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BEYOND GENERATIVE AI: AUTONOMOUS AI AGENTS, SMART AUTOMATION AND THE FUTURE OF EFFECTIVE LIBRARY SERVICES.

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Abstract
The swift emergence of artificial intelligence (AI) is changing the ways that libraries operate and provide their services with the scholarly focus slowly shifting from generative AI (GenAI) to autonomous or agentic AI and intelligent automation. While the applications of GenAI usually involve responding to user queries, an autonomous AI agent has the ability to plan, coordinate, and perform multi-stage tasks with little involvement of a person. This conceptual paper reviews the applications, problems, strategies for responsible deployment, and implications of autonomous AI agents and smart automation in library service delivery. Using contemporary literature, the paper evaluates their possible applications in reference and research services, collection management, cataloging, acquisitions, circulation, interlibrary loans, scheduling, and administration. The paper also addresses the technology, organization, human, ethical, and governance problems related to their deployment and suggests strategies for their responsible adoption. The paper presents a conceptual framework associating AI readiness, autonomous AI and smart automation, human-AI collaboration, and AI governance for responsible use to library services that are effective and future-oriented. The paper states that the usefulness of an autonomous AI system should not only be judged from its degree of automation but also from its ability to enable professional practice and efficiency as well as user-oriented library services.

Keywords: Autonomous Artificial Intelligence, Agentic AI, Smart Automation, Human–AI Collaboration, Effective Library Services.

Introduction

The advent of artificial intelligence (AI) technology is bringing about change in how academic libraries run their operations and deliver their services. The conversation about AI in the library context thus far has largely been about its use in

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generative and assistive purposes, such as chatbots, AI-based reference services, and the use of large language models (LLM) for information search, summarization, and content creation. These applications have shown AI's ability to improve the efficiency of librarians and library users when completing information tasks. However, advancements in AI are moving beyond systems that are simply reacting to user commands. There is now a generation of agentic or autonomous AI systems coming into existence.

The implication of this advancement is one that calls for an important question to be asked of libraries: what does it mean when AI is used not only to aid in the tasks performed by librarians or users but begins to carry out a sequence of library tasks with increased independence? The difference is significant. While a normal AI generative program would answer a query posed by a librarian asking it to write something, summarize a paper, or suggest search terms, the autonomous AI would be able to complete a sequence of connected tasks, make certain decisions along the way, and then follow through without requiring another command at every step. According to Deloitte (2025), agentic AI can be described as systems which are capable of completing multi-stage tasks with limited human intervention.

The importance of this technology is much more than just adding one more AI system in the context of the library. The agentic AI alters the way humans and the technology interact with each other. Rather than employing AI for helping with one specific task, libraries might now be able to entrust some interrelated routine or semi-routine tasks to the smart technology. Smart automation will also be able to help in automating processes which require a lot of repetition from the side of humans, and at

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the same time, involving humans in those processes where professionals' judgment is necessary.

At the same time, increased autonomy creates challenges that cannot be addressed using analysis of technology alone. Libraries work in environments where precision, privacy, accountability, professionalism, freedom of thought, and trust are all major concerns. Thus, allowing the AI system to perform tasks autonomously leads to questions about whether it is still responsible for its choices, how it can be controlled, how much information it is allowed to have access to, and what conditions must be met in order to make it necessary for a human to intervene. Therefore, such matters as infrastructure, staffing, AI literacy, data governance, privacy, accountability, and ethics may become more important as libraries consider moving from supportive to autonomous AI systems.

With regards to the Nigerian setting as well as library and information science at large, prior literature has primarily revolved around the issues of awareness, perceptions, readiness, intentions towards the adoption and use of AI and generative AI. Prior studies have produced useful insights into the issue of librarians' awareness and perceptions of AI technologies (Ajani et al., 2022; Abayomi et al., 2021). However, as the use of generative and assistive AI progresses towards autonomous AI and smart automation, an important conceptual question emerges: how should libraries prepare themselves for the arrival of AI that can undertake interrelated tasks in an increasingly autonomous manner? Ade-Ibijola & Okonkwo, 2023; Ayinde et al., 2026; Akin-Fakorede et al., (2026) submitted that preliminary research studies have been conducted concerning the subject of AI agents in library environment.

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It is for these reasons that the transition from generative AI to autonomous AI agents and smart automation cannot be considered merely as a technological move. Rather, this move may be indicative of a reorganizing process of the very nature of librarianship, including what tasks need to be done by humans, what may be assigned to AI technology, and where there will be no alternative but to make use of human judgment. The present paper attempts to move beyond this preoccupation with generative AI in order to explore the role of autonomous AI agents and smart automation within the context of librarianship. The paper offers a conceptual exploration of the opportunities for the application of autonomous AI and smart automation, the prerequisites and obstacles for the integration of such technology into librarianship, and the changing dynamics between human practitioners and autonomous AI technology.

From generative AI to autonomous AI agents and smart automation

The development of artificial intelligence in libraries is moving beyond systems that primarily generate, retrieve, or summarize information in response to user prompts. Generative AI (GenAI), particularly through large language models (LLMs), has expanded the capacity of libraries to provide conversational assistance, support information discovery, summarize documents, and facilitate research-related activities. These applications have demonstrated the potential of AI to improve the efficiency and accessibility of library services, although concerns relating to accuracy, privacy, ethics, staff competencies, and responsible use remain significant (Ngulube & Mosha, 2024; Zondi et al., 2024). A further development is represented by autonomous or agentic AI.

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Unlike conventional GenAI applications that generally require users to formulate prompts and evaluate generated responses, agentic AI systems can pursue defined goals by planning actions, using available tools, coordinating multiple steps, and adapting their actions with limited human intervention. This distinction is important because it shifts the role of AI from primarily assisting users or librarians towards performing coordinated tasks within organisational workflows. Ayinde et al. (2026) identify potential applications of agentic AI in academic libraries including event scheduling, collection weeding, and reference and research support, while Akin-Fakorede et al. (2026) emphasize that agentic systems can initiate actions, coordinate tasks, and participate more directly in organizational routines and decision-making, including cataloguing, collection culling, and reference and research assistance.

Applications of autonomous AI agents and smart automation in library services

AI agents and automated systems hold a lot of promise when it comes to extending the applications of AI in libraries beyond simple help to orchestrating whole processes and service operations. For instance, an AI agent can be programmed to receive a user's request for information, make sense of the information request, search relevant sources of information, synthesize results and generate a response or escalate any difficult questions to librarians. This means that the technology moves from helping users in the way chatbots do to being more pro-active in providing user services. Agentic AI will lead to more responsive user services and better workflow management since systems will become more adept at situational interpretation, initiating tasks and modifying its actions according to the situation, as observed by Oladokun (2026).

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Another area where there is huge potential for AI is research support. The agent can assist researchers in identifying relevant literature, tracking new literature, organizing information and conducting systematic search process among others. This is not limited to just generating a response to prompts; it can conduct research tasks through various stages based on set objectives. The capabilities of agentic AI as a reference and research agent are specifically pointed out by Ayinde et al. (2026), while also noting some potential in the field of scheduling and other library activities related to academics.

In the area of technical services and collection management, smart automation and autonomous agents can be used to aid cataloging, creation and verification of metadata, acquisitions, collection management, and weeding of collections. AI systems can detect inconsistencies in bibliographic data, suggest metadata, analyze collection use, and alert of materials that need to be considered for removal from the collection according to predetermined criteria. On the other hand, agentic systems can coordinate multiple tasks related to the above processes – detection of collection gaps, generation of recommendations, preparation of acquisition information, and allocation of the task to relevant library staff.

Intelligent automation can have applications in circulation, interlibrary loan, scheduling, and administrative processes as well. Routine tasks could be automated, while a robotic agent could orchestrate a transaction involving multiple steps. For example, an agent for interlibrary loan could find a requested item, check authorized sources, make a request, track the request process, and inform the user or librarian of the need for human intervention. These features could help with improved coordination

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of the workflow and service responsiveness in case there is a need to complete several routine processes in sequence. As noted by Oladokun (2026), the agentic artificial intelligence can make routine work easier and improve coordination in libraries.

However, the use of intelligent automation can go beyond the provision of specific services. Through connecting agents to the systems used in libraries to manage their activities, discover content, and provide authorized information, libraries could create integrated workflows of providing services, in which different processes would be performed in order to achieve a particular goal of a user or an organization. This could result in improved efficiency, response time, personalization, discovery, and consistency of services. Nevertheless, increased autonomy of processes would affect the idea of professional responsibility. Just as Akin-Fakorede et al. (2026) have pointed out, agentic AI may become more involved in organizational activities, raising issues related to professional accountability and ethical stewardship.

In this context, the future potential of autonomous AI agents and smart automation in the library environment cannot be considered merely in terms of how many activities they are capable of automating. Instead, their importance can be seen in terms of how we can re-design library services through the integration of intelligent human-AI collaboration so that the former carries out necessary routines and multi-step activities while the latter makes sure that it is done in a professionally sound manner.

Challenges associated with the adoption of autonomous AI in libraries

The adoption of autonomous artificial intelligence in library environments is faced with numerous technical, economic, human, ethical, and professional issues.

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Current literature on the use of AI in academic libraries pinpoints some of the main obstacles that hinder the use of AI in library environments, such as insufficient infrastructure, inadequate funding, insufficient skills among staff, poor quality of data, problems of integration, and lack of appropriate policy frameworks (Ayinde, Ebiefung, & Oladokun, 2026). The above-mentioned obstacles are especially relevant for autonomous AI systems that may have to interface with different systems and perform a variety of tasks with minimal supervision.

One of the key obstacles is insufficient technological infrastructure. Autonomous AI relies on sufficient digital infrastructure, reliable internet connection, computing facilities, interoperability of information systems, and structured data. In an environment that lacks the above-mentioned facilities, autonomous systems may not be able to access systems and data necessary for the proper performance of their duties. Furthermore, poor quality of bibliographic and institutional data may result in wrong actions or decisions of autonomous systems, while insufficient system integration limits the ability of autonomous systems to perform tasks in different library environments.

Insufficient funding is another problem that needs to be overcome. Money is needed not only for the acquisition or development of appropriate AI tools but also for infrastructure maintenance, security, and technical support. Thus, insufficient funding and poor infrastructure are major obstacles for AI in academic libraries. The second issue concerns human competencies and professionalism. For an AI to operate in an autonomous mode, the library professional should be able to comprehend, observe, assess, and control the process of operation of the AI tool. Akin-Fakorede et al., (2026) noted that insufficiencies in AI literacy, data management, critical analysis of AI output,

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AI agent design, privacy, cybersecurity, and policy issues in the field of AI may stand in the way of successful AI application. Furthermore, the more the process is automated, the less professional knowledge becomes relevant, especially when professional decision-making is gradually replaced by algorithms.

There are various concerns regarding ethics, privacy, accountability, and governance associated with autonomous artificial intelligence. The issue of accountability arises if the decision made using autonomous AI results in an error or a wrong decision, leading to accountability diffusion. The concept of privacy becomes especially significant in libraries because autonomous AI can work with sensitive information about users such as search histories, borrowing history, and interest in research. Other problems as noted by Akin-Fakorede et al. (2026) include bias in algorithms, errors in decisions made using AI, absence of transparency, intellectual property issues, and cybersecurity.

In conclusion, the increasing autonomy in artificial intelligence systems creates some difficulties concerning the proper limit between automation and professional expertise. There are some library operations which involve sensitive data, moral issues, intellectual property rights, or even some very important user decisions. Therefore, the ability of the autonomous system to perform such operations presents some risks when proper human intervention is not guaranteed.

Strategies for improving adoption of autonomous AI in libraries

The use of AI autonomy poses various difficulties that demand the consideration of a thoughtful and structured strategy at the library level rather than the mere adoption of autonomous technologies into the libraries' existing processes. Thus, the

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strategies adopted for responsible adoption have to take care of technological, financial, human, data, ethical, privacy, security, and professional challenges mentioned above. (Ayinde et al., 2026; Ngulube & Vincent Mosha, 2025).

The definition of appropriate AI autonomy needs to be the primary step. Libraries need to decide which tasks can be given to the autonomous technologies, which should demand human permission, and which have to be under professional supervision. The routine and less risky tasks can be left to automation while the tasks requiring decision-making based on ethics, involving sensitive data, intellectual property, and having a lot of impact on users will have to demand more human intervention (Akin-Fakorede et al., 2026). Such an approach will help avoid the problems related to accountability diffusion, poor AI decision-making, excessive reliance on algorithms, and professional deskilling.

Development of technological and organizational readiness is also crucial. Libraries need to identify deficiencies in their infrastructure, connectivity, computing resources, and system integration and take necessary steps to develop adequate digital infrastructure, information systems, and technical support. The necessary budget should be provided for technology procurement, maintenance, security, and support (Ajani et al., 2022; Ayinde et al., 2026).

The improvement of data quality and governance is required because the low quality of bibliographic and institutional data results in inaccuracies of actions made using AI. In this way, libraries have to increase the quality of data as well as implement policies for data access, privacy, security, and proper usage (Ngulube and Vincent

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Mosha, 2025). Thus, such strategy can help avoid problems caused by poor data, privacy concerns, cybersecurity issues, and incorrect AI-assisted decisions.

The development of librarian competencies via continuous professional development is necessary too. They should obtain the skills of AI literacy, data management, critical assessment of outputs provided by AI, agent configuration and monitoring, privacy and cybersecurity, and AI ethics. This way, the librarians will be able to avoid skill gaps and professional deskilling.

Having a clear policy and governance structure is very important in order to deal with problems related to accountability, transparency, ethics, intellectual property, privacy and security. Such a policy document should define the responsibilities for AI-enabled actions, level of autonomy, required human oversight, data access rules and response to mistakes or unethical decisions made by an AI system. In addition, ethical evaluation should be performed especially for systems dealing with confidential data or involving high-impact activities.

Furthermore, a phased approach to implementation should be adopted, which includes assessment, preparation, piloting, evaluation and scaling (Ajani et al., 2022; Ayinde et al., 2026; Ngulube & Vincent Mosha, 20. Assessment phase is dedicated to the identification of potential applications and readiness assessment, preparation phase includes building infrastructure, preparing skills, policies and governance structures. Starting from the lowest risk applications in piloting stage and considering accuracy, efficiency, security, usability and professional issues in the evaluation phase is very important.

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With these approaches, the adoption of autonomous AI can be seen as a continuous process of readiness, controlled introduction, human oversight, evaluation and improvement, helping to solve identified issues and utilizing advantages of autonomous AI and intelligent automation in libraries.

Human – AI collaboration and the future of effective library services

The emergence of autonomous AI agents and smart automation systems cannot be seen as the displacement of library professionals. It provides a chance for librarians, AI technologies, and library users to form a new dynamic relationship. While autonomous systems perform routine and repetitive tasks, librarians still have some unique skills in terms of professional judgment, interpretation of the context, ethical decision making, advocacy, and information assessment. Thus, the future of library operations is likely to be associated with successful human-AI interaction where technological capabilities enhance rather than replace professional capabilities.

In the case of successful human-AI collaboration, librarians can focus on tasks that require the use of their high-level professional and interpersonal skills, and let the autonomous systems carry out corresponding routine tasks. For instance, an AI agent can screen new publications, find materials relevant for a particular task, prepare metadata and offer recommendations to the librarian who makes final decisions. In the same vein, an autonomous agent can address standard reference queries and point the user towards the appropriate information, but any complicated queries which require contextualization, critical appraisal, or ethical judgment should be referred to a librarian. This kind of arrangement would be efficient, yet not at the cost of eliminating the human factor that is integral to providing good library service.

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It is especially important to consider the collaborative approach to such a system since increased autonomy means increased responsibility on the part of humans. An AI system can give out incorrect results, perpetuate bias embedded within its training data, misread the intent of the user, or make improper decisions when it goes beyond its predetermined framework. For these reasons, Akin-Fakorede et al. (2026) stress the importance of carefully calibrated degrees of autonomy and the need for human judgment in AI-enabled library contexts. As Ayinde et al. (2026) point out as well, the factors of accountability, privacy, user autonomy, and equity should be considered when implementing agentic AI in academic libraries.

Effective library service in the future may be marked by a move from librarian versus AI to librarian and AI collaboration. In this approach, effectiveness is not measured by the extent to which human activities can be automated, but rather by the degree to which technology can be used smartly to complement professional competence for better library user outcomes. Autonomous AI would enable faster, round-the-clock, and coordinated performance, while the human librarians will offer judgment, compassion, responsibility, ethical stewardship, and knowledge about the bigger information picture.

This approach also proposes that the position of the librarian will not vanish but change over time. Library specialists will increasingly be taking the roles of AI supervisors, evaluators, trainers, workflow designers, data custodians, and advocates of responsible technology. For this shift to happen, librarians need ongoing professional development and better understanding of AI so that they are capable of analyzing what the technology can and cannot do, and when autonomy would be beneficial. Thus, the

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future-ready library is not just a library that uses more AI technologies; it is a library where AI is intentionally incorporated into the professional practice.

Proposed conceptual framework for the future of effective library services

Based on the preceding discourse, the current paper presents a conceptual framework that views autonomous AI and smart automation as parts of the emerging library service environment. The proposed framework rests on the assumption that the future success of library services depends not only on having AI technologies but also on their interaction with the ability of the organization to use them effectively for libraries. Thus, the success will depend on the interplay between technological ability, organizational readiness, skills of individuals, responsible governance, and the strategic use of AI for libraries.

First of all, the suggested framework assumes that there are conditions of AI readiness. The conditions include technological, organizational, and environmental factors. Technological factors are the availability of adequate digital infrastructures, reliable connectivity, system interoperability, data quality, and cybersecurity. Organizational factors include management support, financial resources, individual skills, organizational policy, and organizational culture promoting responsible innovation. Environmental factors involve regulation, professional standards, vendors, and general technology developments. These are conditions for introducing autonomous AI and smart automation successfully.

Second, adoption of autonomous AI and smart automation should occur. If the right enabling factors are in place, libraries can determine how autonomous agents and smart automation could be beneficial for their services. For instance, they could be used

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for reference and research support, cataloging, acquisition and collection management, circulation, inter-library loans, scheduling, and administration processes. But the use of smart automation must not be motivated by achieving complete automation, but rather by assessing the level of complexity, risk, and sensitivity of each process.

Third, human – AI partnership should be established. Autonomous technologies must work within defined parameters; and there must be human oversight and control of the processes carried out by AI. Librarians can set workflows, define goals, assess outputs from the AI, monitor systems' performance, deal with exceptions, and make decisions based on professional judgment and ethics.

The fourth element is the governance of responsible AI, which applies to all the other phases in the framework. This should take into consideration privacy, data protection, cybersecurity, transparency, accountability, bias, intellectual property rights, user agency, and proper AI autonomy. Continuous evaluation should also be included in order to guarantee that AI services are still precise, safe, ethical, and align with professional library ethics. This is especially important since autonomous systems can perform any activity without having to wait for human intervention each time.

The last element is effective library services of the future. Once readiness is achieved, suitable AI, human-AI partnership, and responsible governance is implemented together, then autonomous AI and smart automation can help to deliver services quickly, efficiently, provide personal assistance to users, reduce routine tasks, improve workflow, and enhance research and information services.

Recommendations

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Based on the previous conceptual framework, this paper suggests that academic libraries should take the following actions:

1. Introduce autonomous artificial intelligence using a risk-based approach that starts with routine and low-risk functions and gradually expands to higher-level applications.
2. Prepare for technological implementation and organizational readiness through infrastructure, connectivity, systems compatibility, quality data, cybersecurity, and necessary funding.
3. Upgrade librarians' expertise in AI through continuous professional development in areas of AI literacy, data management, evaluation of AI-produced output, ethical considerations, privacy, and overseeing autonomous systems.
4. Develop AI governance policies in terms of privacy, transparency, accountability, intellectual property, biases, autonomy of users, and proper degree of AI autonomy.
5. Maintain human oversight when sensitive data, important decisions, ethical considerations, and user influence are involved.
6. Evaluate AI-assisted services based on service outcome and not the level of automation, taking into account such factors as accuracy, accessibility, response time, user satisfaction, efficiency, personalization, and quality of research and information assistance.

Conclusion

The advent of autonomous AI agents and smart automation is a significant milestone that surpasses the existing generation of Generative AI technologies used in

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libraries. While GenAI has been primarily concerned with the creation, retrieval, and processing of information by librarians and users, autonomous AI can make it possible to design systems capable of planning, coordinating, and performing multi-stage processes with little human involvement. Smart automation creates opportunities for the redesigning of existing library processes to increase their efficiency.

The present paper has argued that automation alone will not guarantee the future effectiveness of library services. Instead, their future effectiveness will be guaranteed through the interaction of AI readiness, proper autonomous AI and smart automation technologies, collaboration between humans and AI, and AI governance. The suggested conceptual framework integrates all these aspects and considers future-effective library services to be the desirable outcome of technological development.

The key implication is that the library cannot merely see autonomous AI as an instrument for creating information or reacting to stimuli. Rather, the autonomous AI can become part of larger workflows for reference, research assistance, collections management, technical services, circulation, interlibrary loans, and administrative tasks. Yet increased autonomy has to go hand in hand with appropriate professional oversight, ethical standards, training for employees, and ongoing evaluation of the system. Future-oriented library is not a library where people are replaced by AI but where librarians and intelligent systems work together in order to provide more efficient, more accessible, more responsive, more personalized and more effective services. The suggested model will serve as a theoretical basis for further empirical studies into the relationships between autonomous AI, smart automation, library professionals and library patrons.

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