

# A Study on the Construction of Core Competence for New-Type Academic Librarians in University Libraries in the Digital Intelligence Era: An Indicator System Based on Delphi and AHP

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## Abstract

The objectives of this article are 1) to identify the core competence dimensions of new-type academic librarians in the digital intelligence era, 2) to construct a systematic core competence indicator system using the Delphi method, and 3) to determine the relative importance of each competence dimension and indicator using the Analytic Hierarchy Process (AHP). This study adopted a methodological research design using a competence indicator construction framework as the research basis. The research area focused on university libraries undergoing digital and intelligent transformation. The sample consisted of 15 experts selected through purposive sampling, including academic researchers, library managers, digital transformation specialists, and related stakeholders. The research instruments included 1) a Delphi consultation questionnaire and 2) an AHP judgment matrix. Data were analyzed using descriptive statistics and consistency analysis.

The results of the research showed that: 1. A multi-dimensional core competence framework for new-type academic librarians was established, consisting of technology acceptance competence, explicit competence, and tacit competence. 2. The Delphi consultation confirmed a hierarchical indicator system with refined competence dimensions and sub-indicators that reflect the requirements of intelligent library services. 3. The AHP results indicated that explicit competence had the highest weight, followed by tacit competence and technology acceptance competence, highlighting the importance of AI-enabled skills and digital service capabilities in the digital intelligence era.

The findings provide a practical reference for librarian training, competence evaluation, and professional development planning in university libraries.

**Keywords:** Digital Intelligence Era; New-Type Academic Librarians; Core Competence; Delphi Method; Analytic Hierarchy Process (AHP)

## Introduction

The rapid development of digital intelligence technologies has reshaped the operational models of higher education institutions and accelerated the transformation of university libraries toward intelligent and user-centered services. With the integration of artificial intelligence, big data, and digital platforms, academic librarians are increasingly required to expand their professional roles beyond traditional information management to include data services, intelligent knowledge support, and innovative user engagement. Recent studies have emphasized the importance of digital competencies and service innovation in academic libraries; however, existing research has mainly focused on isolated skill sets rather than developing a systematic competence framework with hierarchical indicators and quantitative weighting (Zhang & Liu, 2023; Wang, 2022). Although scholars have proposed various competence models, there remains a lack of consensus on the core competence structure of new-type academic librarians in the digital intelligence era, indicating a clear research gap.

This study focuses on university libraries undergoing digital transformation and addresses the emerging competence requirements of new-type academic librarians as the target group. Researchers and practitioners have increasingly recognized the need for librarians to possess integrated competencies that combine technological adaptability, professional expertise, and innovative service awareness (Li et al., 2023). However, many existing frameworks are conceptual in nature and lack empirical validation through expert consensus and structured evaluation methods. Drawing on professional practice and recent developments in intelligent library services, this research aims to construct a competence indicator system that reflects real-world needs and supports sustainable professional development.

Therefore, this study aims to identify the core competence dimensions required for new-type academic librarians, to construct a hierarchical competence indicator system using the Delphi method, and to determine the relative importance of competence dimensions through the Analytic Hierarchy Process (AHP). Conducted within the context of digitally transforming university libraries, this research paper presents the development process of the competence indicator system, the weighting results derived from expert judgment, and their implications for librarian training and professional development. The findings contribute to both academic research on librarian competencies and practical strategies for advancing intelligent university library services (Wang, 2022; Zhang & Liu, 2023).



## Research Objectives

1. To identify the core competence dimensions of new-type academic librarians in the digital intelligence era.
2. To construct a systematic core competence indicator system using the Delphi method.
3. To determine the relative importance of each competence dimension and indicator using the Analytic Hierarchy Process (AHP).

## Literature review

### 1. Digital Intelligence Transformation in University Libraries

The rapid development of digital intelligence technologies has accelerated the transformation of university libraries toward intelligent, data-driven, and user-centered services. Artificial intelligence, big data analytics, and smart information systems have reshaped traditional library functions and expanded the roles of academic librarians beyond resource management (Zhang & Liu, 2023; Wang, 2022). Recent research highlights the need for librarians to adapt to digital environments and participate in knowledge innovation and digital service delivery. However, most studies focus on technological applications rather than systematically defining the competence structure required for librarians in the digital intelligence era.

### 2. Competence Development of New-Type Academic Librarians

Scholars have increasingly explored the competencies required for academic librarians facing digital transformation. Existing studies emphasize digital literacy, service innovation, interdisciplinary collaboration, and user-oriented support capabilities (Li et al., 2023). While these studies provide valuable insights into professional development, many competence frameworks remain descriptive and fragmented. There is still a lack of integrated models that combine technological adaptability, professional expertise, and personal attributes into a unified competence structure, indicating a gap in the current literature.

### 3. Core Competence Frameworks in Library and Information Science

Competence frameworks in library and information science have gradually shifted from traditional skill-based models toward integrated multidimensional structures emphasizing digital literacy, service innovation, and intelligent information management. Recent studies indicate that academic librarians are expected to combine technological adaptability with user-centered service competencies in response to digital transformation (Zhang & Li, 2021; Chen & Huang, 2022). However, many existing competence models remain descriptive and lack hierarchical indicator structures supported by empirical



validation, making them difficult to apply to professional training or evaluation systems. This highlights the need for a structured and measurable competence indicator system tailored to the digital intelligence era.

#### **4. Application of Delphi Method in Indicator System Construction**

In recent years, the Delphi method has been widely applied in education management and digital competency research to establish consensus-based indicator frameworks. Scholars have emphasized that iterative expert consultation can enhance the reliability and clarity of complex evaluation indicators in emerging professional fields (Lin et al., 2020; Wang & Zhao, 2021). Compared with traditional survey approaches, Delphi-based frameworks provide a more systematic process for refining professional competencies, especially in rapidly evolving digital contexts. Nevertheless, few studies have applied Delphi specifically to the competence development of new-type academic librarians within digitally transforming university libraries.

#### **5. Application of Analytic Hierarchy Process (AHP) in Competence Weighting Studies**

Recent research has increasingly employed the Analytic Hierarchy Process (AHP) to quantify expert judgment and determine the relative importance of competence indicators. Studies demonstrate that AHP enables researchers to convert qualitative assessments into structured weighting results, improving decision-making transparency in educational evaluation and professional development research (Liu et al., 2019; Zhao & Chen, 2023). Despite its advantages, limited studies integrate AHP with Delphi-derived indicator systems in the context of academic librarian competencies, revealing a methodological gap that this study aims to address.

**Summary of Literature Review** The literature suggests that recent studies have explored digital transformation in university libraries, professional competence development, and methodological approaches such as Delphi and AHP (Zhang & Li, 2021; Zhao & Chen, 2023). However, a systematic and weighted core competence indicator system tailored to new-type academic librarians in the digital intelligence era remains underdeveloped. Therefore, this research integrates Delphi and AHP to construct a hierarchical competence framework that bridges theoretical exploration and practical application.

### **Research Conceptual Framework**

This research is a methodological and indicator-construction study. The researcher developed the research framework based on the competence structure concept of new-type academic librarians in the digital intelligence era. Rather than examining causal relationships among variables, this study



focuses on identifying, structuring, and weighting core competence dimensions through expert consensus and systematic analysis. The framework integrates three primary competence domains: technology acceptance competence, explicit competence, and tacit competence, which together form the core competence structure of new-type academic librarians.

In this research, the study components include competence dimensions and indicators as the main analytical elements. The research process involves expert consultation using the Delphi method and weight analysis through the Analytic Hierarchy Process (AHP). The target group consists of experts and professionals in university libraries, digital transformation, and related academic fields. The conceptual structure serves as a guiding framework for indicator development, refinement, and evaluation rather than representing independent and dependent variables.

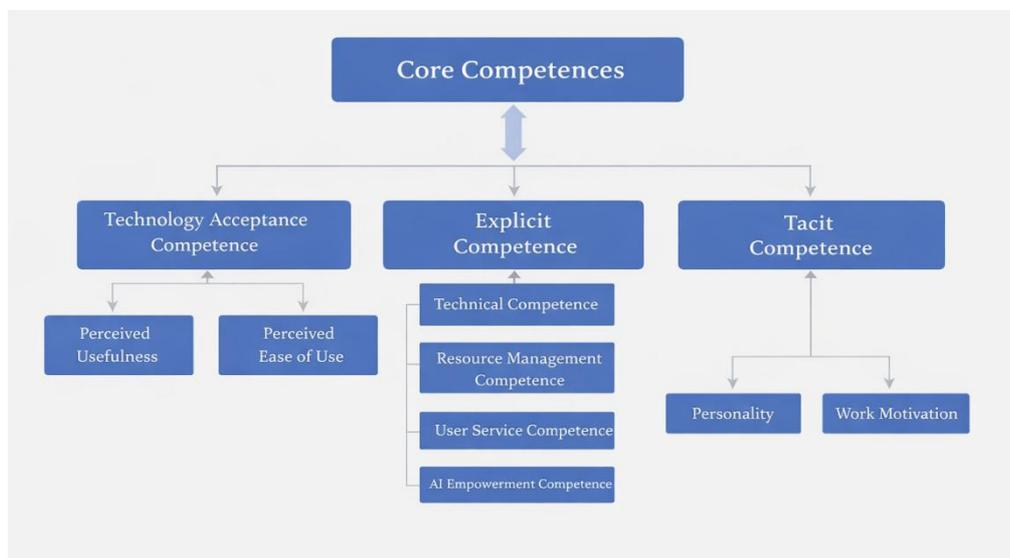


Figure 1 Conceptual framework for research

## Research methodology

This research is a methodological and indicator-construction study using the Delphi method and Analytic Hierarchy Process (AHP) to develop and evaluate the core competence indicator system of new-type academic librarians in the digital intelligence era.

The research procedures are as follows:

### 1. Document Analysis

Education books, research articles, policy reports, and related academic documents were reviewed to establish the theoretical basis and initial competence indicator pool. The document analysis focused on the following aspects:

- 1) Transformation and development trends of university libraries in the digital intelligence era.
- 2) Competence development and professional roles of new-type academic librarians.



3) Indicator construction and evaluation approaches in library and information science research.

## 2. Field Study and Expert Consultation Process

Field-oriented expert consultation was conducted to refine competence indicators and understand practical needs in university libraries. The procedures included:

1) Selecting experts and institutions through purposive sampling based on professional relevance to university libraries and digital transformation practices.

2) Collecting expert opinions through Delphi consultation, including structured evaluation and feedback rounds to revise competence indicators.

3) Conducting in-depth conceptual analysis of competence models, indicator structures, and professional development practices, emphasizing expert participation in refining the framework.

4) Summarizing results from document analysis and expert consultation to form a structured competence indicator system.

5) Analyzing the structural patterns and hierarchical relationships among competence dimensions using systematic comparison.

6) Developing final research conclusions and recommendations for competence development and professional training.

## 3. Key Informants

Key informants were experts selected according to the following criteria:

1) Individuals engaged in university library management, digital services, or related academic research.

2) At least five years of professional experience in library science, information management, or digital transformation fields.

3) Continuous involvement in professional practice or academic research related to librarian competence development.

## 4. Research Tools

The main research tools included:

1) Delphi expert consultation questionnaires for evaluating competence indicators.

2) AHP judgment matrices for calculating the relative weights of competence dimensions and indicators.



### 5. Data Collection

Data were collected through two rounds of Delphi expert consultation and AHP evaluation processes. Experts assessed the importance and appropriateness of competence indicators, and their judgments were recorded for subsequent analysis.

### 6. Data Analysis

Data analysis consisted of:

- 1) Indicator screening and refinement through Delphi consensus analysis.
- 2) Construction of hierarchical structures and weight calculation using Analytic Hierarchy Process (AHP).
- 3) Consistency testing of judgment matrices to ensure analytical reliability.

### 7. Presentation of Research Results

The research results were presented in the form of a hierarchical competence framework, indicator weighting tables, and structural diagrams. The findings provide a systematic reference for competence evaluation and training development of new-type academic librarians.

## Research Results

### Objective 1 To identify the core competence dimensions of new-type academic librarians in the digital intelligence era.

The findings for Objective 1 focused on identifying the core competence dimensions of new-type academic librarians in the digital intelligence era through document analysis and Delphi expert consultation. A hierarchical indicator system consisting of Technology Acceptance Competence, Explicit Competence, and Tacit Competence was established, covering key abilities such as digital technology application, AI empowerment, resource management, and user service. The results indicate a shift from traditional professional skills toward integrated digital and service-oriented competencies.

**Table 1** Finalized Core Competence Indicator System for New-Type Academic Librarians

Primary Dimension	Secondary Dimension	Tertiary Indicators
Technology Acceptance Competence	Perceived Usefulness	Ability to save service time; Ability to adopt new technologies; Ability to use digital tools to accomplish tasks
	Perceived Ease of Use	Interface operation skills; Learning and operational skills

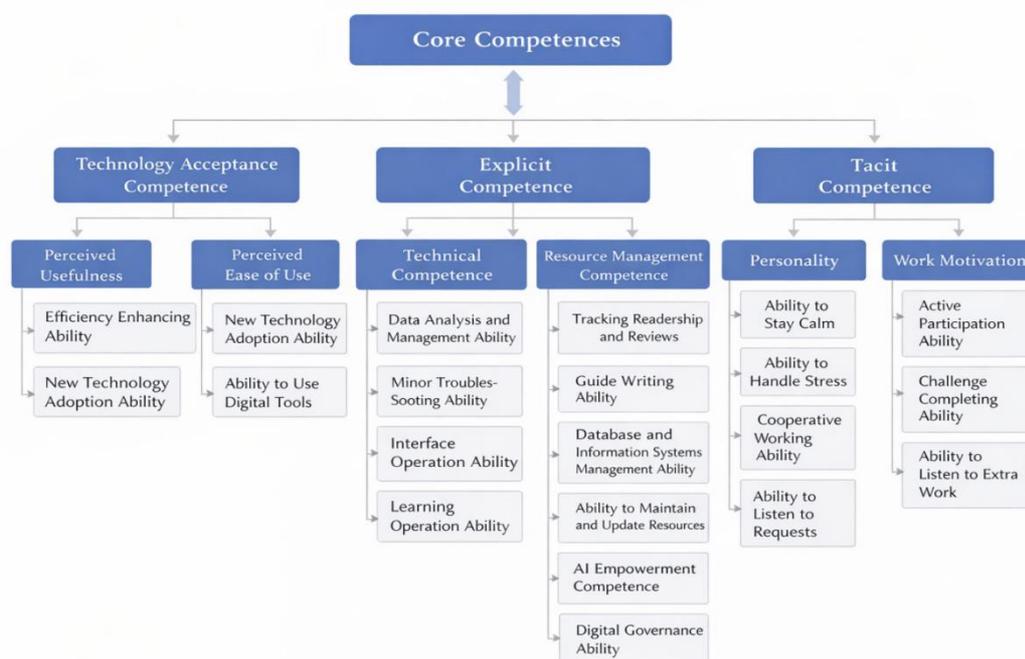


Primary Dimension	Secondary Dimension	Tertiary Indicators
<b>Explicit Competence</b>	Technical Skills	Data analysis and management ability; Minor technical troubleshooting ability; Knowledge management and information flow design ability
	Resource Management Competence	Reading and review tracking ability; Guideline writing ability; Database and information system management ability; Resource maintenance and updating ability
	User Service Competence	User needs insight ability; Communication skills and service awareness; Service consultation ability; Personalized service ability
	AI Empowerment Competence	AI tool application ability; AI knowledge literacy; AI ethics and security awareness; Digital governance ability; Digital service ability
	<b>Tacit Competence</b>	Personality Traits
Work Motivation		Proactive participation in management; Ability to complete challenging tasks; Willingness to undertake additional work; Emergency task handling ability

From Table 1, it can be observed that the finalized core competence indicator system consists of three primary dimensions with multiple hierarchical indicators reflecting the evolving roles of academic librarians in the digital intelligence era. Technology Acceptance Competence emphasizes digital tool usage and adaptability, Explicit Competence highlights professional skills such as resource management, AI empowerment, and user service, while Tacit Competence focuses on personal qualities and work motivation. The structured hierarchy demonstrates that modern librarian competencies require an integration of technical abilities, service innovation, and adaptive professional attributes.



**Objective 2** To construct a systematic core competence indicator system using the Delphi method.



**Figure 2** Hierarchical Structure of the Core Competence Indicator System

The results showed that through multiple rounds of expert consultation using the Delphi technique, the initial competency indicators were screened, revised, and refined until consensus was achieved among the experts. The finalized indicator system consists of three primary competence dimensions: technology acceptance competence, explicit competence, and tacit competence, which are further divided into several secondary categories and specific indicators. The Delphi process ensured the clarity, relevance, and practical applicability of each indicator, forming a structured hierarchical framework for academic librarians in the digital intelligence era. Figure 2 illustrates the hierarchical structure of the finalized core competence indicator system derived from the Delphi analysis.

**Objective 3** To determine the relative importance of each competence dimension and indicator using the Analytic Hierarchy Process (AHP).

**Table 2** Summary of Weighting Results of Core Competence Dimensions

Primary Dimension	Weight (%)	Secondary Dimension	Weight (%)
Technology Acceptance Competence	7.196	Perceived Usefulness	75.009
		Perceived Ease of Use	24.991



Primary Dimension	Weight (%)	Secondary Dimension	Weight (%)
Explicit Competence	64.912	Technical Skills	9.521
		Resource Management Competence	29.016
		User Service Competence	5.639
		AI Empowerment Competence	55.824
		Personality Traits	83.333
Tacit Competence	27.891		
Work Motivation	16.667		

The results showed that explicit competence obtained the highest overall weight (64.912%), indicating that practical professional abilities remain the most critical factor for new-type academic librarians in the digital intelligence era. Within this dimension, AI empowerment competence received the highest secondary weight (55.824%), reflecting the growing importance of intelligent technologies and digital services. Tacit competence accounted for 27.891%, with personality traits showing a significantly higher weight (83.333%) compared with work motivation. Technology acceptance competence represented 7.196%, where perceived usefulness (75.009%) was considered more influential than perceived ease of use (24.991%). These findings suggest that while technological adaptability is necessary, professional expertise and AI-related competencies play a more dominant role in supporting modern academic library services. The detailed weighting results are presented in Table 2.

## Discussion of research findings

The results of the Objective 1 study showed that the core competence framework of new-type academic librarians consists of three primary dimensions: technology acceptance competence, explicit competence, and tacit competence. This finding reflects the transformation of academic librarians' roles from traditional information managers to digitally empowered service professionals. The integration of technical skills, user service capabilities, and personal attributes indicates that librarian competencies have become more comprehensive in the digital intelligence era. This may be because university libraries are increasingly required to provide intelligent and user-centered services supported by digital technologies, which demand both professional expertise and adaptive personal qualities. Previous



studies have also emphasized the importance of integrating technological literacy with service innovation to meet the evolving needs of academic library environments (Zhang & Liu, 2023; Li et al., 2023). The structured competence dimensions identified in this research therefore extend existing models by providing a clearer hierarchical framework for professional development.

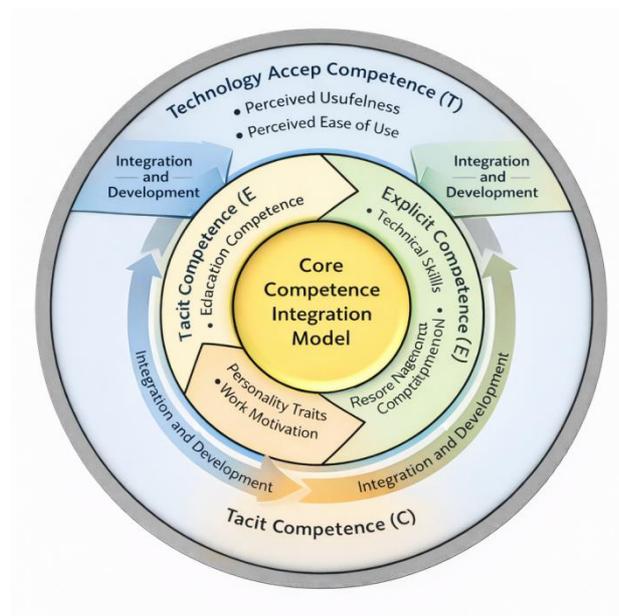
The results of the objective 2 research showed that the Delphi method effectively facilitated expert consensus in constructing a systematic core competence indicator system. Through iterative consultation and evaluation, redundant indicators were removed and the clarity of competence descriptions was improved, resulting in a structured and practical framework. This may be because the Delphi process allows experts from different professional backgrounds to collectively refine complex competence concepts, thereby enhancing the reliability and applicability of the indicator system. Supporting research suggests that expert-based consensus methods are particularly suitable for developing evaluation frameworks in emerging professional contexts where standardized indicators are still evolving (Wang, 2022). The finalized hierarchical structure presented in this study demonstrates how expert knowledge can be translated into a coherent competence model aligned with real-world academic library practices.

The results of the objective 3 research showed that explicit competence obtained the highest weighting among the three primary competence dimensions, followed by tacit competence and technology acceptance competence. This may be because practical professional skills and AI-related capabilities play a central role in supporting digital service innovation within modern university libraries. In particular, the high weight assigned to AI empowerment competence highlights the increasing importance of intelligent technologies in academic library services. Previous literature has indicated that digital transformation requires librarians to possess not only technological awareness but also advanced service and knowledge management abilities (Li et al., 2023). The weighting results therefore provide empirical support for prioritizing professional skill development and AI literacy in future training programs for academic librarians.

### **New knowledge from research**

This research proposes a structured core competence framework for new-type academic librarians in the digital intelligence era. The new knowledge derived from this study can be summarized as a three-layer competence structure integrating technology acceptance competence, explicit competence, and tacit competence. The framework emphasizes the interaction between technological adaptability, professional service capability, and personal development, forming a holistic competence model that reflects the transformation of academic librarians' roles in intelligent library environments.





**Figure 3** Core Competence Integration Model for New-Type Academic Librarians in the Digital Intelligence Era

Technology Acceptance Competence (T) focuses on librarians' ability to understand and adapt to emerging digital tools and intelligent systems. It highlights perceived usefulness and perceived ease of use as key elements that influence how librarians integrate new technologies into daily services.

Explicit Competence (E) represents observable professional skills, including technical competence, resource management competence, user service competence, and AI empowerment competence. This dimension reflects the practical capabilities required for delivering intelligent and user-centered academic library services.

Tacit Competence (C) emphasizes internal characteristics such as personality traits and work motivation. These elements support collaborative work, problem-solving ability, and adaptability in rapidly changing digital environments.

Integrated Application and Development (A) highlights the dynamic interaction among the three competence dimensions. The framework suggests that the effective development and dissemination of professional knowledge rely on balancing technological literacy, professional expertise, and personal growth, enabling academic librarians to respond to the evolving demands of digital intelligence transformation.



## Conclusion

This article provides a systematic overview of the core competence structure required for new-type academic librarians in the digital intelligence era. The study identified a multidimensional competence framework consisting of technology acceptance competence, explicit competence, and tacit competence, reflecting the transformation of librarians' professional roles in intelligent academic library environments. Through the Delphi method, a structured indicator system was constructed and refined based on expert consensus, ensuring the relevance and practicality of each competence dimension. Furthermore, the Analytic Hierarchy Process (AHP) revealed that explicit competence holds the highest importance, followed by tacit competence and technology acceptance competence. These findings highlight the growing importance of AI empowerment, professional service skills, and adaptive personal qualities in supporting digital transformation within academic libraries.

## Suggestions

### 1. Suggestions for the utilization of research findings

The results of the research objective 1 showed that the core competence of new-type academic librarians is composed of three integrated dimensions, indicating the need for comprehensive professional development strategies. Therefore, university libraries and related institutions should design training programs that integrate technological literacy, professional service skills, and personal development to support sustainable librarian development.

The results of the second objective research showed that the Delphi method successfully established a systematic competence indicator framework through expert consensus. Therefore, relevant authorities should adopt this indicator system as a reference for competency evaluation, recruitment standards, and professional training frameworks in academic libraries to ensure alignment with digital intelligence transformation.

The results of the 3<sup>rd</sup> objective research showed that explicit competence, especially AI empowerment competence, obtained the highest weight in the AHP analysis. Therefore, academic libraries should prioritize AI-related training, digital service innovation, and knowledge management practices to enhance librarians' capability in delivering intelligent and user-centered services.

### 2. Suggestions for the next research

This research has generated important new knowledge regarding the integration of technological adaptability, professional competence, and tacit personal attributes within a unified competence framework. Future studies can apply this framework to different cultural contexts, library



systems, or educational environments, with a focus on validating the model through empirical performance evaluation or longitudinal studies. Further research may also explore how emerging AI technologies reshape librarian competencies and how training programs can be optimized to support continuous professional development in rapidly changing digital environments.

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