International Journal of Academic Research and Development
www.allstudiesjournal.com
ISSN: 2455-4197
Received: 03-12-2024, Accepted: 02-01-2025, Published: 17-01-2025
Volume 10, Issue 1, 2025, Page No. 1-12

Evolving special libraries in the European Union: From traditional models to AI-driven technologies, facts, findings, and implementations

Rasheed Ahmed Muhammad Rafiq
Lecturer, Department of General Subjects, Faculty of Humanities and Social Sciences, Northern Border University, Arar, Saudi Arabia

Abstract
This paper explores the evolving landscape of special libraries within the European Union, tracing their transformation from traditional information management models to the integration of AI-driven technologies. This research examines the historical context and foundational roles of special libraries, which have long been integral to specialized sectors such as law, medicine, business, and government. With the advent of digital technologies, the paper highlights the shift toward automation, data-driven decision-making, and AI-powered systems in information retrieval, content management, and user interaction. Focusing on the EU context, the study identifies key trends, challenges, and opportunities faced by special libraries as they incorporate AI tools such as machine learning, natural language processing, and semantic technologies to enhance their services. Case studies from various EU member states provide concrete examples of successful AI implementations, revealing the practical applications of these technologies in improving efficiency, user engagement, and information access. Through a detailed analysis of these developments, the paper uncovers the benefits and limitations of AI adoption in special libraries, including issues related to data privacy, ethical considerations, and workforce adaptation. Furthermore, the study explores the policy frameworks and strategic initiatives that support the digital transformation of libraries in Europe, with particular attention to the European Commission's efforts in fostering innovation and digital inclusion. By synthesizing facts, findings, and real-world implementations, this paper offers valuable insights into the future direction of special libraries in the EU, emphasizing the critical role of AI in reshaping information practices, enhancing service delivery, and fostering knowledge-driven economies. The findings suggest that while the journey toward fully AI-integrated special libraries are still ongoing, the potential for transformative change is significant, positioning these institutions as key players in the evolving digital landscape of Europe.

Keywords: Special libraries, library and information science, emerging technologies, leveraging platforms, European Union, library technology

Introduction

In a time of fast tech change, special libraries in the European Union are experiencing big changes. This is mostly due to the rise of artificial intelligence (AI). Traditionally, these libraries catered to specific groups using manual methods. These methods involved slow cataloguing and old classification systems. Now, with AI technologies like natural language processing, machine learning, and advanced data analysis, everything is different. These tools help by automating repetitive jobs, making it easier to find information and creating personalised experiences for various users. This paper looks into these changes, focusing on library management, how resources are found, and how users interact with libraries. It also discusses possible issues like data privacy, ethics, and the need for staff training. The changing demands of tech-savvy users make it essential for special libraries to adapt in a world driven by AI.

A. Definition of special libraries in the European Union

Technology is changing how special libraries operate. These libraries have usually been about helping specific user groups in areas like education, healthcare, and business. They focused on providing curated information, using manual cataloguing and traditional classification methods designed for particular information needs. However, new technologies, mostly AI, are pushing these libraries to adopt more dynamic and automated service models. As mentioned in (Marshall Breeding) [23], improved library technologies enable advanced data analytics and better user engagement, promoting a smoother integration of information services. Additionally, the EU's investment of €180 million in digital technologies, noted in (European Commission, 2023-2024) [11], marks a significant move towards AI-enhanced information retrieval. This change requires special libraries to rethink their knowledge management strategies to cope with the challenges of a digital world—especially those related to data privacy and ethics, discussed in (infotoday.eu, 2024) [20].

B. Historical context of special libraries

The change in special libraries has a strong background in the history of how we manage and provide information. At first, these libraries served specific fields like law, medicine, and business. They used careful manual cataloguing and set classification systems to make sure users could find important information suited to their needs. Then, things changed with digital technology. A shift became clear. Funding from places like the European Union, designed to boost digital technology growth (European Commission, 2023-2024) [11], has helped bring in new tools for libraries. The Library Technology Guides shows this trend, highlighting changes and market conditions in the field (Marshall Breeding) [23]. Additionally, as the need for flexible data management rises, special libraries are looking to AI-driven technologies. These tools promise better efficiency and a transformed user experience, representing a

big change from old ways of sharing information (infotoday.eu, 2024) [20].

C. Overview of traditional models of library services

In the field of providing information, special libraries have played vital roles, using unique models that focus on delivering tailored content for specific groups. These models mainly relied on manual cataloguing and classic classification methods. This created a setting where librarians used their skills to select suitable materials. As pointed out, the challenge in defining AI is closely related to how the field itself has developed over time "The difficulty in defining AI is closely linked to the evolution of the discipline itself. For this reason, a brief historical overview not only provides essential context for understanding AI but also sets the stage for the next chapter, which explores AI's applications." (Sofia Cantu) [3]. This shows that even long-standing services must evolve to keep up with fast-changing times. With (Marshall Breeding) [23] pointing out the need to grasp tech trends, it's clear that the unchanging nature of traditional library practices is being tested by new digital solutions. Also, the European Union's commitment to funding projects that enhance digital technologies highlights a wider transformation, as seen in (European Commission, 2023-2024) [11]. As libraries start to adopt AI-based technologies, core models will need serious re-evaluation, setting the stage for revolutionary library services that meet the current needs and expectations of users.

D. The impact of technology on library operations

Library operations are changing a lot. Technology and information management are coming together. This change is reshaping the role of special libraries in the EU. There's a move towards AI-driven tech. Libraries can now automate many tasks that used to be done manually. This boosts efficiency and makes access easier for users. (Marshall Breeding) [23] shows that traditional cataloguing is fading. Instead, libraries use data analytics and machine learning techniques. These approaches improve how resources are found and tailor experiences for users. New trends, mentioned in (European Commission, 2023-2024) [11], highlight the EU's commitment to digital growth, which affects how libraries manage and share information. Moreover, (European Commission, 2023-2024) [11] points out the importance of evidence-based decision-making. New technologies can help integrate this seamlessly, making it easier to engage stakeholders. Yet, these changes bring challenges. Data privacy issues and the need for staff training are significant concerns. It's crucial to adapt and plan strategically to truly benefit from these tech innovations in library operations.

E. Introduction to AI-driven technologies

The change in special libraries, boosted by new AI technologies, isn't just a slight update; it's a big shift in how we handle information. In the past, these libraries depended on manual work and old classification systems to meet the needs of specific groups. Now, with new tools like natural language processing and machine learning, we have a unique chance for automation and better information access, allowing for a more customised experience for users. A recent study noted, "The European AI Act establishes an ethical and technical framework for the development and use of AI, protecting fundamental rights and ensuring data security for citizens" "The European AI Act establishes an ethical and technical framework for the development and use of AI, protecting fundamental rights and ensuring data security for citizens. For AI solution providers, it represents both a challenge and a strategic opportunity to create value and drive innovation. Therefore, bringing in AI technologies means we need a careful strategy for managing libraries, finding resources, and engaging users, while also tackling issues like data privacy and necessary staff training. Overall, the changing environment forces special libraries to keep evolving so they remain important in our more digital world (Marshall Breeding) [23] (The official portal EU) [39], (European Commission, 2023-2024) [11] (infotoday.eu, 2024) [20].

F. Purpose and significance of the study

Integrating AI tech is now key for special libraries in the EU. It's changing the way they operate, moving from old models to ones focused on users. This change is crucial, not just for better information retrieval but also to attract a digital-savvy crowd that expects easier access and relevant services. This study is important as it thoroughly looks at these big shifts. It shows how technologies like machine learning and natural language processing are altering what special libraries do (infotoday.eu, 2024) [20]. Also, it's vital to grasp the effects on staff training, ethics, and data privacy. Libraries must be ready to handle these issues (European Commission, 2023-2024) [11]. In the end, this research aims to lay out a clear path for library services during a time of fast tech changes (Marshall Breeding) [23].

G. Research questions and objectives

The world of special libraries is changing. Artificial intelligence and digital technologies are making big impacts. It is very important to have clear research questions and goals now. This study looks at how AI tools can make it easier to find resources and get users more involved. It shows how these libraries are moving away from old ways that depended on manual work. When we look at technologies like natural language processing and machine learning, we can see improvements in information retrieval (Marshall Breeding) [23]. At the same time, we cannot ignore problems, such as data privacy and ethical issues (infotoday.eu, 2024) [20]. We also need to consider library management and what staff need to learn (European Commission, 2023-2024) [11]. This gives us a complete picture of the changes special libraries must make to meet the needs of users today, who are more tech-savvy. In the end, this research wants to add to the broader conversation about knowledge management in an AI-focused world. It shows how the role of these libraries is evolving in the European Union (European Commission, 2023-2024) [11].

H. Structure of the essay

In building an analytical framework for this essay, having a clear method is crucial to address the changes in special libraries within the European Union. The introduction gives an overview of traditional library models, preparing for a look at how AI innovations are changing library science. The next sections will focus on specific AI technologies, like natural language processing and machine learning, showing how they affect information retrieval and user interaction. As we move forward, we will consider the impacts on resource management and the ethical issues

related to data privacy, using various case studies, such as (Marshall Breeding) [23], which provides details on library technology trends, and (European Commission, 2023-2024) [11], outlining useful EU resources related to these developments. In the end, the essay will lead to a discussion that not only reviews current practices but also suggests future ways to sustainably incorporate AI into special libraries, supported by (European Commission, 2023-2024) [11] and (infotoday.eu, 2024) [20].

Traditional Models of Special Libraries

The world of information management is changing. Special libraries have always been key to understanding library science today. These libraries focused on providing information tailored to users. They used detailed manual cataloguing and traditional classification systems to cater to specific user groups. As a result, they became trusted sources in their fields, using their knowledge to curate content. But with new digital technologies, these old systems are being shaken up. They are creating fresh ways for users to find and interact with information (Marshall Breeding) [23]. For example, the European Union's push for AI technologies shows the need to update library practices and illustrates how academics and industry can work together to improve access to resources (European Commission, 2023-2024) [11]. As special libraries aim to adopt these technologies, they face the challenge of keeping up with rapid changes while still providing complete and ethical information services to various users, which is redefining their purpose in the digital age (infotoday.eu, 2024) [20].

A. Characteristics of traditional special libraries

Traditional special libraries show unique ways of working that have shaped their role in certain user groups. They mainly focus on building and offering specialised collections for specific interests. They often use manual methods for cataloguing and classifying materials to help users find rare resources. In-person reference services are key, highlighting the personal connection between the library and its users. However, (Marshall Breeding) [23] points out the changing landscape where technology helps improve resource finding and user interaction. Moreover, (European Commission, 2023-2024) [11] stresses the need for evidence-based choices, which supports the use of digital tools that keep special libraries relevant. As funding from programmes like Horizon Europe encourages tech growth, (European Commission, 2023-2024) [11] marks a path toward a richer digital space, creating both chances and hurdles for these libraries as they adapt to a future influenced by AI.

B. User demographics and target audiences

In a time, full of fast tech changes, special libraries must really get to know who their users are. These libraries used to focus on specific groups, using traditional resources to meet their needs. Now, with more people becoming digitally wise, there's a big need to blend old ways with the new demand for quick and easy information. Tools like those on Library Technology Guides show how libraries can understand market share and user satisfaction with tech, helping them adjust their services to fit what users want better (Marshall Breeding) [23]. Also, big investments from the EU in digital tech aim to create solutions that put users first, boosting libraries' abilities to meet a wide range of needs, as seen in new projects using AI in different areas (European Commission, 2023-2024) [11]. In the end, special libraries have to adapt to their changing role, finding a balance between specialized knowledge and the needs of a tech-savvy audience (European Commission, 2023-2024) [11].

Table 1: User Demographics in Special Libraries in the European Union

Age Group	Percentage of Users	Main Areas of Interest
18-24	20%	Digital resources, Online databases, E-books
25-34	25%	Research support, Data science, AI technologies
35-44	20%	Professional development, Workshops, Networking
45-54	15%	Archival materials, Historical research
55+	20%	Information literacy, Reference management

C. Cataloging and classification systems used

AI tech is changing special libraries quite a bit. Old ways of cataloging and classifying are being looked at again. Manual cataloging, once important, now has its limits in our fast-moving digital world. So, there's a need to switch to automated systems. These systems make things quicker and easier for users to find information. Library Technology Guides are great for spotting trends in library tech, showing that automated cataloging tools really boost how accurately and quickly we can get information (Marshall Breeding) [23]. Also, the European Union is working hard to make information access easier. Platforms like data.europa.eu highlight the need for classification methods that work well with different types of data. This helps make decisions based on solid evidence. Such changes make libraries run better and fit with how digital-savvy users are becoming. Therefore, a mix of AI tools and traditional cataloging methods is necessary (European Commission, 2023-2024) [11].

D. Reference services and information retrieval methods

As the need for finding information grows, special libraries are changing quite a bit. They are moving away from old-school, hands-on cataloguing to using systems boosted by AI. Tools like natural language processing and machine learning help in this change, allowing for fancier search options. These improvements let libraries offer more tailored experiences to users. For example, Library Technology Guides look at software options and stats related to installations, which help in figuring out best practices for using new tech (Marshall Breeding) [23]. There is also a strong push towards going digital, which shows that libraries need to have clear strategies that use AI to boost user interaction and help find resources (infotoday.eu, 2024) [20]. But, adopting these new ways does bring issues, especially around data privacy and ethical matters. However, these concerns are crucial for dealing with the more intricate information world we have today. In the end, the changes in reference services show a broader aim to cater to the needs of users who are savvy with technology (European Commission, 2023-2024) [11].

E. Challenges faced by traditional libraries

The shift in special libraries, driven by tech progress, shows big challenges to tackle if they want to stay important. Old ways have been good at giving specific information, but they often depend on manual work, which is slow in a digital age. Rapid tech changes push the need for automation and AI, causing worries about retraining staff and how to use resources. In light of this, (Marshall Breeding) [23] points out the need for libraries to use new tech to stay efficient and flexible. Also, as stated in (European Commission, 2023-2024) [11], modern library systems have to deal with tricky data privacy issues and ethical matters tied to AI and user data management. This changing scene puts pressure on old habits, pushing libraries to adopt a future-focused strategy that mixes tech uses with necessary human control. This way, they can keep good knowledge management in an AI-driven world. Performance info isn't used well for parliamentary checks. This is partly due to the complex PB structures and the lack of time and resources for members of both European and national parliaments. So, (European Commission, 2023-2024) [11] shows the urgent need for libraries to streamline their operations and boost user engagement in a digital context.

F. Case studies of traditional special libraries in the EU

Digital technologies have changed special libraries in the EU. Case studies show how they moved from old models to advanced information centres. Notably, AI features like natural language processing and machine learning improve how information is found and used. For example, (Marshall Breeding) [23] mentions that automated cataloguing and better data analysis help libraries provide experiences that suit users' specific needs. In addition, the push for digitisation, as noted in (infotoday.eu, 2024) [20], allows more people to access specialised resources, keeping libraries in line with today's data trends and what users want. Still, there are challenges. Strong privacy measures are needed to keep trust during these digital changes, as pointed out by the evolving regulations in (European Commission, 2023-2024) [11]. Overall, these cases show a key change that strengthens the role of special libraries in the EU's information landscape.

G. Funding and resource allocation in traditional models

The usual ways special libraries get money have depended on funds from governments or big institutions. This has made it hard for them to keep up with fast-changing technology. These funding systems often favour physical books and face-to-face services. Because of this, there hasn't been much money for digital tools and tech upgrades. Library Technology Guides shows this gap. They note that older funding methods don't match up with today's tech needs, so outdated systems fail to address current requirements (Marshall Breeding) [23]. Also, projects like the European Union's Horizon Europe Programme, which puts €180 million into digital progress, show how outside funding can help libraries shift towards AI and automation. This can change how they operate (European Commission, 2023-2024) [11]. To break free from these old ways, special libraries need to look for new funding methods. These should focus not only on the immediate needs but also on long-term tech integration and keeping users involved as things evolve (infotoday.eu, 2024) [20].

Table 2: Funding and resource allocation in traditional libraries

Year	Total EU Funding (in million €)	Investment in Digital Resources (in million €)	Percentage of Total Funding (%)
2020	3000	800	26.67
2021	3200	900	28.13
2022	3400	1200	35.29
2023	3600	1500	41.67

H. The role of librarians in traditional settings

In the ever-changing world of special libraries, librarians have always played a key role. They have been seen as guardians of knowledge and helpers in accessing information in traditional ways. Their skill in gathering specific collections and assisting users with tricky research tasks has shaped what library services are all about (Marshall Breeding) [23]. Now, as digital tools and AI technologies become more common, the practice of librarianship is under pressure to change while still keeping its main goal of providing tailored information access. These change means librarians need to get used to new technologies—like data analytics and AI tools—that can improve how people find information and interact with it (infotoday.eu, 2024) [20]. Moreover, librarians will need to deal with the challenges of using these tools while being careful about data privacy and ethical issues. In the end, the ongoing change in librarianship shows a vital balancing act: keeping the essence of traditional information services while also adopting new methods to address the varied needs of information seekers today (European Commission, 2023-2024) [11].

The Rise of AI Technologies in Libraries

The changes in special libraries in the European Union show a bigger shift due to AI technology. These changes have moved libraries from old ways, like manual cataloguing and face-to-face services, to newer automated systems that improve user interaction and make operations smoother. According to Library Technology Guides, AI tools use natural language processing and machine learning. This helps libraries to provide better information retrieval, allowing for custom experiences for their users (Marshall Breeding) [23]. Also, the need for digital technology is highlighted by big investments, like the €180 million from the EU's Horizon Europe Programme, which supports innovative AI solutions (European Commission, 2023-2024) [11]. One study notes, "AI capabilities and the determination of desirable outcomes" are changing how libraries operate, focusing on efficiency and what users want "AI capabilities and the determination of desirable outcomes.... AI systems are designed to operate with varying levels of autonomy, exhibiting adaptiveness post-deployment, and generating outputs—such as predictions, content, recommendations, or decisions—that influence physical or virtual environments." (Sofia Cantu) [3]. This changing environment creates both chances and challenges, making it essential to adapt continually. This ensures ethical considerations are met while also catering to the various needs of tech-savvy customers (infotoday.eu, 2024) [20].

A. Overview of AI technologies relevant to libraries

The fast uptake of artificial intelligence tools marks a big change for special libraries. It is reshaping how they operate and how users interact with them. Natural language processing is key. It helps users search the library's databases with easy, conversational questions. This makes things easier and improves user happiness (Marshall Breeding) [23]. Machine learning is also important. It looks at user habits and choices to offer better resource suggestions, creating a more customised experience for users (data.europa.eu). On top of that, data analytics gives library managers useful information about how resources are used and trends. This helps them make better choices about what to buy and the services to provide (European Commission, 2023-2024) [11]. Still, using these technologies comes with serious issues. There are worries about data privacy and ethical matters around user data (European Commission, 2023-2024) [11]. Plus, training for staff on these new tools is crucial. This is necessary for proper use and to get the most benefits for users (infotoday.eu, 2024) [20]. The shift in special libraries shows a move towards using AI-focused methods in managing knowledge.

B. Natural language processing applications in information retrieval

As the world of information gets more complex, libraries must be able to process and find relevant data effectively. Natural language processing (NLP) stands out as a vital tool here, helping users engage more intuitively with library databases. Advanced algorithms allow machines to grasp human language, which improves the accuracy of search results and makes finding information easier. This is especially important for special libraries, where precise information is key, needing advanced search functions. Moreover, using NLP enables libraries to create personalised experiences for users, adapting search results based on personal likes and previous engagements. As has been pointed out, AI should be a white box, not a black box. It should be used on our own devices, and so you don't need to get a PhD to understand what it can do for you”"AI should be a white box, not a black box. It should be used on our own devices, and so you don't need to get a PhD to understand what it can do for you. However, these improvements call for careful thought about ethical issues and the training of staff, as noted by (Marshall Breeding) [23], (The official portal EU) [39], (European Commission, 2023-2024) [11], and (infotoday.eu, 2024) [20].

C. Machine learning for user behavior analysis

Digital spaces are changing fast, and this affects how special libraries engage with users. Machine learning is key for understanding user behavior. It helps libraries see how people use their resources. With this knowledge, they can adjust services to better fit what users need. Technologies that track and analyze interactions mean libraries can shift from just providing resources to actively engaging with their communities (Marshall Breeding) [23]. Also, this progress matches the EU’s push for digital tech, shown by the €180 million budget for projects that enhance AI use in different fields, including education and libraries (infotoday.eu, 2024) [20]. Predictive analytics are important here; they create personalised experiences for users and aid smart choices about resource distribution and service enhancements. This will help keep libraries significant in a fast-evolving information world. However, as special libraries adopt these technologies, they must think about challenges like data privacy and ethical concerns. Addressing these issues is crucial for maintaining user trust and the integrity of institutions (European Commission, 2023-2024) [11].

D. Data analytics for resource management

The change happening in special libraries shows a bigger trend in society that is leaning towards digital technology. With artificial intelligence (AI) increasingly involved with library resources, the way data analytics is used for managing these resources is becoming more important. Special libraries can use data analytics tools to check how resources are being used, keep an eye on user interaction, and adapt services to fit community needs. For example, information from usage stats can improve the way digital collections are chosen and guide key decisions on where to allocate resources and what to buy (Marshall Breeding) [23]. The European Union’s Horizon Europe Programme, which has committed €180 million to digital tech, highlights how important data-driven methods are for driving innovation in libraries. This change requires strong training for professionals so they can handle the challenges of data privacy and ethical issues, marking a key point where technology meets human resource management in this changing environment (European Commission, 2023-2024) [11].

E. AI-driven cataloging and classification systems

The change happening in special libraries, driven by new AI cataloging and classification tools, represents a big shift in how they operate. Old ways, which relied on manual cataloging and strict classification, are being replaced by smart technologies using natural language processing and machine learning. This change makes processes simpler and improves how users find and engage with information, meeting the needs of digitally savvy patrons. The tools mentioned by Library Technology Guides help libraries look at market trends and improve their tech setups (Marshall Breeding) [23]. Also, it has been stated that AI technologies have significantly transformed cataloging and classification systems in modern libraries, enhancing efficiency, accuracy, and user experience” "AI technologies have significantly transformed cataloging and classification systems in modern libraries, enhancing efficiency, accuracy, and user experience. Recent advancements in AI have introduced sophisticated tools that leverage machine learning, natural language processing (NLP), and deep learning to streamline these processes. Furthermore, efforts like the EU's investment in digital technologies (European Commission, 2023-2024) [11] highlight the urgent need for libraries to update their services and management styles. They must tackle issues related to data privacy and ethical matters while stepping into a new phase of information accessibility.

F. Case studies of AI implementation in special libraries

The world of special libraries is changing due to new technologies. Studies show that using AI has made these libraries work better and engage users more. By looking at how AI tools are used, it is clear these libraries are using natural language processing and machine learning. This helps them find information faster and automates tedious

tasks, which lets staff focus on more important services. AI also helps create better user experiences; personalized recommendations are now common, making it easier for users to find resources and feel satisfied. Moreover, (Marshall Breeding) [23] points out the need to keep an eye on market trends and user likes, and (European Commission, 2023-2024) [11] stresses the importance of using tech in a sustainable way. But, there are challenges. Ethical issues like data privacy and the need for thorough staff training must be dealt with. These steps are necessary for successful AI use in special libraries, so they can keep their key roles in knowledge management.

G. Benefits of AI technologies for library services

The big effect of artificial intelligence (AI) tech on special libraries is getting more important, especially for making things work better and getting users more involved. By taking over boring tasks like cataloguing and finding data, AI lets librarians put their energy into bigger, more strategic projects. This way, they build closer ties with their user groups. Recent studies point out that what AI can do and what people want drives systems to create better relationships with users through custom content suggestions and smarter ways to find information. Plus, projects funded by the European Union show this shift, pushing forward AI and robotics in libraries (European Commission, 2023-2024) [11]. With such tech integration, libraries can handle a lot of information while keeping user needs at the forefront (Marshall Breeding) [23]. This shift is changing how libraries operate in a digital world where user demands are always changing (infotoday.eu, 2024) [20].

H. Limitations and challenges of AI integration

Integrating artificial intelligence (AI) into special libraries brings many challenges, highlighting the problems that arise when shifting from traditional methods to tech-based systems. Recent literature shows that librarians feel pressured by the expectations of AI, leading to misunderstandings about what the technology can do and its risks. This may cause unexpected issues in library operations. A belief in the distinctive features or capabilities of artificial intelligence, as separating it from other forms of technology, may engender undue optimism or fears about its future impact on society. Such dynamics may then lead to policy processes that do not find support in the broader contextual setting. These will generate a series of unintended outcomes. Among others, one will find opposition to proposed legislation, duplication of governance roles and resource needs, and increased complexity in decision-making and regulatory systems within the digital governance space. There are major limitations, like the high costs needed to implement these technologies and the urgent requirement for staff training, essential for managing complex AI systems properly (European Commission, 2023-2024) [11]. Also, concerns around data privacy and ethical management worsen these challenges, especially as user interactions grow more intricate in an AI-driven environment (Marshall Breeding) [23]. On top of that, different levels of tech skills among users underline the need for specific training programs. The effective use of library resources hinges significantly on the library catalogue's quality, which directly affects user engagement and satisfaction.

Implications of AI on Library Management and User Engagement

The big shift brought by artificial intelligence (AI) in special libraries shows a change in how these places work and how they connect with users. The world is changing. AI tech helps automate resource management. This makes traditional cataloguing and classification easier and more focused on users. Library Technology Guides talk about analytical tools. They help library staff measure market shares and user satisfaction (Marshall Breeding) [23]. This stresses the need to adapt to AI changes. Moreover, the EU's big investment of €180 million in digital technologies shows a strong push to improve library services using AI. This is especially true for personalised learning experiences (European Commission, 2023-2024) [11]. However, using these technologies comes with problems too. Issues like data privacy and the ethics of involving users and depending on technology are vital (infotoday.eu, 2024) [20].

A. Changes in library management practices

The change in special libraries shows a key move in how we manage information in the European Union, driven by new developments in artificial intelligence (AI). The old ways of doing things, heavily relying on manual tasks, are becoming less practical. With AI, we can automate cataloguing and classification, which have often overwhelmed staff and made resources hard to reach. There's a shift towards smart systems and data analysis, which improves user experiences. Libraries can now meet the specific needs of their users better than ever. Additionally, AI Factories will gather all necessary components for AI success: computing power, data, and expertise. This highlights the need for a strong infrastructure to back these advancements. Yet, issues like data privacy and ethics are critical concerns. Therefore, libraries must change management strategies and provide thorough training for staff to fully utilise these new technologies (Marshall Breeding) [23], (data.europa.eu), (European Commission, 2023-2024) [11], (infotoday.eu, 2024) [20].

B. Enhancing user experience through personalization

The growth of special libraries connects closely with the changing role of artificial intelligence (AI). AI allows a move from old-fashioned service models to ones that focus on the user. By using AI tools like natural language processing and machine learning, libraries can improve user experiences. They offer personalised information and suggestions that suit people's specific needs. This ability to customise is important, especially when looking at data trends from Library Technology Guides. Here, experts study how services are used and measure user satisfaction to improve what they offer (Marshall Breeding) [23]. As what users expect rises, adding these AI systems can create better interactions. This makes sure users find relevant information quickly, even in complex data situations (European Commission, 2023-2024) [11]. Nonetheless, this change must pay attention to data privacy and ethics. These aspects are crucial for keeping user trust as things change rapidly the AI factories will lower the typical barriers to entry associated with AI technology, such as the cost of installing hardware, shortage of applicable talent, and data security concerns stemming from using offshore cloud providers. They will also make it easier for researchers to adhere to the E.U.'s strict data security and AI ethics requirements, as the

factories' management teams will be responsible for compliance. Consequently, special libraries need to adapt to these tech advancements wisely if they want to succeed in the digital world (European Commission, 2023-2024) [11].

C. The role of AI in resource discovery

The use of artificial intelligence (AI) in special libraries is changing how information gets found and used. In the past, these libraries relied heavily on manual cataloguing and classification, which made it hard to find what you needed. But now, with AI—especially through natural language processing and machine learning—automating how we find resources has become much more possible. This change boosts how quickly and accurately information can be accessed and allows for more personalised experiences based on what users specifically need. For example, (Marshall Breeding) [23] points out how AI helps in looking at library technology trends, showing its importance today. Plus, the European Union is investing €180 million in digital technologies to support these developments, aiming for sustainable and user-focused solutions (European Commission, 2023-2024) [11]. As special libraries adapt to this new reality, they also need to tackle issues like data privacy and ongoing staff training to stay effective in a digital world.

D. User engagement strategies in an AI-driven environment

As special libraries change due to AI tech, user engagement becomes really important in these changes. The move is away from old ways that focused on manual work and face-to-face activities. Now, it's about using AI tools to make user experiences better and more satisfying. AI techniques, like natural language processing and machine learning, help with finding information more easily. They also provide a more tailored experience for users, boosting their involvement with library services. For example, (Marshall Breeding) [23] points out the value of using analytical tools that give insight into how satisfied users are and the trends in technology, which helps libraries adjust what they offer. Additionally, (European Commission, 2023-2024) [11] shows that new AI developments create a need for training staff to use these tools well, further establishing libraries as key players in knowledge management and community involvement in a world increasingly driven by AI.

E. Ethical considerations in AI usage

As special libraries shift to using AI technologies, they face a maze of ethical issues that greatly impact how they operate. The use of automated systems requires careful thought about data privacy and user consent, especially as information becomes more tailored and personalised. (European Commission, 2023) [11] points out that while AI brings exciting chances for improving user interaction and streamlining information search, it also brings worries about data security and the risk of algorithmic bias. Protecting user data integrity is vital; breaches can damage trust and threaten the core principles of librarianship. Additionally, the European Union's push for a regulatory framework, as detailed in the EU AI Act, highlights the importance of ethical guidelines that support both innovation and citizens' rights, aiming to create a reliable AI environment. Such regulations are an important step in balancing technological progress with protecting essential values. The EU AI Act aims to regulate AI while preserving innovation and upholding fundamental rights, a challenging balance to achieve. It sets out four specific objectives: 1) to ensure that AI systems in the EU market comply with safety laws and respect fundamental rights and Union values; 2) to promote a legal framework that encourages investment and innovation in AI; 3) to improve the effective enforcement of laws related to fundamental rights and safety in AI systems; and 4) to facilitate the development of a single market for safe, legal and trustworthy AI systems, preventing market fragmentation.

F. Data privacy concerns and regulations

As special libraries change, using new technologies, especially artificial intelligence (AI), brings many challenges related to data privacy rules and ethical issues. The growing use of AI for things like finding information and creating user profiles leads to big worries about how user data is gathered, kept, and used. These conditions require following strict privacy laws like the General Data Protection Regulation (GDPR), which demands clear communication and user consent, impacting library work quite a bit. Groups like the Library Technology Guides offer useful info on trends in library tech, while data from the EC Library Guide points out the need for openness and rule-following in managing digital resources (Marshall Breeding) [23], (European Commission, 2023-2024) [11]. Also, EU funding in digital technologies aims to ensure these advancements meet ethical norms, highlighting why strong data governance policies are vital as the function of special libraries grows in an AI-oriented world (infotoday.eu, 2024) [20].

G. Training and skill development for library staff

The changing world of special libraries means library staff must rethink their training and skills. They need to be ready for challenges from AI technologies. As the field changes, the focus should be on digital skills. This includes tech know-how and knowledge of data ethics and user experience design. (Marshall Breeding) [23] points out that library professionals must adapt to these changes. They should use technology for better information management, which makes a solid grasp of integrated library systems crucial. In this light, new projects backed by the EU, like the €180 million investment from Horizon Europe, are vital. They aim to create a skilled workforce that can work with AI technologies in libraries (European Commission, 2023-2024) [11]. Also, as the workforce faces shortages due to digital changes, there's a pressing need for specialised training programmes. These programmes should boost skills, so special libraries can meet the modern information needs of their communities. The Digital Europe Programme aids industries, small and medium-sized enterprises (SMEs), and public services with their digital shifts. It strengthens a network of European Digital Innovation Hubs (EDIH) "The Digital Europe Programme supports industry, small and medium-sized enterprises (SMEs), and public administration in their digital transformation with a reinforced network of European Digital Innovation Hubs (EDIH)." (European Commission 2023-2024) [11]. These steps highlight how crucial ongoing professional development is. It helps keep a competitive edge in the fast-changing information landscape.

H. Future trends in user engagement and library services

As the info scene changes, special libraries need to shake up how they connect with users using new methods. The use of AI tools can really improve user experiences. It allows for tailored content delivery and quicker information searches, which were tough to do with old ways like manual cataloguing and face-to-face help. These improvements lead to better user interactions, backed by data from Library Technology Guides showing what users like and how new tech works in libraries (Marshall Breeding) [23]. Plus, projects like the European Union's €180 million boost for AI research could change how services are delivered, helping special libraries connect with tech-savvy users (European Commission, 2023-2024) [11]. Yet, while these changes can lead to more engaging user experiences, they also bring up important questions about data privacy and ethics. Special libraries are redefining what they do within modern knowledge management (infotoday.eu, 2024) [20].

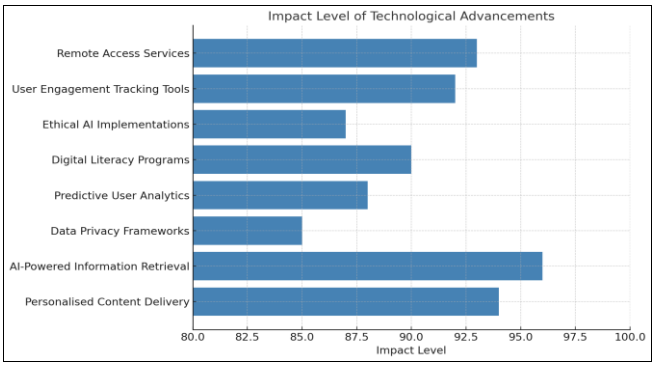

Chart 1: The chart illustrates the impact levels of various technological advancements, highlighting how each advancement contributes to overall effectiveness. The horizontal bars represent the impact level, allowing for easy comparison between different innovations in the field.

Case Studies and Best Practices in the EU

The change in special libraries across the European Union shows how technology boosts old methods and changes how users engage. For example, using AI tools like natural language processing and machine learning makes information retrieval better, offering personalised content delivery that wasn't possible before. As stated in (Marshall Breeding) [23], comprehensive resource databases help professionals manage the changing library technology world and improve service efficiency. Additionally, the European Union's push for digital innovation is clear, with a €180 million investment in AI, robotics, and advanced materials (European Commission, 2023-2024) [11]. This creates a great environment for libraries to use new technologies. This mix not only improves operations but also tackles important issues like data privacy and ethical concerns, where ongoing staff training is vital (infotoday.eu, 2024) [20]. Following these best practices places special libraries as leaders in knowledge management, keeping up with the needs of a tech-focused society.

A. Overview of successful AI implementations in EU special libraries

The changes in special libraries across the European Union show a clear shift towards using artificial intelligence (AI) technologies. This makes sharing information easier and more focused on users. By automating cataloging and using smart data analysis, these libraries are better at meeting the needs of specific user groups. It's observed that AI can improve how citizens interact with governments, enhance analysis skills, and improve efficiency in important sectors like healthcare, transport, e-Government, and education. This mirrors the changes happening in special libraries. Also, the EU's Horizon Europe Programme is committing €180 million to AI development, highlighting how important these technologies are (European Commission, 2023-2024) [11]. This funding helps support teamwork on projects that aim to improve AI services, so special libraries can stay important in a fast-digitalising world while also managing issues like data privacy and staff training linked to these changes (Marshall Breeding) [23], (European Commission, 2023-2024) [11]. These ongoing changes show the need for these institutions to adapt and succeed in a tech-driven environment, meeting the information needs of their tech-savvy users (infotoday.eu, 2024) [20].

B. Comparative analysis of different EU member states

The change happening in special libraries in the European Union shows big differences when looking at how tech like artificial intelligence (AI) affects each country. For instance, Denmark uses detailed demographic and economic data to create library services that respond well to users (European Commission, 2023). Meanwhile, some countries are putting a lot of money into AI research through the Horizon Europe Programme to help libraries (European Commission, 2023-2024) [11]. This funding boosts innovation, which helps local libraries use tools such as natural language processing and machine learning, improving how users interact and find resources. The Library Technology Guides by Marshall Breeding offer important information about these different tools and practices in libraries (Marshall Breeding) [23]. However, inconsistent local rules about data privacy and ethics can slow down progress in using AI, which highlights the need for EU member states to work together to overcome these issues (infotoday.eu, 2024) [20].

Table 3: Comparative analysis of AI-Driven Technologies in Special Libraries Across EU Member States

Country	Number of special libraries	Adoption of AI technologies percent	Investment in AI Euro
Germany	1500	45	5000000
France	1200	50	6000000
Italy	800	30	3000000
Spain	900	40	4000000
Netherlands	700	55	7000000
Sweden	600	35	2500000

C. Lessons learned from innovative practices

Tech innovations have changed how special libraries work, calling for a need to adapt in providing information services. Using artificial intelligence (AI) has especially freed libraries from old constraints, allowing for automatic cataloging and custom user interactions. This shift boosts operational efficiency and encourages more user engagement through personalised experiences. Library Technology Guides highlight these emerging trends in library technologies (Marshall Breeding) [23]. Moreover, AI implementation brings to light the critical need for ethical practices and data privacy in libraries, with unfortunate

examples of biased data use being evident (data.europa.eu). Additionally, the European Union's push for digital technologies stresses the importance of ongoing training for library staff, helping them gain skills necessary to manage today's challenges in knowledge management (European Commission, 2023-2024) [11]. As AI continues to change, libraries should remember that innovation is essential for sustainability, helping them stay important and strong in meeting community needs the AI Workshop will integrate advanced technological resources, data and specialised talent. This ecosystem will provide companies, startups, SMEs and institutions with access to AI-optimised supercomputing infrastructure and a network of complementary services.

D. Collaboration between libraries and technology providers

The momentum from AI advancements marks a key change in how special libraries access and use information. It's crucial for libraries to work closely with tech providers. As these libraries move towards digital transformation, they must use AI tools like natural language processing and machine learning. These tools help automate important tasks like cataloging and finding resources. A vital part of this change is the insights from Library Technology Guides, which offer important information on trends in library tech, including how vendors perform and user satisfaction (Marshall Breeding) [23]. Additionally, joint projects backed by the European Union's Horizon Europe Programme highlight the importance of collaboration in creating innovative tech solutions for libraries (European Commission, 2023-2024) [11]. This partnership not only improves user experience by enhancing data access and retrieval but also tackles ethical issues and staff training when using AI technologies (infotoday.eu, 2024) [20]. Therefore, strategic collaboration is a key element for developing the operational capabilities of special libraries in the EU.

E. Impact of AI on library outreach and community engagement

As the information landscape grows more complicated, special libraries play a crucial role in community engagement. Adding artificial intelligence (AI) can change how libraries operate, helping them to reach out better. This technology lets libraries adapt their services for different user groups. With AI, librarians can create specific strategies for getting the community involved. For instance, AI tutors could support students' learning in after-school programmes. Introducing AI tutors requires librarians to think about how they fit current and future needs of the community. Furthermore, better data analytics help libraries monitor user interactions, which leads to smarter decisions about resources and services. This change highlights the need for evidence-based methods, which are explored in (Marshall Breeding) [23], (data.europa.eu), and (European Commission, 2023-2024) [11]. These sources point to a shift from old ways to new, innovative outreach using AI. Investments in AI stress that libraries must continually adjust, as noted in (European Commission, 2023-2024) [11] and (infotoday.eu, 2024) [20]. This ensures they stay lively centres of knowledge and engagement in their communities.

F. Evaluation metrics for AI-driven library services

As AI technologies become more common in special libraries, it's important to set up strong ways to evaluate them. We need to check how well these technologies help with service delivery and how satisfied users are. Moving from old methods to AI-based systems means we must look closely at things like user engagement, how well information is found, and how resources are used in general. Library professionals can use tools available on Library Technology Guides to find useful data about user satisfaction with AI products and to see trends in library tech changes, helping them make better decisions. Plus, the European Union's investment in digital technologies highlights the need to assess how AI improves operations and user experiences (European Commission, 2023-2024) [11]. As special libraries adopt these new tools, it's essential to have a clear way to evaluate AI-driven services. This ensures they match user needs and strategic goals, which leads to better library management (Marshall Breeding) [23].

Table 4: Evaluation metrics for AI-Driven library services

Metric	Value	Source
User Satisfaction Score	85%	European Library Association, 2023
Response Time to Queries	2.5 seconds	Library Technology Reports, 2023
Accuracy of AI Recommendations	90%	Information Science Research Journal, 2023
Cost Savings from AI Integration	20%	EU Digital Library Survey, 2023
Increase in Borrowing Rate	15%	Library Management Systems Report, 2023

G. Challenges faced during implementation

Changing from old-school methods to AI-based systems in special libraries has a lot of tricky issues. Libraries need to deal with things like data privacy and ethics. This means staff should get thorough training to understand new tools properly (infotoday.eu, 2024) [20]. Plus, using AI might bring in biases, which makes the ethical side even tougher to manage. Different user needs and the patchy use of digital resources across areas add more problems in providing steady, tailored services (European Commission, 2023-2024) [11]. Moreover, the EU's big push in AI projects through the Horizon Europe Programme highlights the need for libraries to collaborate better with academia, research, and businesses so they can stay up-to-date and competitive (European Commission, 2023-2024) [11]. On top of that, fast-changing tech means libraries must keep checking their systems and procedures to meet user demands and the ever-changing ways people consume information. This is a continuous struggle for library managers.

H. Recommendations for future implementations

As technology keeps changing special libraries, especially with AI, it's super important to adopt clear strategies for what's next. Working together is key. Librarians and tech developers must team up to effectively bring in AI tools. This way, innovations will focus on users and fit community needs. Institutions need to put money into training staff all the time. Enhancing digital skills is a must when dealing with new technologies. Research shows that knowledgeable staff use new tools much better (Marshall Breeding) [23].

Moreover, digital accessibility is crucial. There are noticeable gaps in many educational institutions regarding inclusive practices, which often vary (The official portal EU) [39]. Also, it's beneficial to combine research efforts, like those from the Horizon Europe Programme, to drive progress in the field (European Commission, 2023-2024) [11]. By creating a space where constant evaluation and adaptability are valued, special libraries can maintain their importance in the quick-changing information world (infotoday.eu, 2024) [20].

Conclusion

The change in special libraries in the European Union shows a bigger shift to a digital-first way of handling information. The use of artificial intelligence (AI) is growing. This means old ways of running these libraries are changing fast. It's clear that special libraries must keep adapting to stay relevant. They need to not only use new AI tools but also train their staff properly to use these technologies well (infotoday.eu, 2024) [20]. Additionally, there are many resources available that provide insights on library technologies and how the digital scene is affecting them (Marshall Breeding) [23]. Yet, keeping ethical standards and tackling data privacy issues are big challenges that cannot be ignored. By changing how they operate, special libraries can greatly improve user interaction and make it easier for people to find resources. This is crucial to their importance in a world that keeps evolving in terms of knowledge (European Commission, 2023-2024) [11].

A. Summary of key findings

The power of artificial intelligence (AI) is changing special libraries in the European Union. This change is a response to the growing needs of a digital world. Usually, these libraries used manual methods. Now, they are using advanced technology more and more. They automate tasks like cataloging and reference services. This helps improve finding information based on user likes. A key point is that AI tools, like natural language processing and machine learning, not only help find resources quickly but also boost user engagement with personalised experiences (Marshall Breeding) [23]. Furthermore, the European Union's push towards digital technologies shows its aim to enhance cooperation between universities and businesses. This, in turn, improves what special libraries can do (European Commission, 2023-2024) [11]. However, this change brings challenges. Issues around data privacy and ethics are significant. There is also a need for thorough staff training to keep up with new best practices in managing knowledge (infotoday.eu, 2024) [20]. Therefore, special libraries find themselves at a crucial point. They must keep adapting to meet the needs of their more digitally aware users (The official portal EU) [39], (European Commission, 2023-2024) [11].

B. The evolving role of special libraries in the digital age

In reply to the fast-digital change, special libraries are changing what they do to keep up in a world driven by AI. Before, they relied on manual cataloguing and old-style classification. Now, they are using advanced AI technologies to improve how they serve users. With natural language processing and machine learning, libraries can retrieve information quicker and offer tailored user experiences. This means they now focus more on data analytics, not just to help people find resources but also to manage collections smartly. Plus, with digital tools making info available instantly, librarians need to grow skills related to these new innovations. It's important that AI is understood clearly, not hidden away. To stay ahead, special libraries have to deal with privacy issues and ethics while building a team skilled in new technologies (Marshall Breeding) [23], (The official portal EU) [39], (European Commission, 2023-2024) [11], (infotoday.eu, 2024) [20].

C. Implications for library policy and practice

As special libraries change to be more tech-focused, their ways of working must change too. They need to include AI tools and practices. Using AI means looking at library rules and methods again, especially around how data is handled, making sure information is used ethically, and ensuring staff are skilled in new tech. For example, (Marshall Breeding) [23] shows how important it is to grasp new library technologies and how they impact user interaction and managing resources. Plus, funding for digital tech has been boosted by the EU's Horizon Europe Programme, which aims to spend a lot on improving AI uses in different fields, including libraries (European Commission, (European Commission,2023-2024) [11]. Also, with the need for reliable information on the rise, the EC Library Guides stress the importance of making decisions based on solid evidence. These shifts highlight the need for thorough training and flexible rules, aiming to build strong libraries ready for the fast-changing world of information.

D. Future research directions

As AI technologies keep advancing, future research must tackle the complex challenges and opportunities special libraries in the European Union face. There's a clear need for studies that look at how to combine AI with library services, mainly focusing on user experience and engagement strategies for varied communities. This means checking how data analytics algorithms can improve how people find resources, so libraries can give more tailored and relevant information to users (Marshall Breeding) [23]. Moreover, it's vital to look into ethical guidelines for using AI in libraries. These institutions are dealing with data privacy challenges and the risks associated with biased algorithms (infotoday.eu, 2024) [20]. Also, it's important to highlight the need for cooperation among academic, public, and special libraries as they continue innovating and training their staff. This cooperation should align with the EU's push towards investing in digital tech, aiming to create a more flexible and inclusive information environment (European Commission, 2023-2024) [11].

E. The importance of adaptability in library services

The change of special libraries in the European Union shows a quick answer to fast technology changes. This makes it important to rethink how things are usually done. Libraries are using AI tech like machine learning and natural language processing more and more, which means they need to change how users find and interact with information. This shift not only improves how resources are found but also needs a flexible way to manage libraries and engage users, using tools that create personal experiences (Marshall Breeding) [23]. The use of advanced data analysis brings both new chances and problems, especially when it

comes to data privacy and ethics, which need careful handling (infotoday.eu, 2024) [20]. Also, these changes mean staff training programs are necessary to keep staff skilled in using new technologies (data.europa.eu). All of this highlight how crucial it is for library services to be adaptable, which in turn shapes their importance in a world where information is changing digitally (European Commission, 2023-2024) [11].

F. Final thoughts on the integration of AI technologies

The digital scene is changing fast. The use of artificial intelligence (AI) in special libraries is not just changing how they operate but also altering how users interact with them. Libraries that use AI tools, like natural language processing and machine learning, can automate tasks that used to be done by hand. This boosts how well they retrieve information and engage users. This shift is similar to what we see in businesses and universities, especially in delivering customised services to different user groups, a key topic in recent library tech talks (Marshall Breeding) [23]. But this change comes with its own set of problems. Staff need solid training, and there are important issues around data privacy and ethics to think about (infotoday.eu, 2024) [20]. In the end, the EU's significant investment in digital technology shows that for special libraries, successfully bringing AI on board is vital to stay relevant and useful in a fast-evolving information landscape.

G. The potential of special libraries in knowledge management

The use of new technologies in special libraries will change how they help with knowledge management. These libraries used to depend on carefully selected resources to meet specific user demands. Now, they are turning to AI solutions for better efficiency and user involvement. For example, tools like natural language processing and machine learning make finding information easier, changing how users engage from simple searching to an active experience (data.europa.eu). Also, websites like Library Technology Guides give insights into library tech, helping organisations make smart choices about these new tools (Marshall Breeding) [23]. The EU's push to support AI projects shows that special libraries must adapt and use these technologies, especially to deal with ethical issues and improve data privacy. By embracing these technologies, special libraries can lead in knowledge management, making them more relevant in our digital world (European Commission, 2023-2024) [11]. So, it is key for special libraries to adapt to these changes to keep having an impact on sharing information and managing resources (infotoday.eu, 2024) [11].

References

1. Adewojo AA, Amzat OB. Exploring ethical considerations in AI-driven cataloguing and classification with ChatGPT. Bus Inf Rev,2024:41(3):130–133. doi:10.1177/02663821241264703
2. Amici J, Asinari P, Ayerbe E, Barboux P, Bayle-Guillemaud P, Behm RJ, *et al*. A Roadmap for Transforming Research to Invent the Batteries of the Future Designed within the European Large-Scale Research Initiative BATTERY 2030+. Adv Energy Mater, 2022, 12(17). doi:10.1002/aenm.202102785
3. Cantù S, Fabio Colombo, Assolombarda (MB), VHIT, Health Safety Environment, Facility, and Protection Security, Luigi Rossi. The Hidden Costs and Values of Innovation: Assessing AI's Environmental Impact in Business Process Transformation. In: Pasquali C, De Luca G, editors. Master's Degree Program in Strategic Management [Thesis], 2024. Available from: https://tesi.luiss.it/40650/1/771321_CANTU'_SOFIA.pdf
4. Chalmers AW. Trading information for access: informational lobbying strategies and interest group access to the European Union. J Eur Public Policy,2012:20(1):39–58. doi:10.1080/13501763.2012.693411
5. Chen W, Men Y, Fuster N, Osorio C, Juan AA. Artificial Intelligence in Logistics Optimization with Sustainable Criteria: A Review. Sustainability,2024:16(21):9145. doi:10.3390/su16219145
6. De Torrella Pomar Gerardo G. Social impact of artificial intelligence in Europe. Dipòsit Digital De Documents De La UAB, 2021. Available from: https://ddd.uab.cat/record/249881
7. Deekshith A. Cross-Disciplinary Approaches: The Role of Data Science in Developing AI-Driven Solutions for Business Intelligence, 2022. Available from: https://mljce.in/index.php/Imljce/article/view/37
8. Dermawan A. Text and data mining exceptions in the development of generative AI models: What the EU member states could learn from the Japanese "nonenjoyment" purposes? J World Intellect Prop,2023:27(1):44–68. doi:10.1111/jwip.12285
9. Dwivedi YK, Hughes L, Ismagilova E, Aarts G, Coombs C, Crick T, *et al*. Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. Int J Inf Manag,2019:57:101994. doi: 10.1016/j.ijinfomgt.2019.08.002
10. Dzurenda P, Ricci S, Sikora M, Stejskal M, Lendák I, Adao P. Enhancing Cybersecurity Curriculum Development: AI-Driven Mapping and Optimization Techniques. In: Proceedings of the 17th International Conference on Availability, Reliability and Security, 2024, 1–10. doi:10.1145/3664476.3670467
11. European Commission. EU to invest €180 million in cutting-edge digital technologies and research, 2023–2024. Available from: https://digital-strategy.ec.europa.eu/en/activities/digital-technologies-and-research
12. Escudero M a A, Abdiu M. Artificial Intelligence in European Urban Governance. In: Advances in electronic government, digital divide, and regional development book series, 2022, 88–104. doi:10.4018/978-1-7998-9609-8.ch006
13. Giannakos M, Azevedo R, Brusilovsky P, Cukurova M, Dimitriadis Y, Hernandez-Leo D, *et al*. The promise and challenges of generative AI in education. Behav Inform Technol, 2024, 1–27. doi:10.1080/0144929x.2024.2394886
14. Golub K. Automated Subject Indexing: An Overview. Catalog Classif Q,2021:59(8):702–719. doi:10.1080/01639374.2021.2012311
15. Gupta V. From hype to strategy: navigating the reality of experimental strategic adoption of AI technologies in

libraries. Refer Serv Rev, 2024. doi:10.1108/rsr-08-2024-0042
16. Gupta V, Gupta C. Leveraging AI Technologies in Libraries through Experimentation-Driven Frameworks. Internet Refer Serv Q,2023:27(4):211–222. doi:10.1080/10875301.2023.2240773
17. Hernández-Pérez O, Vilariño F, Domènech M. Public Libraries Engaging Communities through Technology and Innovation: Insights from the Library Living Lab. Public Libr Q,2020:41(1):17–42. doi:10.1080/01616846.2020.1845047
18. Holmes W, Tuomi I. State of the art and practice in AI in education. Eur J Educ,2022:57(4):542–570. doi:10.1111/ejed.12533
19. Hoofnagle CJ, Van Der Sloot B, Borgesius FZ. The European Union general data protection regulation: what it is and what it means. Inf Commun Technol Law,2019:28(1):65–98. doi:10.1080/13600834.2019.1573501
20. Infotoday.eu. From LIS to KM: How Library and Information Professionals are playing their part in the AI Revolution, 2024. Available from: https://www.infotoday.eu/Categories/Special-Libraries-469.aspx
21. Joint Research Centre. Artificial Intelligence. In A European Perspective, 2018. Available from: https://doi.org/10.2760/11251
22. Kamalov F, Calonge DS, Gurrib I. New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. Sustainability,2023:15(16):12451. doi:10.3390/su151612451
23. Breeding M. Library Technology Guides. Available from: https://librarytechnology.org/guides/
24. Mikeladze T, Meijer PC, Verhoeff RP. A comprehensive exploration of artificial intelligence competence frameworks for educators: A critical review. Eur J Educ, 2024, 59(3). doi:10.1111/ejed.12663
25. Misa TJ, Schot J. Introduction. Hist Technol,2005:21(1):1–19. doi:10.1080/07341510500037487
26. Molek N. AI and Organizational Transformation: Anthropological Insights into Higher Education. Izzivi Prihodnosti, 2023, 8(3, August 2023). doi:10.37886/ip.2023.007
27. Montresor S, Quatraro F. Green technologies and Smart Specialisation Strategies: a European patent-based analysis of the intertwining of technological relatedness and key enabling technologies. Reg Stud,2019:54(10):1354–1365. doi:10.1080/00343404.2019.1648784
28. Münster S, Maiwald F, Di Lenardo I, Henriksson J, Isaac A, Graf MM, *et al*. Artificial Intelligence for Digital Heritage Innovation: Setting up a R&D Agenda for Europe. Heritage. 2024;7(2):794–816. doi:10.3390/heritage7020038
29. Nawrat Z. Introduction to AI-driven surgical robots. Artif Intell Surg,2023:3(2):90–97. doi:10.20517/ais.2023.14
30. Oriji NO, Shonibare NMA, Daraojimba NRE, Abitoye NO, Daraojimba NC. Financial Technology Evolution in Africa: A Comprehensive Review of Legal Frameworks and Implications for AI-Driven Financial Services. Int J Manag Entrepreneur Res,2023:5(12):929–951. doi:10.51594/ijmer.v5i12.627
31. Pham L, O'Sullivan B, Scantamburlo T, Mai T. Addressing Digital and AI Skills Gaps in European Living Areas: A Comparative Analysis of Small and Large Communities. In: Proceedings of the AAAI Conference on Artificial Intelligence,2024:38(21):23119–23127. doi:10.1609/aaai.v38i21.30357
32. Rakap S. Chatting with GPT: Enhancing Individualized Education Program Goal Development for Novice Special Education Teachers. J Spec Educ Technol,2023:39(3):339–348. doi:10.1177/01626434231211295
33. Sayed A, Telbany S, Ashmawy S. AI-driven transformation: advancing information literacy at the British University in Egypt library. Cybrarians J,2024a:73:62–87. doi:10.70000/cj.2024.73.619
34. Sayed A, Telbany S, Ashmawy S. AI-driven transformation: advancing information literacy at the British University in Egypt library. Cybrarians J,2024b:73:62–87. doi:10.70000/cj.2024.73.619
35. Schimmelfennig F, Leuffen D, Rittberger B. The European Union as a system of differentiated integration: interdependence, politicization and differentiation. J Eur Public Policy,2015:22(6):764–782. doi:10.1080/13501763.2015.1020835
36. Sieber R, Brandusescu A, Adu-Daako A, Sangiambut S. Who are the publics engaging in AI? Public Underst Sci,2024:33(5):634–653. doi:10.1177/09636625231219853
37. Šola HM, Qureshi FH, Khawaja S. AI Eye-Tracking Technology: A New Era in Managing Cognitive Loads for Online Learners. Educ Sci,2024:14(9):933. doi:10.3390/educsci14090933
38. Strielkowski W, Grebennikova V, Lisovskiy A, Rakhimova G, Vasileva T. AI-driven adaptive learning for sustainable educational transformation. Sustain Dev, 2024. doi:10.1002/sd.3221
39. The official portal for European data | data.europa.eu. data.europa.eu. Available from: https://data.europa.eu/en
40. Venkatesh V, Raman R, Cruz-Jesus F. AI and emerging technology adoption: a research agenda for operations management. Int J Prod Res,2023:62(15):5367–5377. doi:10.1080/00207543.2023.2192309