate what could be promising AI tools and techniques. There are three subsections to highlight here:
- Create a roadmap: every library should have a long-term strategy about technological implementation, including not only what technology to introduce imminently but also how to update and change to different ones in the future. Technology changes so quickly that often libraries end up using outdated technologies because change comes at a cost – skills, technical, infrastructural or financial – that they cannot afford.
- Incorporate AI literacy: AI literacy is to be included as part of the librarian's skillset as well as a service to offer for users. It is no use having advanced technologies if there is no one capable of operating or using them.
- Library value: focus on the value of a library and promote this value via outreach to users and the library community.



## Practical approaches

Just as technology has already become an irreplaceable part of our lives it is highly likely that the future will see further AI development and use in library spaces and services. This is particularly true in areas where traditional capabilities, skills and repetitive tasks can be replaced by AI innovations. AI has the potential to revolutionise the way libraries operate and provide services. Libraries can leverage AI to automate routine tasks, personalise services and provide enhanced access to information.

There should be an emphasis on individual rather than practical skills. As technology continues to advance, it is essential for librarians to keep up with the latest developments in the field of AI. The responsibilities mentioned in this list are crucial for librarians to perform their duties effectively in the AI era:

- **providing content** means librarians should ensure that their collections are up-to-date and include relevant information on AI and its applications
- **procuring content** for AI involves finding and acquiring sources and resources on AI, its development, and its impact on society
- **data quality control** is an important aspect, as it ensures that the data used in AI systems is accurate, reliable and of high quality
- **obtaining AI tools** is also crucial, as it allows librarians to perform their duties efficiently and effectively
- **data curation** involves organising, preserving and maintaining the data used in AI systems
- **designing data** infrastructure involves creating a system for managing and organising the data used in AI systems
- **explaining how to navigate the infrastructure** involves helping users understand and make use of the data and information available in the system
- **teaching critical data literacy** involves educating users on how to evaluate and make sense of the data and information they encounter
- **designing AI mechanisms** involves creating systems that can help automate tasks and processes, making them more efficient and effective
- **data analysis and designing algorithms** involves analysing data and creating algorithms that can help make predictions and decisions based on the data.

So, librarians in the AI era need to have a strong understanding of technology and its applications, as well as the skills to manage and curate data and information effectively.

Another of the key ways that AI can be used in the library is through the development of personalised services. By analysing user data, AI algorithms can provide personalised recommendations for books, articles and other materials. This can help libraries offer relevant resources to patrons and enhance the overall user experience. For example, libraries can use machine learning algorithms to make recommendations to patrons based on their reading history and preferences. This can help patrons discover new books and resources they may be interested in. Additionally, libraries can use natural language processing to improve the accuracy and speed of reference services, so librarians can answer patrons' questions more quickly and effectively. An example of how to better personalise library services is to intelligently use data from student card-swipe or login to library computers. The data from user login and library browsing history, book reading and/or borrowing as well as journal use, constitute valuable information that could be used to plan acquisitions, funding, resources allocation, library space and use.

**Reference and information services:** Chatbots and other AI-powered tools can be used to provide instant, 24/7 access to information. By answering basic questions and directing users to other resources, chatbots can help libraries handle routine inquiries and free up staff time for more complex tasks. Chatbots, in particular, are a cheap and often useful technology. The most important characteristics of a chatbot are their 'always on' availability, quick and direct responses, and their role as a central source for information gathering. With the arrival of ChatGPT and Bard it seems inevitable that chatbots will enter library spaces and services. Bringing them in early is recommended so that the library can both support users in engaging with them and use chatbots for library support.

- **AI can support re-evaluation of library spaces and use:** AI technologies can be used to optimise space in libraries. By tracking use patterns, AI algorithms can identify which areas of the library are under-used and suggest changes that improve the overall user experience. A specific recommendation is to pay close attention to library furniture and space design, to make sure both are adaptable to major challenges (like a pandemic) and other changing user needs. This includes consideration of the library sections and their design to include a quiet zone, food zone, group vs. private zone, etc. These zones should be clearly marked. AI would be of use to redesign the library spaces by tracking student and staff movements and use of space.
- **Further, AI can aid accessibility:** AI technologies can be used to improve accessibility for patrons with disabilities. For example, AI algorithms can be used to develop alternative formats for print materials, such as audio books and large-print editions.
- **AI can support the 'hybrid library', balancing physical and digital assets:** This would enable the library to have balanced access to resources. This recommendation must be complemented with outreach that clearly communicates with users what library resources they have access to and in what format. Outreach and instruction are just as important as having resources.

- **There should also be consideration of an implementation based on machine intelligence or machine-aided intelligence:** it's important to have a clear, precise definition of AIs in terms of their components such as chatbots or interactive technologies and to focus on the practical applications of the technology for users to engage with it. A specific recommendation was to avoid kiosks or self-service machines; most responders said the novelty wears off quickly and the machines become dust collectors.

Another area where AI can have a significant impact is in the management and organisation of library collections. AI can assist libraries in managing their collections, from acquiring new materials to cataloguing, processing and organising existing collections. AI algorithms can help libraries identify gaps in their collections, suggest new acquisitions based on patron demand and track usage patterns to determine which materials are most in demand. For example, libraries can use image recognition technology to automate the cataloguing process, reducing the time and resources required to keep collections up to date. Additionally, libraries can use AI to monitor the use of their collections and make informed decisions about what to purchase and preserve for the long-term. Behind the scenes, it is particularly valuable to use AI for repetitive tasks to open up time and space for librarians to focus on areas that require a human connection. An example would be to use AI for selecting journal subscriptions based on access statistics. Another recommendation is to link library repositories in consortium-style management systems. This would enable the consortium to, for instance, have two copies of a classical text instead of 26, thus freeing funding and space in the process of re-scaling.

However, it's also important to be mindful of the potential risks associated with using AI in libraries. For example, AI algorithms can perpetuate existing biases and discriminatory practices, particularly if the algorithms are trained on biased data. Additionally, there are concerns about privacy and security, as libraries collect and store sensitive information about their patrons. Libraries must take these risks into account and put appropriate safeguards in place to protect patron privacy and prevent the misuse of AI.

In summary, AI has the potential to significantly enhance the operations and services offered by libraries. By leveraging AI technologies libraries can improve the user experience, streamline their operations and provide relevant resources to their patrons. However, it's important to use AI in a responsible and ethical manner that aligns with the library's mission and values. By carefully considering the potential benefits and risks of AI and implementing appropriate safeguards, libraries can use AI to improve their services and better serve their patrons.



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## Context-specific recommendations for the University of Leeds Libraries

This section uses material from both the interviews and the survey data, and primarily focuses on practical recommendations about what can be implemented in the University of Leeds Libraries, where and how:

- There are several areas that would benefit, reducing both our own staff time spent on manual processes and also researcher time. Often, the problem is that we don't know what we don't know. For example, we could use AI to tidy up a lot of the data-heavy processing. Things like lost lists and requests etc, involve manually looking things up and cross-checking. With AI this could be done in seconds. There are so many opportunities, but we would argue that starting with the small, low-hanging fruit ("like the myriad processes that need waste walking!" [responder's direct comment]) would demonstrate the value. Introducing AI can be a difficult process if it removes work – in a workforce where the culture is strained at best there is a lot of value in engaging small and medium-sized enterprises (SMEs) and working with them to demonstrate the possibilities of working with AI. It is the future, so we need to start understanding how to use it to work smarter. A practical example would be to have our own library chatbot to reduce the need for us to respond manually to basic enquiries.
- There are also recommendations that relate to an upgrade of library services. The new booking system we have discussed, based on Microsoft Dynamics 365, would be a start. Our old system is unreliable and frequently glitches. We desperately need an update or, better yet, something new. Moreover, AI use (particularly) in text mining and in many areas where automation can be achieved would be welcome. These areas would include literature searching, bibliometrics, research visibility, research information systems management and open research.
- Incorporating new technologies and the necessary accompanying skills that allow us to provide a better service. For instance, greater use of APIs to enhance metadata would be useful. There was a proof of concept for use on reading list citations but there isn't the skillset to develop this further or apply it more widely (although it could have broader applications in the library). Another example is to use technology to run our enquiries and webchat services more effectively, by creating up to date FAQs, for example by scanning our enquiries inbox.
- We also need to simplify our decision-making processes, both on the human and the technological side of things. One of the challenges in an academic library is that many stakeholders are involved in decision-making processes, so progress with innovation projects is often very slow. We could use AI to help, for example, within the ExLibris library management system there is a Data Analysis Recommendation Assistant (DARA) that can make recommendations to purchase or cancel journals based on usage. We don't use it at the moment because we still have to consult with schools and faculties, but it would be useful.

- In terms of study practices, there are all sorts of useful applications of AI, for instance with awareness of medicine and health. AI would be really valuable in terms of understanding or engaging with particular healthcare processes and scenarios, the human body, etc. Similarly, with transport, where you could have a virtual vehicle or other research that requires visualisation and/or scenario development. There are holo-like technologies currently used in shipbuilding that would be very useful in the library spaces for teaching and study purposes. There are many research, study, and other applications for AI.
- Another aspect would be the personalisation of services. Extensive metadata could help our library users to have a more phenomenological relationship with knowledge in library spaces, from a sense of moving between texts and artifacts, and there is an aspect of enabling skills for library users. In the University of Leeds Libraries context, our enquiries are mainly face-to-face, which does not tie in with research done with the demographic of our user group. Research tells us that they like to use more digital methods of communication.
- Library spaces is another area where AI could help. For example, Google Maps are well-known, and most patrons know how to use them. We had the idea to link Google-type maps to our campus maps, or even develop a library map (as an app or website) that would help users find what they are looking for more easily. Another aspect of library spaces is to examine the library as a community hub where people can go to use and/or borrow items – from books, computers and headphones for podcasts/music to potentially interactive equipment such as podcast recording booths, recording studios, and places where people can go to relax and take care of their mental health. In this context, AI use expands to enhance many more services the library could or is already offering.
- Another area where AI would be recommended is resource management. At the University of Leeds Libraries we can use AI to understand what resources we have. We have many that are still being evaluated, and AI could help us sort through them and share them.
- Another recommendation relates to getting back services that we have lost over time. We need a return of the specialist library technical support the library used to have, so we can keep pace with developments and make the most of opportunities.

## Where to go from here?

University libraries are facing new challenges in the digital age and must provide access to a vast and growing array of digital resources and technology to meet the needs of students, faculty and researchers. To meet these challenges, they should embrace technology as appropriate for their needs to improve their services. One way to do this is by adopting the latest cloud-based technology, which allows for access to digital resources and services from anywhere, at any time and on any device. This can help libraries better serve their patrons and provide access to the information they need.

Libraries should also consider investing in technologies that enhance the user experience, such as virtual and augmented reality, mobile technologies and gamification. These technologies can provide a more engaging and interactive experience for patrons and help to increase use of library resources.

Moreover, libraries should focus on data analytics to better understand the usage patterns and preferences of their patrons. This data can be used to inform decision-making, such as purchasing decisions and resource allocation, and to improve the overall user experience.

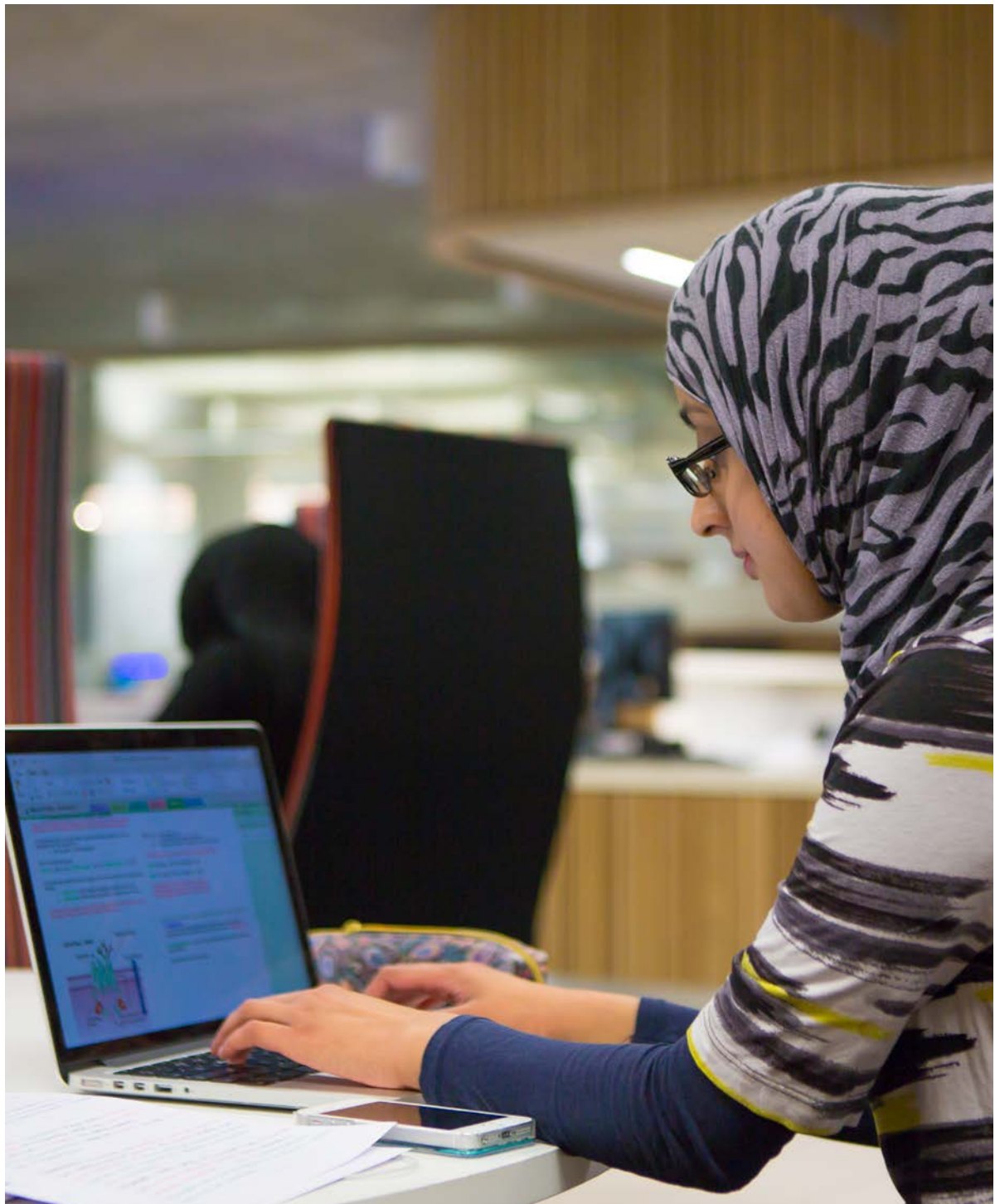
There is a long history underpinning these technologies. AI technology, it can be argued, is not necessarily innovative but it is certainly useful. AI has been around for several decades and has been used in various industries to automate routine tasks and make decision-making processes more efficient. While AI has come a long way in recent years with advances in machine learning and deep learning, it builds on a solid foundation of earlier research and development.

The usefulness of AI lies in its ability to process large amounts of data quickly and accurately, identify patterns and relationships and make predictions based on that analysis. This can help libraries to automate routine tasks, reduce errors and make more informed decisions. AI has also been used to improve customer service by providing fast and accurate responses to inquiries and improving the overall customer experience.

Moreover, long-established AI technologies are often considered to be reliable because they have been developed and tested over time. Their long history means that they have a proven track record of performance and a large user base, which can provide confidence in their reliability. Additionally, because these technologies have been around for a while, there is a wealth of documentation and support available, making it easier for libraries to adopt and integrate even previously unused technologies into their existing systems. However, it's important to note that having a long history doesn't automatically make a technology reliable. The technology must still be maintained and updated over time to ensure that it remains relevant and effective. It's also important to carefully evaluate the technology to ensure that it meets the specific needs of the library and its users. Therefore, libraries should only consider introducing those technologies that are linked to their specific needs, evaluate the technology and its track record, and seek expert advice when making technology decisions.



In conclusion, while AI technology may not be seen as innovative in the sense of being completely new or ground-breaking, its usefulness lies in its ability to automate routine tasks, reduce errors, improve decision-making and analyse vast amounts of data. By leveraging the power of AI, libraries can improve their efficiency, competitiveness and overall performance. Thus, universities should consider these technology recommendations to improve their library services and better meet the needs of their patrons in the digital age. By embracing technology and making strategic investments, libraries can provide access to the information and resources that patrons need, enhance the user experience and serve their communities better.





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## Annexes

### **ANNEX A - Expert list of interviews**

All experts on this list have prior publications on the topic of this report and are seen as an authority in the research field.

#### **Andrew Cox**

Andrew Cox is currently a senior lecturer at the University of Sheffield. After graduating from Aberystwyth with an MSc in Library Studies, he spent a number of years working in development projects around the use of ICT in library contexts, funded by EC, Jisc and others. He completed his PhD at Loughborough in 2006. His main research area has been the response of information professions to contemporary societal challenges such as new technologies, increasing managerialism, data-fication, changing conceptualisations of learning and a perceived crisis of well-being. Building on work over a decade on the role of information professionals in data stewardship, in the last two years he has developed a particular focus on artificial intelligence. In addition, he has an interest in communities of practice as a theoretical construct and increasingly the application of practice theory (Schatzki, Nicolini) to information science, to theorise how people seek and create information and unravelling the complex process of technology adoption and use.

#### **Andy McGregor**

Andy McGregor is the Director of edtech, Jisc. He is responsible for managing Jisc's portfolio of research and development projects. These projects are aiming to develop new services that help universities and colleges improve education and research. In addition, he is responsible for Jisc's work with edtech startups which is designed to help startups and universities and colleges work together to develop innovative new education and research products.

#### **Brady D. Lund**

Brady Lund is a doctoral candidate at Emporia State University's School of Library and Information Management, where he also earned a master's degree in library science. He is author of over two dozen articles published in well-known library and information science journals as well as two books. His work generally encompasses information technology, information behaviour, and statistical methods applied to library and information topics.

#### **Daniel Agbaji**

Daniel Agbaji is a software developer associate at Flint Hills Resources. He is an experienced researcher, data scientist/software developer, instructional designer, information scientist with many years of teaching and training learners in different professions. His work experience spans from the education sector to business - both public and private. As an experienced researcher, he has a good number of publications in his field of expertise.

**David J. Evans**

David J. Evans is dean and assistant VP for library services at Kennesaw State University. He has an M.L.S. degree and a Ph.D. His research interests are Big Data, artificial intelligence, the future of academic libraries, and personal empowerment. Evans is celebrating 40 years of being a librarian.

**Jean-Philippe Moreux**

Jean-Philippe Moreux is the Gallica scientific advisor at the BnF (Bibliothèque Nationale de France). He works on all the BnF heritage digitisation, digital mediation and digital humanities programmes. He participates in national and international research projects on these topics. Prior to that, he was an IT R&D Engineer and project manager, and worked as a science editor and a consultant in the publishing industry. He's also a former member of the METS and ALTO boards and the CENL AI in Libraries Network Group chairman.

**Neil Fitzgerald**

Neil Fitzgerald is the Head of Digital Research of the British Library. He leads the Digital Research Team that works across the organisation to ensure the Library's collections, systems, policies, and processes meet the emerging needs of those who want to deeply integrate digital content, data, and methods, into their work. He is a digital cultural heritage professional with extensive practical and management experience across the international cultural heritage and higher education sectors. A member of a number of advisory boards in the fields of digital humanities and digital cultural heritage. He has also been accountable for the successful delivery of a number of major digital initiatives in the UK and internationally. Before joining the Library, he worked in the commercial sector.

**Sandy Hervieux**

Sandy Hervieux is the Head Librarian, at Nahum Gelber Law Library, McGill University. She is responsible for working closely with administration, faculty, and students at the Faculty of Law to support all aspects of learning, teaching, and research. She holds a Bachelor of Arts (German Studies) as well as a Master of Library and Information Sciences from McGill University. Her main areas of interest include aspects related to Virtual Reference, Artificial Intelligence in academic libraries, Digital Humanities, and Information Literacy.

**Solomon Tijani**

Solomon Tijani is assistant researcher at the Nigeria Institute of Social and Economic Research. He is one of the authors of "Perceptions toward Artificial Intelligence among Academic Library Employees and Alignment with the Diffusion of Innovations' Adopter Categories".

**Stephen Pinfield**

Stephen Pinfield is a Professor of Information Services Management at the University of Sheffield. He joined the School in 2012, having previously worked as a senior information practitioner in the UK Higher Education sector. Latterly, he was Chief Information Officer at the University of Nottingham with responsibility for a large converged IT and library service supporting Nottingham's campuses in the UK, China and Malaysia. He has experience of leading a wide range of research-and-development projects and participating in national policy initiatives, and bring this experience to bear on his research and teaching. His main research and teaching interests focus on scholarly communication, research data management, open access and open science, digital scholarship, research policy, and managing information and technology services in organisations. He is currently the Associate Director of the Research on Research Institute (RoRI), an international collaboration carrying out translational research on the research system. He is also School Director of Learning and Teaching.

**Anonymous**

Library Director from a university in Hungary

**Anonymous**

Associate Professor and Library Director from a university in Hungary

**Anonymous**

Librarian, who holds a PhD in AI in Library Spaces from a University in Nigeria

**ANNEX B - University of Leeds Libraries staff**

Anonymous: Research and Digital Futures

Anonymous: Content Acquisition and Discovery

Anonymous: Learning Development

Anonymous: Research Support

Anonymous: Customer Services

Anonymous: Digital Advice





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