



Artificial Intelligence in the Library: Advantages, Challenges and Tradition

An Ex Libris Whitepaper

Executive Summary

Whether we call the new library "the hybrid library" or "library-as-a-platform", one thing becomes clear: at the heart of every key role the new library is going to adopt, are the technologies that will be integrated into its services and management systems. In their efforts to provide valuable experiences to their new patrons in today's hyper-connected digital world, libraries will find that artificial intelligence (AI) can play a critical role in updating and expanding their value proposition.

This whitepaper explores the ways in which advanced technologies, and artificial intelligence in particular, can help academic and research libraries reach their potential in the digital age. It is a measured call for taking leadership in the new information marketplace, with a confident leap into the world of AI.



Table of contents

Introduction 3

The Information Landscape is Changing, Disrupting Libraries' Traditional Roles 4

New Horizons for Libraries 6

The Librarian's Angle 7

Artificial Intelligence: A Cross-Industry Game Changer 9

Challenges of Integrating AI into the World of Libraries 10

Harnessing AI's Unique Practical Benefits to Overcome Libraries' Biggest
Challenges in the New Information Landscape 14

Conclusion 16



Introduction

The future of academic and research libraries in the digital age has been a well-discussed topic in recent research over the last few years. And rightly so; libraries are trying to find their footing in a new marketplace where unlimited information is available at the click-of-a-mouse, learning and teaching techniques are dramatically changing, and a new generation of patrons is increasingly unaware of the library's many benefits.

It is on these unfamiliar grounds that libraries find themselves in search of both a new competitive advantage and a way to provide better service to their patrons. They need to not only prove their unparalleled value and expertise, but identify opportunities to attract and engage

new patrons with high digital fluency through advanced services and user experiences.

In this hyper-connected era, the most effective way to achieve those new goals is by implementing advanced technologies within daily librarianship operations.

This whitepaper discusses the challenges disrupting the library's traditional activities and suggests its potential emerging roles. Just as new advancements, especially artificial intelligence, are transforming other industries, there are practical ways in which such technologies can enable libraries to flourish in the digital age, overcoming internal reservations and adoption difficulties.



The Information Landscape is Changing, Disrupting Libraries' Traditional Roles

The rapid development of advanced technologies in recent decades is affecting industries in ways we are just now beginning to witness. These innovative technologies are not only changing our everyday experiences, but they are also impacting global-scale processes and trends for entire sectors around the world. Traditional roles are changing, with new skill requirements, new opportunities, and new challenges. In the world of academic and research libraries (ARL), this transformation is impacting librarians, library services, and the very role of the library as we know it.

From the digitalization of information to the Internet of Things (IoT), Big Data analysis and intelligent machine learning, technological trends like these are reshaping the way we consume, access and distribute information, as well as our ability to process it, derive meaning out of it and, ultimately, make decisions based on it. In the eye of this storm of changes in habits and experiences stands the library, the traditional provider of high-quality collections of information. And the burning question is: **How will libraries continue to meet the increasing demands of today's digital information age?**

The best way to begin answering that vital question is by mapping out the main challenges faced by libraries all over the world today.

- **Financial uncertainty**

When government funds are shrinking and political or economic changes are underway, cultural institutions are often the first to suffer cuts. Following the latest recession in 2008 (from which [50% of chief academic officers](#) in 2016 believed their institutions had not yet recovered), and since the beginning of the current US administration, libraries are increasingly experiencing financial instability as a [top concern](#).

In many ways, the struggle for institutional or government funding is much like the chicken and egg problem. Libraries are expected to show value for money and demonstrate cost-effective practices, but they can't do that without integrating new technologies to upgrade their physical spaces, offer new services, and improve the user experience for today's patrons – all of which requires additional funding. Thus, today's libraries often find themselves in a financial limbo - unable to show value without additional funding.

- **Attracting new and more diverse audiences**

For libraries to appeal to their existing audiences and engage new ones, they need to offer services that meet the expectations of the new generation of hyper-connected patrons. This includes rethinking the library's traditional physical space, moving from a quiet place filled with bookshelves for reflective reading and writing to something entirely different. For the library to remain relevant, it needs to become a vibrant space for collaboration and innovative activities, alongside a quiet space for reflective studying. The new approach should view patrons as creators, and the library as a [creation hub](#), offering makerspaces with visionary resources such as 3D printing, virtual reality, gamification, flexible displays, media production tools, natural user interfaces, and more.

- **Providing a faster, better user experience**

Another integral part of remaining relevant to existing and new audiences depends heavily on providing faster learning experiences that develop the real-world skills and hands-on studying that students require today.

A recent [Digital Study Trends Survey](#) conducted by McGraw-Hill Education shows 53% of students prefer digital learning technologies, with 94% saying digital learning technology helps them retain new concepts. This, combined with what we know about people's reading habits (according to a [PEW research](#), 42% of e-readers read on their computers, 29% on their cell phones, and [one in every five Americans](#) now listens to audiobooks), makes it clear today that changing learning and reading habits have gradually led younger generations to expect from libraries the same fast, interactive and intuitive experience they get in other daily online experiences.

- **Emerging skill gaps**

The digitalization of information has impacted both library operations and systems. Today, the digital realm is just as important as the physical one, if not more so, making it essential for libraries to develop new skills not only to stay competent, but to better serve patrons in the digital age. These services require new competencies, such as: higher levels of digital fluency, the ability to provide the most relevant resources at a much faster pace, and supporting hands-on creative activities to maximize a patron's learning experiences.

- **Competing with today's alternative sources of information**

[According to a 2017 Horizon report](#), a survey found that 68% of college students start their research with Google and Wikipedia. These free providers of information, along with the emerging [open access trend](#) in scholarly publication methods, are daring libraries to rethink their distribution of high-quality information in to the context of maintaining a vital presence in the new information landscape.

- **Difficulty to show ROI**

Without standard key success factors, performance indicators or metrics to show value, libraries cannot prove themselves worthy of funding. Despite the perception that a 'businesslike' approach is the '[McDonaldisation](#)' of academic libraries, forcing library services to be dominated by managerialism (as was proposed by [Karen P. Nicholson](#) in 2015), it seems that, in this age, it is vital for libraries to demonstrate operational efficacy and to prove ROI using effective management tracking and analytics tools.

- **Re-defining the value proposition in today's information marketplace**

With only 2% of the [Ithaka S+R survey](#) respondents reporting that they use library staff or services for scholarly pursuits, and 40% of faculty staff saying their students rarely interact with campus librarians at all, it seems current generations view themselves as more and more [self-sufficient](#) in their information-gathering skills. In a reality in which Google and various scholarly online resources are free, libraries struggle to convey what distinguishes them in terms of unique expertise and benefits to their patrons.

Those challenges, faced by libraries all over the world today, pose a tangible risk to the traditional role of libraries as we know it. Libraries are now struggling with operational inefficiency, technological disadvantage, difficulty in maintaining current audiences and engaging new ones, and an inability to demonstrate value and benefits to all stakeholders.

Nonetheless, library professionals seem to be quite positive regarding the future of libraries:

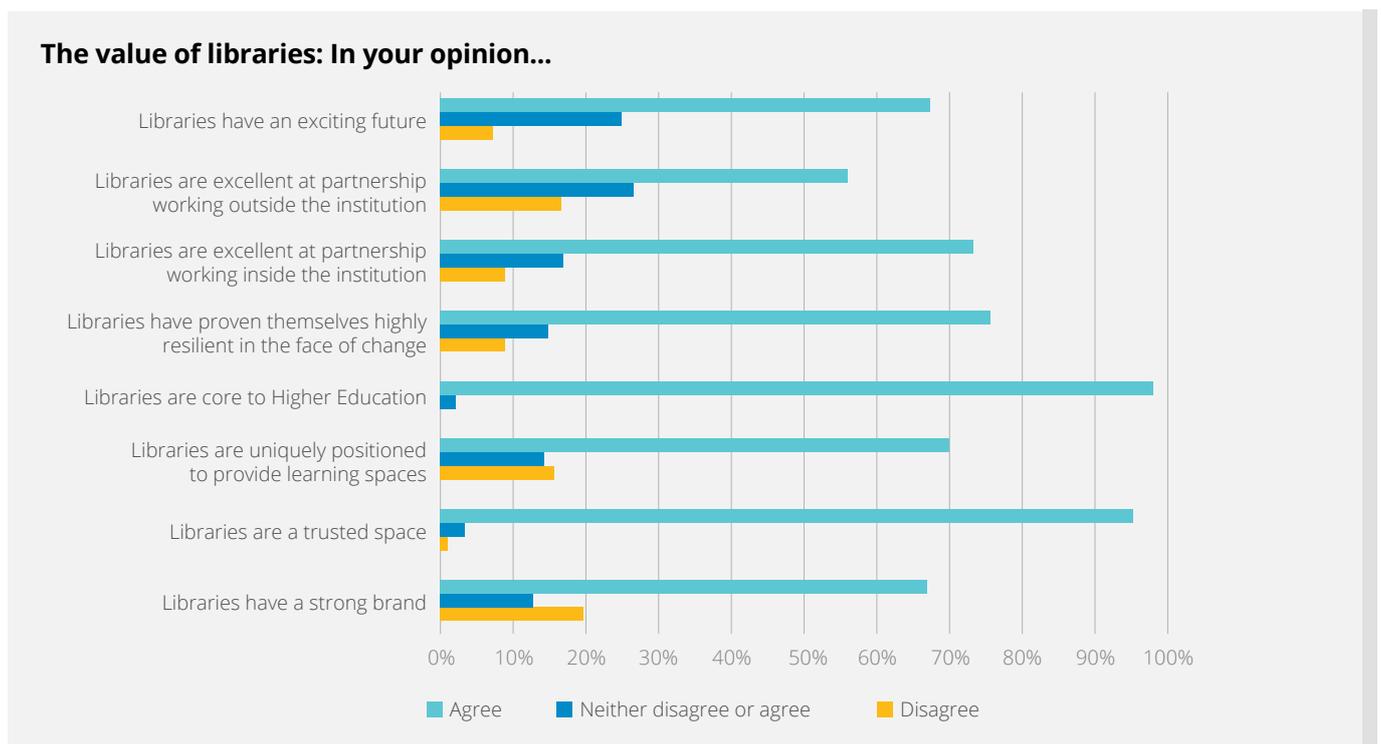


Figure 1: Taken from a 2017 SCONUL report: "Mapping the Future of Academic Libraries"

Perhaps library professionals have a good reason to be positive

The challenges faced by libraries today present opportunities to take on new roles. By revamping their traditional models of providing high-quality collection, reference, and instruction, libraries today have a chance to introduce new services under a novel role in the hyper-connected, digital information landscape.

The question is: What new roles should the modern library adopt?



New Horizons for Libraries

A Novel Role in Today's Information Marketplace

The intense pressure to provide high-quality research, while showing value for money and attempting to attract new audiences forces libraries to rethink their traditional business models, data analytics methods, managerial practices, and services. Today, the role of libraries as managers and providers of unique information collections is being quickly replaced by more meaningful roles in the new information marketplace.

- **Navigating the information landscape**

The abundant resources of information and the ease and availability of data online is both a gospel for the democratization of data, as well as a threat to truthful, reliable, quality information. Though most students and researchers consider themselves [self-sufficient](#) in searching for information without expert research guidance, search results often lack relevancy or quality requirements.

This is where librarians can take the leading role in helping patrons navigate the overwhelming information available online, providing them with guidance to find relevant content in a world of data overload.

- **Promoting digital inclusion by expanding equal access to quality information**

In promoting equality in access to information, academic, research and public libraries have always played a vital role in making information accessible in communities around the world. Today, libraries can take this role even further, offering [digital access](#) to those who need it the most, while ensuring their patrons' data privacy and improving their digital literacy.

- **Safeguarding neutrality, freedom of expression, critical thought, and trust in a world of "fake news" and information bias**

Perhaps more than ever, today's conception of truth, facts, and neutrality is being challenged by numerous forces. In the face of the eroding value placed on factual information, libraries can take yet another leading role in advocating, educating, and training for the critical consumption of data.

- **Supporting and advancing creative learning, cross-disciplinary research, and collaboration**

Today, when the passive absorption of data is replaced by interactive and creative learning, libraries can play a critical role in teaching and research both in physical makerspaces and in the digital realm. With the help of new technologies, libraries can become allies with research institutions, helping them reach student success benchmarks and maximize learning experiences.

As active learning organizations, libraries could also leverage open access publishing, making it a library-based service. They could also use it to spark cross-disciplinary collaboration and a free exchange of research and knowledge.

Those roles offer an inspiring future for libraries. Yet, today they often find themselves struggling to keep up with their traditional daily tasks, with limited budgets and increasing patron expectations.

In this reality, the question arises: How can librarians provide new services and acquire new competencies, while they are still struggling to keep up with their current tasks?



The Librarian's Angle

Adopting New Technologies

If librarians are to accomplish higher-value tasks, libraries first need to find a way to support and empower library staff in their daily operations through useful, practical technologies.

According to a 2017 SCONUL report, when [asked](#), library managers are well aware of the necessity of offering new services. In fact, most show confidence in the adoption of advanced technologies such as 3D printing, gamification, voice recognition, artificial intelligence, and more, as shown in a recent survey:

	Already adopted	Will be adopted	Will be partially adopted	Will not be adopted	Total
Artificial intelligence / Machine learning	10.88% 16	35.37% 52	35.37% 52	18.37% 27	147
Voice recognition	4.79% 7	38.36% 56	34.93% 51	21.92% 32	146
Augmented reality	14.08% 20	30.28% 43	35.92% 51	19.72% 28	142
Virtual reality	20.27% 30	25.00% 37	34.46% 51	20.27% 30	148
3D printing	51.95% 80	25.97% 40	10.39% 16	11.69% 18	154
Fulfillment automation via kiosks / robots	40.79% 62	26.97% 41	19.74% 30	12.50% 19	152
Gamification / Living labs / Technologies that may improve teaching & learning	34.00% 51	37.33% 56	20.67% 31	8.00% 12	150
Other advanced technologies	7.84% 4	25.49% 13	17.65% 9	49.02% 25	51

Figure 2: Taken from the "2018 Ex Libris Future Library" survey

It is also clear from the same survey, that librarians are aware of the benefits advanced technologies could provide the library:

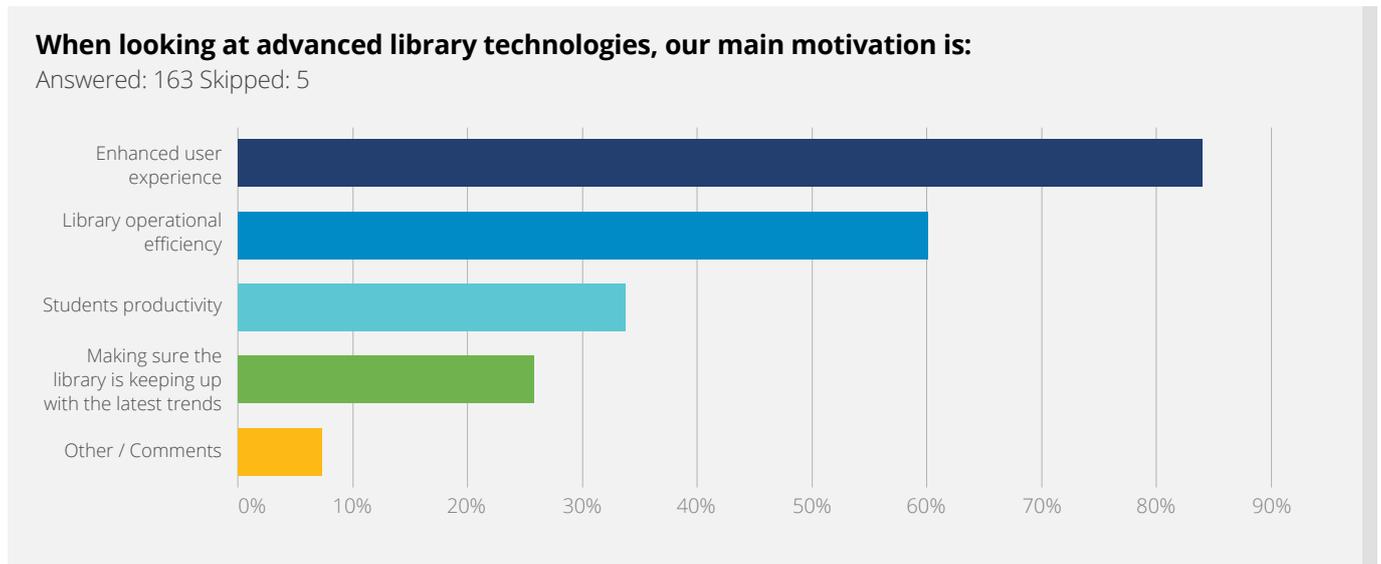


Figure 3: Taken from the "2018 Ex Libris Future Library" survey

These statistics indicate that there is a growing readiness among librarians and library managers to adopt advanced technologies, in order to stay relevant and provide the patrons of the digital age the services they require.

Further [research](#) shows that various technologies have proven to be of great potential value in helping libraries meet their new objectives:

- **Big Data analysis** can be used to analyze in-house library data from online resources, along with digital services and social media, to identify strategic services, personalized to every patron's needs.
- **IoT technology** can be used to facilitate smart library infrastructure to maintain makerspaces and other library equipment.

- **Gamification labs, augmented reality, and virtual reality technologies** can provide real-world learning experiences to students.
- **Advanced unified library management systems and discovery services** can provide access to all patrons across multiple devices.
- **Optimized search technologies** can produce more accurate subject-specific results and citations.

All of those technologies, and many others, enable new services in the future library. However, there is one technology that stands out in its immediate, practical, and proven ability to provide real, instant value to both end-users and library operators – today.

This technology is called Artificial Intelligence (AI).



Artificial Intelligence: A Cross-Industry Game Changer

AI has entered almost every sector, bringing with it new competitive advantages. It is said to be as transformative as [electricity](#) once was in our daily lives. And though still in its infancy, it is already applicable in so many ways.

What is Machine Learning and Artificial Intelligence?

In order to understand why artificial intelligence has the capability to transform so many of our practical routines and tasks, we first need to understand the way it works. This does not necessarily mean examining the technical mechanism that drives it, but the underlying concept making it so powerful and effective in performing human tasks.

[Catherine Nicole Coleman](#) put it well: "The power (of AI) lies in the fact that machines can recognize patterns efficiently and routinely, at a scale and speed that humans cannot approach."

Machine learning, in the most basic sense, is when machines create their own classifications by learning from examples, dramatically accelerating statistical pattern recognition. In other words, AI technologies and applications are all based on machine learning algorithms.

Once a futuristic vision, AI today is used as a "mere" enabler for specific applications to solve real problems across industries, such as:

Finance

From tracking spending patterns and customer behavior to offering tailored financial advice, from using neural networks to identify fraudulent activity to analyzing a large number of disparate datasets for accurate risk assessment – AI helps financial institutions and investors make smarter decisions on a daily basis.

Healthcare

AI is used to design the best treatment plans, and to recommend personalized medications and care based on patient data. The more personal data the AI algorithms are fed, the better they identify potential anomalies earlier on, enabling early diagnosis and real-time case study [prioritization](#).

Cybersecurity

AI detects vulnerabilities and [anomalies](#) in user and data behaviors, allowing companies to detect any suspicious activity in real-time. Using machine learning, many cyber threats are identified even before they occur, more effectively protecting people and data from cyber-attacks and data breaches.

Marketing

From content curation to email marketing automation, brands are using AI to personalize their campaigns based on preferences and user [behaviors](#). Furthermore, by leveraging Natural Language Processing (NLP) and machine vision, brands can analyze and act upon content generated by the customer.

Everyday use

From a voice recognition application that takes telephone orders at [Domino's Pizza](#), to smart home virtual assistants such as Amazon's [Alexa](#) or [Google home](#), to smart thermostats learning your energy routines, and location-based services that predict traffic and recommend optimal routes and destinations based on historical data – artificial intelligence is already making our daily tasks easier and playing a growing role in our everyday lives.

As is clearly shown by a [2018 Deloitte report on "Artificial Intelligence Innovation"](#), artificial intelligence has already begun transforming industries across the globe, including property management, manufacturing, interior design, law enforcement, construction, and even the [environment](#).

Libraries can seize this opportunity to leverage the available practical benefits of artificial intelligence for their own objectives: optimizing workflows, maximizing operational performance, and developing new services.

The only question is: Are libraries ready to embrace AI technology?

Challenges of Integrating AI into the World of Libraries

There seems to be an inherent dichotomy in attitudes to adopting AI applications in libraries today. On the one hand, research and surveys (see chapter three herein) show librarians and library managers are keen on adopting advanced technologies in their libraries. Yet, on the other

hand, it seems so few of them see artificial intelligence becoming a significant part of their library systems now or in the near future. A recently conducted survey showed that only a small percentage of librarians run AI-related operations in their libraries today:

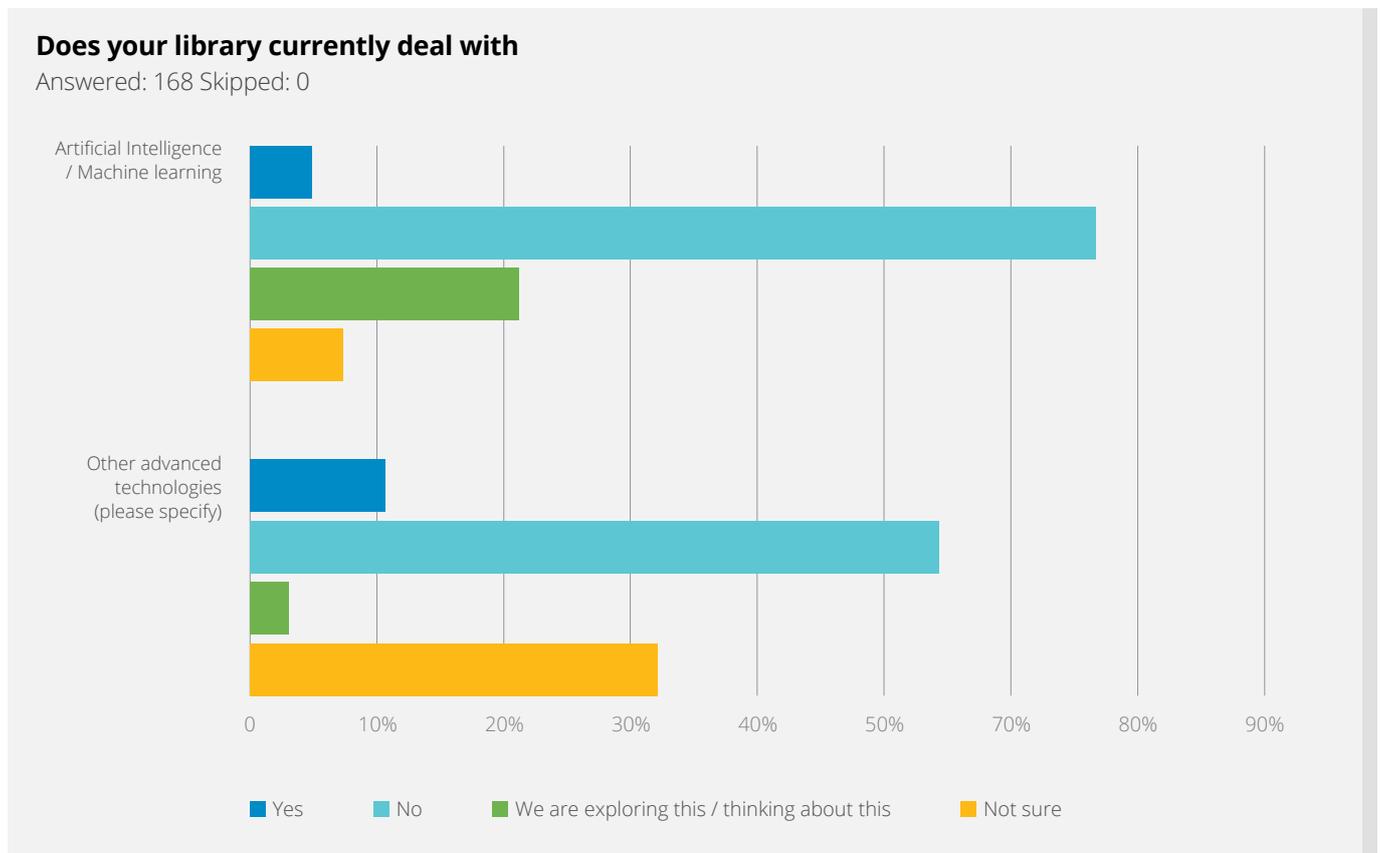


Figure 4: Taken from the "2018 Ex Libris Future Library" survey



According to the statistics shown in figure 5, most librarians see AI as one of the last technologies to be integrated into their libraries:

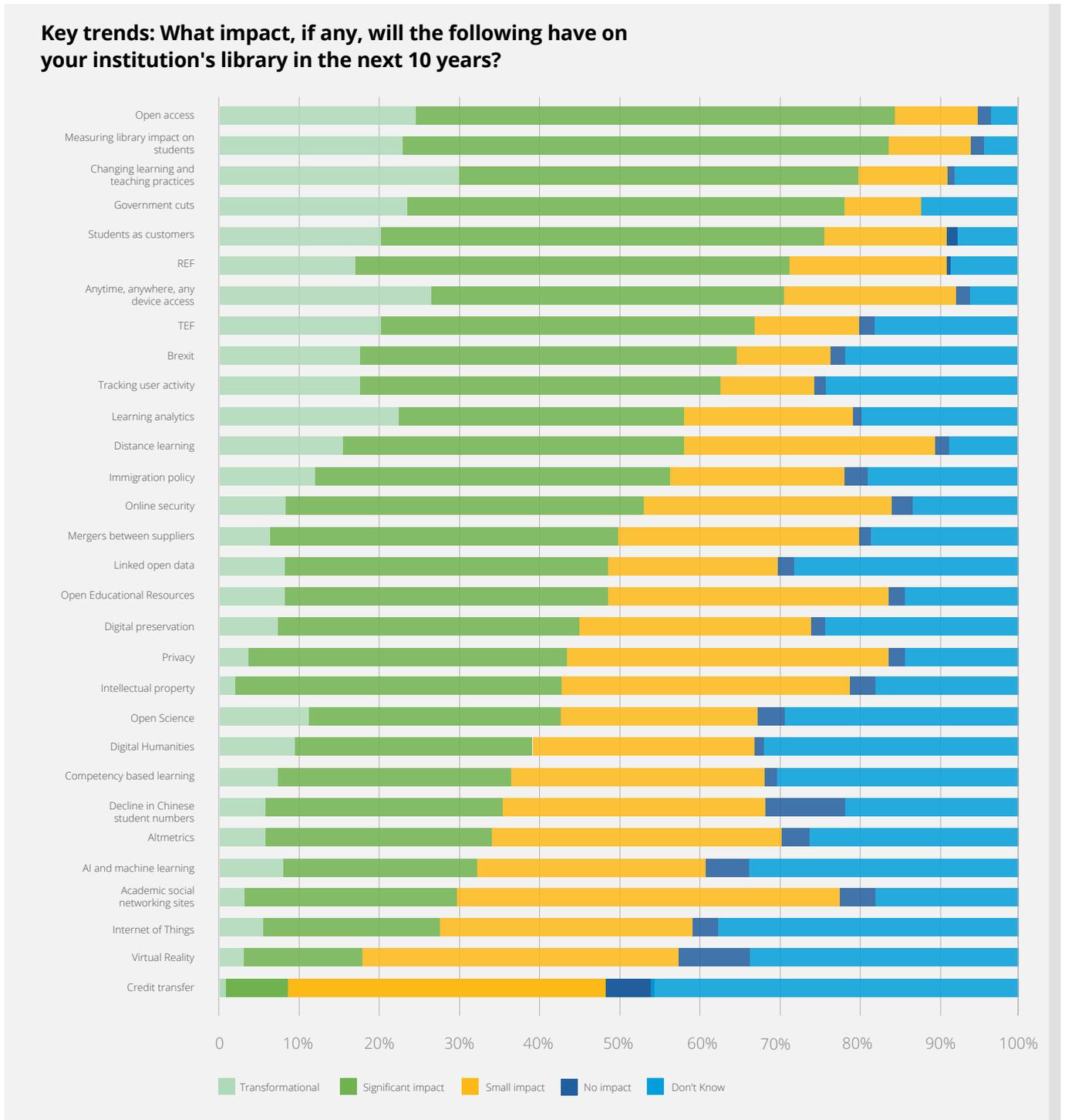


Figure 5: Taken from the [SCONUL 2017 report](#) on "Mapping the Future of Academic Libraries"



In other words, it seems that, despite the growing awareness among librarians and library managers for the need to integrate new technologies, there are still some internal reservations preventing AI technology from penetrating into the information management sector. Uncovering the source of this resistance might lead to a better understanding of the challenges in implementing AI in libraries, as well as the ways to overcome them.

Why is AI still not widely integrated into libraries?

Inability to get executive buy-in and funds

In a single sentence, how do you envision your library 10 years from now?

"With current management, exactly the same as it is now but with different wallpaper."

This quote from one of the respondents in the abovementioned 2018 Ex Libris survey echoes the voices of many others in the industry, struggling to get their management to integrate AI in their libraries, with the toughest hurdle being ROI. The lack of sufficient knowledge and [awareness](#) regarding the practical benefits and dramatic cost-savings AI can bring to the library makes it difficult for librarians to demonstrate the value of implementing this technology into library systems. Therefore, it's no wonder budget still ranks as the top challenge in adopting new technologies in libraries today:

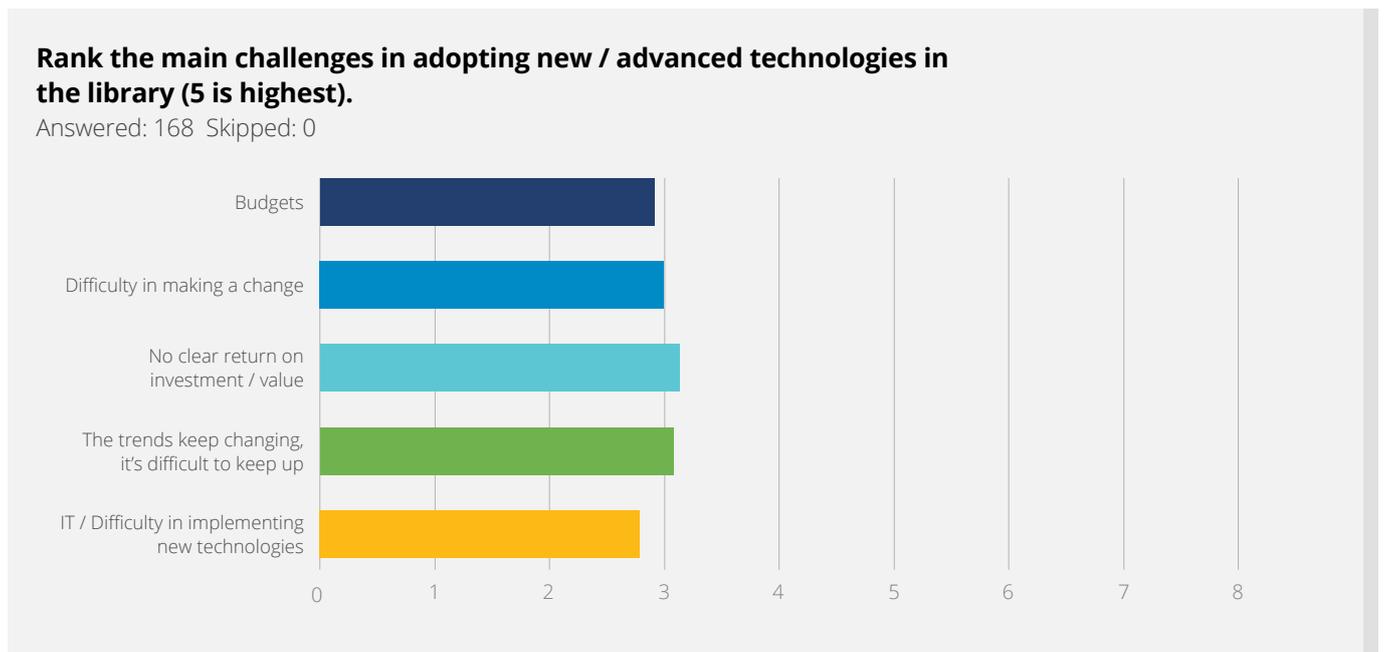


Figure 6: Taken from the "2018 Ex Libris Future Library" survey



Resistance to change in workflow processes and adoption of new technologies

Budget isn't the only thing stopping libraries from adopting AI, along with other technologies. According to the [2017 SCONUL report](#), library staff often shows resistance to change and even a sort of defensiveness in their approach to technological change.

Steep learning curves among library staff

As [shown](#) in a recent study at Ithaka S+R, libraries are demonstrating motivation for adopting new flexible workflows and technologies; yet, the learning curves are still steep among staff. Skill gaps in digital fluency are proving to be a hindrance in adopting AI technologies (and others).

Fear of AI's possible risks

Along with all of the above, libraries seem to show internal resistance to adopting AI technology in particular, due to a few significant concerns about the potentially damaging effects of this disruptive technology on libraries. **Some of the major concerns raised by librarians are:**

1. [AI \(or rather, robots\) will replace human librarians](#). With an alarming figure of [38% of jobs](#) at high risk of being replaced by AI in the next 15 years, librarians' fear of losing their jobs to AI robots can be well understood.
2. Human creativity and empathy would no longer be necessary due to the efficiency of AI, creating a world in which the library's connection to its community and valuable human characteristics are [devalued and rare](#).
3. AI would magnify injustices such as inequality, bias, and discrimination, and help propagate misinformation. There is already a [lack of basic neutrality](#) in search engine algorithms and other examples show how AI can be so easily turned into a racist tool (as occurred with Microsoft's [Tay](#) after just 24 hours on Twitter). It can also be manipulated for promoting [bias](#) and fake information, or used for [political purposes](#).
4. AI might jeopardize [data privacy](#), a traditionally important value to libraries, even more so in today's digital age.

Despite these challenges, libraries can still benefit from the unique attributes of AI. In the words of one library manager ([2017 SCONUL report](#)):

"How do you get mindsets opened up so that we are not defensive about our own traditional practice, but are proactive and open? I think we should be defensive of the values that we aspire to in terms of access to information and sharing of that information, but the way that we do it, I think can be very different, and we really need to be open to that. Open up to the fact that the professional practices we have learned over the years may not be the right ones for the future."



Harnessing AI's Unique Practical Benefits to Overcome Libraries' Biggest Challenges in the New Information Landscape

Leveraging machine learning for library applications can help libraries maintain a new innovative relevance, take up new roles and services, and prevent them from becoming obsolete. But tackling the adoption difficulties of AI is a necessary step in the library's transition.

The best way to overcome reticence regarding AI might be to shift perception. Rather than viewing AI as a destructive force coming to replace librarians, familiar workflows and traditional values, library staff and management could benefit from the way AI is viewed in other industries – as an enabler to solve real-world problems.

How can AI be used to solve real problems for libraries?

Here are a few ways in which AI applications can bring immediate, measurable value to libraries:

- **Improve operational efficiency**

Libraries can identify and magnify operational efficiency by improving service effectiveness and reducing operational costs with process automation, optimized research data management, and digital asset management (DAM). Implementing machine learning in the library's processes and digital resources can optimize collection analysis, visualization, and preservation, and reduce expenses associated with delivering services. Adopting advanced library services platforms (LSP) can help develop initiatives that further improve operational efficiency.

- **Engage larger audiences through better user experience and new services**

By optimizing search engine results with chatbots and location-based services, machine learning algorithms can tailor content instantly from thousands of resources, replacing the manual sifting of just a fraction of that data. AI systems can also leverage data on user touchpoints, past interactions and habits to identify needs and develop high-quality, engaging experiences for patrons. This includes producing personalized, precise research recommendations and even aligning search results with the individual student's knowledge level for more effective learning.

- **Help librarians achieve their new goals**

By cutting manual daily routine search and reference operations down to a minimum, AI implementation can reduce human errors and inefficiencies. This automation also frees library staff to focus on higher-value complex tasks, such as assisting lecturers in formulating reading lists, teaching students how to refine their research efforts, developing library collections, and the like.

- **Establish a strong foothold for libraries in the new scholarly information landscape**

AI technology can enable cross-disciplinary alignment within academic research by helping to locate connections to large data sets otherwise [overlooked](#). Additionally, by joining hands with open publication organizations, along with implementing research systems that operate with other institutions, libraries can help create a seamless exchange of data and research across sectors and disciplines. Their collections become more discoverable, searchable, and analyzable, ultimately supporting a rich, high-quality global network of resources.



Overcoming barriers to enter the library world

The unique and practical benefits that make AI so effective in other industries can help overcome the reservations and concerns raised by librarians in adopting AI in libraries. For example:

Showing measurable ROI to make AI a selling point for executive buy-in

By integrating analytics and feedback loops into services and operations, library management can gain real-time visibility into patron engagement rates, retention, and satisfaction. Furthermore, by quantifying outputs, libraries can demonstrate value like never before.

Adoption much quicker and easier than legacy infrastructure

The steep learning curves and difficulty to adapt to new workflows and systems is often the first barrier to collapse when implementing artificial intelligence applications, thanks to their ability to integrate easily with existing workflows and infrastructure. Furthermore, in the adoption of a SaaS solution, these barriers quickly dissolve since the interface is much more intuitive than traditional library systems.

Embracing AI not as users, but as active players to fight the risks of bias, misuse, and discrimination

If libraries take an active role in the implementation of artificial intelligence applications in the information management landscape, then they can help programmers find the best data for their algorithms. Once they assume the leading role, librarians can be co-creators of "an intelligent information system that respects the sources, engages critical inquiry, fosters imagination, and supports human learning and knowledge creation," according to Catherine Nicole Coleman. AI solutions can also facilitate both more process transparency and greater data control, with libraries able to safeguard their most important principles and maintain trust, neutrality, freedom of expression, mindful media consumption, and equal access to information, while promoting digital inclusion and data privacy.



Conclusion

Global trends, advanced technologies, expanding digital space, new learning habits, changing generations, and political events are only a few of the phenomena rocking the boat for academic and research libraries. To stay afloat in the changing information environment, libraries need to shift the focus from traditional roles and skills to an entirely new direction, one that welcomes change, embraces technology, and supports a new generation of patrons in their evolving needs.

In surveys, library staff and management demonstrate a positive approach to adopting advanced technologies, in order to flourish in the new information landscape. However, there is a gap between their willingness and motivation to embrace technologies in theory and their ability and openness to adapt to the necessary changes in their workflows, services, and skills. The gap is particularly evident when it comes to embracing AI technology, which raises additional concerns regarding the potential compromise of library core principles.

Yet, as it has given companies in so many other industries a competitive advantage, artificial intelligence has the power to take libraries through these stormy times, transforming roles and services to better serve a new generation of

patron. AI can also help libraries attract funds, find their new value proposition, show a tangible, measurable ROI, improve operational efficiency, identify patterns and use them for better decision-making, save costs, empower librarians, expand cross-disciplinary research, support patron needs, and allow libraries to stand for their most important values.

Without AI, alongside other innovative technologies, libraries may not be able to reinvent themselves and maintain their status in the new information landscape. However, when library management takes an active role in implementing practical AI applications in their systems, they will not only be responding to change – they will be taking a leading role in shaping their future.

As one advocate for change, Ben Johnson of [Information Today, Inc.](#), has suggested:

"Advocacy should not be directed at maintaining traditional librarianship, but in influencing the development of the emerging information systems."

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