Development of a Training Curriculum in Asset and Facility Management for University Staff in China: A Needs Assessment Approach

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ABSTRACT
The purposes of this research were to: (1) develop a training curriculum in asset and facility management for university staff in China, and (2) evaluate the appropriateness of the developed training curriculum. The sample for this research consisted of two phases: Phase 1 included 30 university staff members in China, and Phase 2 included 5 experts comprising 2 specialists in curriculum and instruction, 2 in measurement and evaluation, and 1 administrator in China. The research instruments consisted of: (1) a needs assessment questionnaire, (2) a draft training curriculum in asset and facility management for university staff, and (3) an evaluation form for assessing the appropriateness of the training curriculum. The data were analyzed using mean, standard deviation, and Modified Priority Needs Index (**$PNI_{Modified}$**) analysis. The research results revealed the following findings: (1) From the ranking of essential needs, the Priority Needs Index analysis found that the necessary competencies for Process Skills and Techniques for Asset and Facility Management include life cycle cost analysis skills, preventive maintenance planning skills, asset valuation skills, strategic asset management planning skills, and asset registry system management skills, with **$PNI_{Modified}$** values of 0.92, 0.74, 0.64, 0.55, and 0.53, respectively. The Basic Knowledge and Concepts of Asset and Facility Management include knowledge of trends and developments in asset management, knowledge of asset life cycle, understanding of types and classification of university assets, knowledge of principles and concepts in asset management, and understanding of facility management in universities, with **$PNI_{Modified}$** values of 0.92, 0.68, 0.50, 0.44, and 0.42, respectively. Both competency areas require further development through systematic training interventions. (2) The training curriculum in asset and facility management for university staff contains five essential curriculum components: principles and rationale, training objectives, content scope and training time, training approach and training activities, and measurement and evaluation. (3) The evaluation of the appropriateness of the training curriculum in asset and facility management for university staff found that the curriculum elements across seven evaluation areas were rated as "Most Appropriate," with an overall average score also rated as "Most Appropriate."
Keywords: Asset management, Facility management, Needs assessment approach, $PNI_{Modified}$, Training curriculum

INTRODUCTION
Public infrastructure constitutes an essential component of government assets, providing fundamental support for ensuring efficient operations and performance of administrative institutions, improving public service delivery levels, and promoting healthy economic and social development. However, contemporary asset management practices are hindered by various systemic factors, particularly the lagging development of infrastructure management systems and related operational frameworks. The widespread emphasis on asset management remains insufficient, leading to incomplete accounting practices, non-comprehensive government balance sheets, unclear asset management unit boundaries, and inadequate asset management systems with ambiguous management subjects and unclear lines of authority.

Asset and facility management for university staff is crucial for ensuring that personnel possess the knowledge, understanding, and capabilities to perform their duties effectively. The increasing complexity and strategic importance of managing physical assets and facilities in higher education institutions has elevated the significance of this field. The development of asset and facility management has evolved with international standards such as

ISO 55000, which focuses on lifecycle management guidelines and asset value optimization (Tse, 2018). Facility management has similarly progressed as a professional discipline, combining knowledge management, property management, and process management, with specialized curricula developed to meet industry-specific requirements (Chin, 2007).

The importance of effective asset and facility management in universities cannot be overstated, given the substantial financial investments in infrastructure development and the significant impact of facility quality on academic outcomes and institutional reputation (Mahmoud et al., 2024; Naji et al., 2023). Consequently, inadequate facility management can result in operational inefficiencies, increased costs, and compromised learning environments (Aigbavboa & Aghimien, 2023; Chikafalimani et al., 2021).

Preparing university personnel with the competencies necessary for effective asset and facility management requires the development of comprehensive training curricula and curriculum standards, which are often tailored to the specific needs of each institution (Awang et al., 2014). While some universities have developed training curricula, significant differences remain in training quality, particularly across diverse institutional contexts (Peiris et al., 2024). A contentious issue persists regarding the optimal balance between technical skills development and the ability to manage various operational aspects of asset and facility management. Additionally, there are ongoing challenges in integrating emerging technologies such as Building Information Modelling (BIM), Geographic Information Systems (GIS), and Internet of Things (IoT) technology into training curricula (Di Giuda et al., 2024; Hanum et al., 2024; Ismaeil, 2023).

The absence of formal regulations and quality assurance mechanisms for asset management training further exacerbates this competency gap. Knowledge deficiencies among personnel create significant risks to the sustainability and operational efficiency of university facilities, with broader implications for educational quality and institutional sustainability (Antwi et al., 2024; Chikafalimani et al., 2021).

In the context of widespread information technology adoption today, implementing effective information management technology requires the construction and improvement of comprehensive asset information systems, inventory adjustments, and regular disclosure and verification of fixed assets in public facilities. Dynamic supervision of fixed assets in public facilities can be achieved through various information technologies, including databases and network barcode systems. Public infrastructure projects require information support and data assurance throughout their entire lifecycle, from asset procurement and allocation to operational management and disposal. Public infrastructure modules can be independently established with detailed project divisions and standardized configurations. The classification labels of public infrastructure assets can be clearly defined and integrated into comprehensive fixed asset information systems (Hamidah, 2024; Saito & Tsunekawa, 2024).
Asset and facility management in higher education institutions is increasingly recognized as a critical component for enhancing institutional operational efficiency. However, implementation challenges often arise due to insufficient staff capacity and the lack of systematic training curricula designed to develop essential competencies in this specialized field.

Developing training curricula represents an effective approach to enhancing the practical competencies of professionals. By establishing clear training objectives, designing modular curricula, strengthening interactive and self-directed learning opportunities, optimizing learning experiences, and implementing continuous monitoring and evaluation strategies, training effectiveness can be significantly improved, cultivating highly skilled practitioners for organizations. With the continuous advancement of technology and ongoing innovation in educational methodologies, training curricula will play an increasingly important role in professional development and talent cultivation.

Therefore, this research aimed to develop a training curriculum to enhance learning achievement in asset and facility management among university staff in China. This training approach combines the flexibility of modular learning with the practical benefits of face-to-face instruction. The blended format enables participants to acquire theoretical concepts through structured modules while applying their knowledge through hands-on workshops and practical training sessions. This study addresses the challenges of time constraints and diverse learning needs among university staff, allowing them to develop essential competencies without disrupting their daily work responsibilities.

LITERATURE REVIEW

Asset and Facility Management Competencies

The ability to manage assets and facilities in Chinese universities with a focus on sustainability practices represents a major component of the globally expanding field of sustainable development research and plays a crucial role in

higher education institutions (Du et al., 2020; Oliveira & Proença, 2025). Over the past decade, Chinese educational institutions have evolved from initial green campus initiatives to more comprehensive sustainability frameworks, reflecting both national policies and global sustainability goals (Du, 2021). With more than 2,600 higher education institutions serving millions of students, the environmental impact and operational efficiency of university facilities have become increasingly significant, emphasizing the practical importance of effective asset and facility management for sustainable development (Wang, 2024). Furthermore, such management practices enhance institutional reputation and promote stakeholder engagement in asset and facility governance (Lok et al., 2024; Mahmoud et al., 2024).

Despite growing interest, challenges in implementing effective asset and facility management with sustainability practices persist in Chinese universities (Wang, 2024). Existing frameworks often lack comprehensive stakeholder engagement and integration (Dawodu et al., 2023). Many studies emphasize technical and infrastructure improvements, while some focus primarily on regulatory compliance factors, overlooking the critical role of leadership and organizational culture in facility management (Qiu & Li, 2017). This gap leads to improper resource utilization, resulting in inefficient asset management and inadequate sustainability integration (Liu & Gao, 2020). Therefore, developing comprehensive asset and facility management capabilities in Chinese universities requires a focus on sustainable practices and the implementation of evidence-based best practices (Mahmoud et al., 2024; Wang, 2024).

Training Curriculum Development

The development of training curricula comprises several essential components that cannot be overlooked, including setting clear learning objectives aligned with institutional goals, determining appropriate training content, implementing learner-centered training approaches, and conducting continuous assessment. The framework for developing an effective training curriculum for university personnel demonstrates a variety of approaches, including theoretical concepts, design principles, technological integration, competency-based frameworks, participatory learning strategies, and stakeholder involvement. As detailed:

1) Stakeholder engagement and contextual relevance involves faculty, students, and the community in curriculum design, ensuring that the curriculum responds to operational, educational, and societal development needs. Collaboration and co-design foster ownership, improve curriculum quality, and enhance alignment with local contexts (Gaweł et al., 2023; Nicolettou et al., 2024).

2)Establishing a framework and model for training curriculum development with an emphasis on collaboration involves implementing a structured approach that links curriculum outcomes to societal and industry needs. Expert review ensures consistency between learning objectives, content, training methods, and assessments, maintaining curriculum coherence and relevance (Lin et al., 2024; Selvakumar et al., 2024; Steketee et al., 2024).

3)Learning management principles emphasize a highly learner-centered approach that promotes active learning and creates a sense of community, which is essential for developing effective curricula (Gachago et al., 2021). The importance of objective consistency, regular instructional activities, and systematic assessments promotes meaningful learning experiences for participants (Selvakumar et al., 2024).

4)Integration of technology and digital competencies plays a crucial role in modern curriculum development, incorporating frameworks for digital competency development and the integration of online and blended learning models (Albashiry et al., 2024; Phan et al., 2024). Online training curricula demonstrate practical strategies that leverage digital tools and promote comprehensive STEAM capabilities, where technology adoption contributes significantly to curriculum success (Uzorka et al., 2025).

5)Continuous evaluation and improvement encompasses a curriculum development cycle that includes design, implementation, and evaluation phases, with a focus on continuous improvement decisions (Nicolettou et al., 2024). For example, systematic approaches are employed to assess curriculum quality and the competency development of staff members who participate in training. Faculty development curricula include assessment components to evaluate knowledge acquisition outcomes and behavioral changes among participants (Azme, 2024; Kohan et al., 2023).

Need assessment

Needs assessment is a critical process in training curriculum development that identifies gaps between current and desired conditions to ensure that training curricula are developed effectively to meet organizational requirements. This process is essential for aligning training curriculum objectives with organizational goals and ensuring that curricula are relevant and appropriately targeted. The Enhanced Priority Needs Index methodology (**$PNI_{Modified}$**) serves as a systematic tool for prioritizing these identified needs, ensuring that the most significant gaps are addressed first. This approach is particularly valuable in educational settings where the development of competencies such as critical thinking and profession-specific skills among personnel is paramount. Using **$PNI_{Modified}$** to prioritize training needs involves comparing current competency levels with desired competency

standards (Klaharn, 2017), enabling the identification of competency gaps and priority areas that help effectively prioritize training curriculum development needs (Park et al., 2023).

Research Objective

This research has two primary objectives:

1)To develop a training curriculum in asset and facility management for university staff.

2)To evaluate the appropriateness of the developed training curriculum.

Research Hypotheses

This research proposes two hypotheses:

1)The training curriculum in asset and facility management for university staff includes comprehensive curriculum components.

2)The training curriculum in asset and facility management for university staff demonstrates high appropriateness.

Conceptual Framework

Figure 1

Conceptual Research Framework

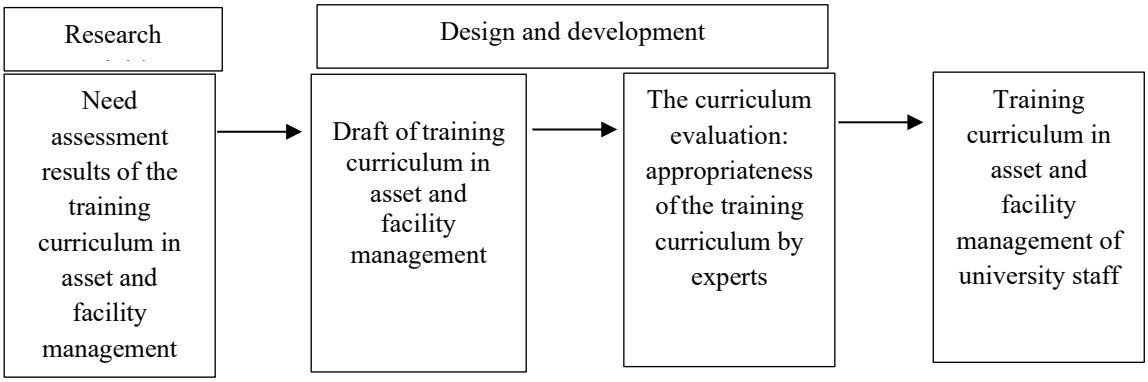

Figure 1.1 Conceptual research framework of the development of training curriculum in asset and facility management for university staff in China

Research Methodology

Research Design

The design of the research was research and development (R&D)

Population and Sample

Phase 1: Assessing the Needs for Developing a Training Curriculum

The research population includes university staff members responsible for asset and facility management operations at universities in China. These personnel actively manage institutional assets, facilities, and related organizational resources. The study employs a sample of 30 staff members currently serving in asset and facility management positions at Sichuan University of Science and Engineering in China during the 2025 academic year. The sample selection utilizes purposive sampling technique to ensure representation of various roles and responsibilities within the asset and facility management domain.

Phase 2: Developing a Training Curriculum in Asset and Facility Management for University Staff

This phase included 5 experts comprising 2 specialists in curriculum and instruction, 2 specialists in measurement and evaluation, and 1 administrator in China.

Research Instrument:

1)Needs Assessment questionnaire for Training Curriculum Development Asset and Facility Management for University Staff.

The questionnaire development process involved the following systematic steps: 1) Literature review of research related to asset and facility management competency frameworks; 2) Design of the initial questionnaire using a comprehensive instrument covering four main sections based on the Priority Needs Index (PNI) method, employing a dual assessment system (current situation versus desired situation) with five-level indicators. The questionnaire was divided into four sections: general information of respondents, assessment of current and desired situations, content requirements and training format, and problems, obstacles, and suggestions; 3) Content and structural validation by three experts, with Index of Item-Objective Congruence (IOC) values ranging from 0.67 to 1.00; 4) Pilot testing and refinement to address identified issues; 5) Finalization of the complete instrument; and 6) Data collection from a sample of 30 participants.

2) Draft Training Curriculum in Asset and Facility Management for University Staff

The researchers developed a draft training curriculum in asset and facility management for university staff through the following systematic steps:

1)Data Analysis: Researchers analyzed data collected from the needs assessment questionnaire and organizational documents. The analysis focused on identifying key competency gaps, training priorities, and specific requirements for asset and facility management staff to inform curriculum development.

2)Objective Development: Based on the analyzed data, specific learning objectives were created. These objectives were designed to address knowledge, skills, and attitudes in asset and facility management, with measurable performance indicators aligned with job requirements.

3)Content Organization: The curriculum content was organized into four comprehensive modules based on identified competency areas. Each module was designed with specific learning objectives, content, activities, and assessments that align with the identified needs and organizational context of Sichuan University of Science and Engineering.

4)Training Activity Design: Training activities were designed using a blended learning approach, combining lectures by expert speakers, group discussions, practical workshops, and online learning components. Training activities were specifically aligned with the established objectives and content requirements.

5)Evaluation System Development: A comprehensive evaluation system was developed to measure learning effectiveness. This included pre-training assessments to establish baseline competencies and post-training assessments to evaluate overall learning outcomes. The evaluation framework examined the training process comprehensively, including curriculum objectives, content delivery, and instructional activity effectiveness.

6)Internal Quality Review: The researchers assessed the appropriateness and consistency of the draft training curriculum elements before submitting it to external experts for evaluation.

7)Expert Validation: The evaluation form was submitted to five experts to assess the appropriateness of the draft curriculum using a 5-point rating scale (5 = highest, 4 = high, 3 = moderate, 2 = low, 1 = lowest). The evaluation criteria were: 4.51-5.00 = Highest, 3.51-4.50 = High, 2.51-3.50 = Moderate, 1.51-2.50 = Low, 1.00-1.50 = Lowest. Expert assessments ranged from 4.64 to 5.00, with an overall mean of 4.95 and standard deviation of 0.19, indicating "Most Appropriate" suitability.

8)Curriculum Refinement: The researchers made adjustments based on expert recommendations before implementation.

9)Final Implementation: A complete training curriculum manual was created and prepared for practical implementation.

Data collection

The data collection process was conducted through the following systematic steps:

1) Institutional Authorization: The researcher obtained official permission from Sichuan University of Science and Engineering in China to conduct the research study, ensuring compliance with institutional research protocols and ethical guidelines.

2) Questionnaire Distribution: The researcher distributed questionnaires to the target sample of 30 staff members working in asset and facility management positions across various departments within the university.

3) Participant Briefing: The researcher provided clear instructions and comprehensive explanations of the research objectives to all participants to ensure accurate and complete responses. This included clarification of any questions regarding the questionnaire items and research procedures..

4) Data Collection: The completed questionnaires were systematically collected and organized for subsequent data analysis, maintaining confidentiality and proper documentation procedures.

5) Data Validation: The researcher verified the completeness and validity of all returned questionnaires before proceeding with data analysis, ensuring data quality and research reliability.

Data analysis

Phase 1: Assessing the Needs for Developing a Training Curriculum

The following statistical methods were employed to analyze the collected data:

1)Demographic Analysis: The demographic information from the questionnaires was analyzed using descriptive statistics, including frequency distribution and percentage calculations, to describe the characteristics of the respondents.

2)Training Needs Assessment: The training needs and interests data were analyzed using mean (M) and standard deviation (SD). The interpretation of the 5-point rating scale followed these criteria: 4.51-5.00 (highest), 3.51-4.50 (high), 2.51-3.50 (moderate), 1.51-2.50 (low), and 1.00-1.50 (lowest).

3)Priority Needs Analysis: The Modified Priority Needs Index (**$PNI_{Modified}$**) was employed to identify and prioritize training needs using the following formula (Wongwanich, 2019):

The Modified Priority Needs Index (**$PNI_{Modified}$**) which has the following formula

$$PNI_{Modified} = (I - D) / D$$

Where:

I (Importance) represents the desired level of conditions that should occur (Desired Situation)

D (Degree of Success) represents the current level of actual conditions (Current Situation)

This index enables the identification of competency gaps by comparing desired performance levels with current capabilities, with higher PNI values indicating greater training priority.

4) Qualitative Data Analysis: The qualitative data from open-ended responses were analyzed using content analysis to identify key themes and patterns. These findings were synthesized with the quantitative results to provide comprehensive insights for curriculum development.

Phase 2: Development of a Training Curriculum in Asset and Facility Management for University Staff

The data analysis for determining the appropriateness and consistency of the training curriculum employed the following evaluation criteria:

Interpretation of Mean Scores:

The expert evaluation ratings were interpreted using a 5-point scale with the following criteria:

4.50 – 5.00: Most appropriate
3.50 – 4.49: Very appropriate
2.50 – 3.49: Moderately appropriate
1.50 – 2.49: Less appropriate
1.00 – 1.49: Least appropriate

These criteria enabled systematic assessment of curriculum components, including content relevance, structural organization, instructional design, and overall appropriateness for the target audience. The mean scores from expert evaluations provided quantitative measures of curriculum quality and guided refinements to ensure optimal training curriculum effectiveness.

Results

In developing the training curriculum in asset and facility management for university staff in China, the results are as follows:

Phase 1: Assessing the Needs for Developing a Training Curriculum

Section 1: General Information of Respondents

The general information from 30 respondents revealed several key demographic characteristics. There was an equal proportion between males and females, each accounting for 50 %, demonstrating a balanced gender distribution among respondents. Most respondents were in the 31-40 years age range, accounting for 33.33 %, while other age groups showed equal distribution at 16.67 % each, including 20-30 years, 41-50 years, 51-60 years, and over 60 years.

Regarding educational background, most respondents held education levels lower than a bachelor's degree, accounting for 33.33 %, followed by those with bachelor's degrees at 26.67 %. Master's and doctoral degree holders each represented 16.67 % of the sample, while those with other qualifications comprised 6.67 %.

Departmental distribution showed that most respondents belonged to the Finance Department (26.67 %), followed by the Logistics Department (23.33 %), the Laboratory Management Office (16.67 %), and other university departments (33.33 %). Job positions were evenly distributed across all organizational levels, with each position accounting for 16.67 %, including administrators, department heads/section heads, supply/asset officers, facility officers, academic staff, and support staff, representing comprehensive organizational hierarchy coverage.

Experience in asset and facility management varied significantly among respondents. Most had 1-3 years of experience (30.00 %), followed by those with less than 1 year of experience (23.33 %), no experience (20.00 %), 4-6 years of experience (16.67 %), and more than 6 years of experience (10.00 %). This distribution indicates substantial experience gaps in asset and facility management.

Regarding previous training, the majority (33.33 %) had never received any training in asset and facility management, while only 10 % had received advanced-level training. The remaining respondents (53.33 %) had received basic to intermediate-level training. These findings demonstrate that respondents possess diverse knowledge and experience backgrounds but lack systematic training in asset and facility management, presenting

significant opportunities for training curriculum development.

Section 2: Assessment of Current Situation and Desired Situation

The analysis of needs assessment data in asset and facility management for university staff revealed significant gaps between current and desired situations across all competency dimensions. The Priority Needs Index ($\mathbf{PNI_{Modified}}$) results can be classified into three distinct groups:

1)High Priority Needs Group ($\mathbf{PNI_{Modified}} > 0.60$): This group includes knowledge of trends and developments in asset management ($\mathbf{PNI_{Modified}} = 0.92$), life cycle cost analysis skills ($\mathbf{PNI_{Modified}} = 0.92$), preventive maintenance planning skills ($\mathbf{PNI_{Modified}} = 0.74$), asset life cycle knowledge ($\mathbf{PNI_{Modified}} = 0.68$), and asset valuation skills ($\mathbf{PNI_{Modified}} = 0.64$). These areas represent the most critical competency gaps requiring immediate attention in training curriculum development.

2) Moderate Priority Needs Group ($\mathbf{PNI_{Modified}}$ 0.40-0.60): This group includes strategic asset management planning skills ($\mathbf{PNI_{Modified}} = 0.55$), asset registry system management skills ($\mathbf{PNI_{Modified}} = 0.53$), understanding of types and classification of university assets ($\mathbf{PNI_{Modified}} = 0.50$), knowledge of principles and concepts in asset management ($\mathbf{PNI_{Modified}} = 0.44$), and understanding of facility management in universities ($\mathbf{PNI_{Modified}} = 0.42$). These competencies require structured development but represent less urgent training priorities.

3) Low Priority Needs Group ($\mathbf{PNI_{Modified}} = 0$): This group encompasses knowledge of information technology for asset management across all dimensions, indicating that personnel already possess strong technological capabilities and are well-prepared to utilize technology as a tool for enhancing asset management efficiency. This existing technological strength provides an excellent foundation for developing skills in other areas where competency gaps persist. Detailed results are presented in Tables 1-4.

Table 1: Current and Desired Competency Levels in Basic Knowledge and Concepts of Asset and Facility Management

Topics	Current Situation			Desired Situation			$\mathbf{PNI_{Modified}}$	Rank
	Mean	SD	Level	Mean	SD	Level		
1) Knowledge of principles and concepts in asset management	3.2	0.8	Moderate	4.6	0.5	High	0.44	4
2) Understanding of types and classification of university assets	3.0	0.9	Moderate	4.5	0.6	High	0.50	3
3) Knowledge of asset life cycle	2.8	1.0	Moderate	4.7	0.4	Highest	0.68	2
4) Understanding of facility management in universities	3.1	0.7	Moderate	4.4	0.5	High	0.42	5
5) Knowledge of trends and developments in asset management	2.5	1.1	Low	4.8	0.3	Highest	0.92	1

The assessment results of basic knowledge and concepts revealed significant competency gaps across all components, particularly in knowledge of trends and developments in asset management, which demonstrated the highest $\mathbf{PNI_{Modified}}$ value of 0.92. Knowledge of asset life cycle ranked second with a $\mathbf{PNI_{Modified}}$ value of 0.68, representing a critical foundation for long-term budget planning and strategic decision-making. Other basic knowledge areas exhibited $\mathbf{PNI_{Modified}}$ values ranging from 0.42 to 0.50, indicating the need to strengthen systematic knowledge foundations. The wide range of standard deviations (0.7-1.1) reflects considerable variation in knowledge levels among personnel, necessitating curriculum design that accommodates multiple learning levels and diverse educational backgrounds. These analysis results underscore the urgent need to develop contemporary and practical theoretical knowledge components within the training curriculum.

Table 2: Current and Desired Competency Levels in Process Skills and Techniques for Asset and Facility Management

Topics	Current Situation			Desired Situation			$\mathbf{PNI_{Modified}}$	Rank
	Mean	SD	Level	Mean	SD	Level		

1) Strategic asset management planning skills	2.9	0.9	Moderate	4.5	0.6	High	**0.55**	4
2) Asset registry system management skills	3.0	0.8	Moderate	4.6	0.5	High	**0.53**	5
3) Preventive maintenance planning skills	2.7	1.0	Moderate	4.7	0.4	Highest	**0.74**	2
4) Life cycle cost analysis skills	2.5	1.2	Low	4.8	0.3	Highest	**0.92**	1
5) Asset valuation skills	2.8	0.9	Moderate	4.6	0.5	High	**0.64**	3

Regarding process skills and techniques for asset and facility management, significant competency gaps exist across all dimensions. Life cycle cost analysis skills demonstrated the highest $\mathbf{PNI_{Modified}}$ value of 0.92, reflecting critical shortages in financial analysis capabilities essential for strategic decision-making. Preventive maintenance planning skills ranked second with a $\mathbf{PNI_{Modified}}$ value of 0.74, directly affecting asset life cycle extension and repair cost reduction. Strategic asset management planning skills and asset registry system management skills exhibited $\mathbf{PNI_{Modified}}$ values of 0.55 and 0.53 respectively, indicating the need to develop systematic management competencies. High standard deviation values (0.8-1.2) in these complex skill areas underscore the necessity for intensive technical training approaches. These analysis results support the development of a training curriculum that emphasizes analytical capabilities and the practical application of financial management tools in asset and facility management contexts.

Table 3: Current and Desired Competency Levels in Knowledge of Information Technology for Asset Management

Topics	Current Situation			Desired Situation			$PNI_{Modified}$	Rank
	Mean	SD	Level	Mean	SD	Level		
1) Knowledge of information systems for asset management	4.7	0.3	Highest	4.7	0.3	Highest	0	
2) Skills in using asset management software	4.5	0.5	High	4.5	0.5	High	0	
3) Knowledge of IoT technology for asset management	4.6	0.4	Highest	4.6	0.4	Highest	0	
4) Skills in using technology for asset tracking	4.8	0.2	Highest	4.8	0.2	Highest	0	

Knowledge of Information Technology for Asset Management: The respondents demonstrated high to highest competency levels across all information technology dimensions (mean scores ranging from 4.5-4.8) with no identified gaps ($\mathbf{PNI_{Modified}} = 0$). Skills in using technology for asset tracking achieved the highest mean score of 4.8, indicating strong readiness for advanced technology implementation in asset management operations. Low standard deviation values (0.2-0.5) reflect consistent competency levels among personnel across all technology-related areas. This technological proficiency provides a solid foundation for integrating advanced applications in cost analysis and maintenance planning within the training curriculum.

Section 3: Content Requirements and Training Format

Content Priority and Interest Levels

Respondents demonstrated high interest in strategic asset management planning (mean = 4.5), followed by principles and concepts of asset and facility management (mean = 4.2) and evaluation of asset management efficiency (mean = 4.1), reflecting the recognized need to develop planning capabilities and performance measurement skills. Preventive maintenance and repairs (mean = 4.0) received equally high levels of attention from participants. Information systems for asset management (mean = 3.8) and laws, regulations, and policies related to asset management (mean = 3.5) received moderate levels of interest. Notably, life cycle cost analysis (mean = 3.0) represented the topic with the lowest interest level, despite being identified as a high-priority need according to PNI analysis results, indicating a potential gap between perceived importance and actual training requirements.

Training Format Preferences

The most preferred training methods and delivery formats among respondents were lectures by speakers (26.67%), followed by group discussions (23.33%), case studies (20.00%), practical workshops (16.67%), online learning (10.00%), and simulations (3.33%). These preferences indicate a strong inclination toward interactive and expert-led learning approaches.

Regarding training duration, respondents showed the highest preference for 2-day training programs (12-16 hours) at 30.00 %, followed by 3-day programs (18-24 hours) at 23.33 %. For scheduling preferences, weekdays were most favored (33.33 %), followed by weekends (26.67 %) and public holidays (23.33 %). These preferences suggest that participants value structured, concentrated learning experiences that can accommodate their professional schedules.

Phase 2: Development of a Training Curriculum in Asset and Facility Management for University Staff

1) Training Curriculum Design Results

The design of the draft training curriculum in asset and facility management for university staff demonstrates comprehensive curriculum components as follows: "Training Curriculum Development: Asset and Facility Management for University Staff," which was developed by the researchers and includes essential components:

1) Principles and Rationale: The development of this training curriculum is based on needs assessment results (Phase 1) that revealed significant competency gaps among university personnel, particularly in knowledge of trends and developments in asset management ($\mathbf{PNI_{Modified}} = 0.92$) and life cycle cost analysis skills ($\mathbf{PNI_{Modified}} = 0.92$). The curriculum addresses the limited professional experience among staff (43.33% having less than one year of experience or no experience) and the lack of systematic training (33.33% never received training), while leveraging existing technological strengths ($\mathbf{PNI_{Modified}} = 0$ across all information technology areas).

2) Training Objectives: The curriculum establishes integrated learning objectives encompassing three dimensions: Knowledge (Cognitive) focuses on building foundational understanding of asset management principles, classification systems, life cycle analysis, and cost analysis methodologies with 70% accuracy according to post-training assessments. Skills (Psychomotor) emphasizes developing competencies in software operation, strategic plan creation, cost calculations, maintenance planning, and technology tool application, with proficiency demonstrated through hands-on activities. Attitudes emphasizes instilling values in systematic asset stewardship, cross-departmental collaboration, standardized procedure compliance, and professional responsibility toward institutional resource optimization.

3) Content Scope and Training Time: The curriculum comprises four learning units with a total duration of 12 hours, following a progressive skill-building approach. Unit 1: Foundation Building - Understanding Asset Management Principles (3 hours) covers basic principles, asset classification systems, and legal and policy frameworks. Unit 2: Strategic Planning and Life Cycle Analysis (3 hours) focuses on planning methodologies, life cycle understanding, and practical cost calculation techniques. Unit 3: Technology Integration and Practical Implementation (3 hours) emphasizes asset registry systems, tracking tools, and software practice sessions. Unit 4: Performance Monitoring and Continuous Improvement (3 hours) covers preventive maintenance planning, performance evaluation, and continuous improvement strategies.

4) Training Approach and Training Activities: The training methodology design responds to participant preferences, incorporating lectures by expert speakers (26.67%), group discussions (23.33%), and case studies (20.00%) through a balanced learning approach between theory and practice (40% theory: 60% practice) within each unit. The approach emphasizes collaborative learning with expert guidance and utilizes real-world experiences from university personnel to provide practical insights and best practices in authentic institutional contexts.

The training curriculum includes diverse learning activities beginning with pre-training assessment (30 minutes) and concluding with post-training assessment (30 minutes). Key activities include hands-on asset classification exercises using institutional examples, strategic planning template development within participants' departmental contexts, cost calculation practice using software tools, technology tool demonstrations and practice sessions, maintenance schedule development with actual equipment data, and action plan creation for workplace implementation.

5) Measurement and Evaluation: The multidimensional assessment system encompasses three learning objectives: Knowledge - pre-training and post-training assessments (70% minimum pass criterion), Skills - performance-based evaluations during hands-on activities (70% minimum pass criterion for software tasks), and Attitudes - self-reflection surveys and behavioral observation (average score of 4.0 or higher on 5-point scales) to ensure sustainable and practical learning outcomes.

6) Expected Outcomes: The training curriculum anticipates that participants will successfully implement standardized asset management processes and procedures in their daily work routines, utilize planning software and templates effectively, improve work efficiency and accuracy in asset documentation and reporting, and develop enhanced capabilities in preventive maintenance scheduling. These improvements are expected to result

in sustainable enhancement of institutional service quality and contribute to healthy socio-economic development within the university environment.

2) Results of Expert Evaluation on Training Curriculum Appropriateness in Asset and Facility Management for University Staff

The appropriateness assessment of the asset and facility management training curriculum for university staff conducted by 5 experts yielded results at the "Most Appropriate" level (overall mean = 4.95, SD = 0.19), demonstrating high quality and appropriateness of curriculum design across all evaluation dimensions.

Table 4: Expert Evaluation of Training Curriculum Appropriateness in Asset and Facility Management for University Staff

Assessment list	M	SD	Interpretation
1. Curriculum principles and reasons			
1.1 The rationale clearly explains why this training is necessary	5.00	0.00	
1.2 The background information supports the need for a curriculum development.	4.80 5.00	0.45 0.00	Most appropriate
1.3 The curriculum addresses current university asset management issues	5.00	0.00	
1.4 The training approach is logical and well-reasoned.	5.00	0.00	
Overall	4.64	0.01	Most appropriate
2. Training Objectives			
2.1 The training objectives are based on background data analysis of curriculum development.	5.00	0.00	
2.2 The three domain objectives (K, P, A) are clearly stated.	5.00	0.00	Most appropriate
2.3 Cognitive objectives specify what participants will understand.	4.80	0.45	
2.4 Psychomotor objectives describe specific skills to be developed.	5.00	0.00	
2.5 Affective objectives address attitudes and professional values.	5.00	0.00	
2.6 Objectives are measurable with specific criteria.	5.00	0.00	
Overall	4.97	0.01	Most appropriate
3. Content Structure and Organization			
3.1 Defining content following the training objective.	5.00	0.00	
3.2 The four units follow a logical sequence from basic to advanced	5.00	0.00	
3.3 Unit titles clearly indicate the content to be covered.	5.00	0.45	Most appropriate
3.4 Sub-topics within each unit are appropriate and comprehensive.	5.00	0.00	
3.5 Content covers essential asset management knowledge areas.	4.80	0.45	
3.6 The progression from Foundation → Strategic → Technology → Performance makes sense.	4.60	0.55	
Overall	4.90	0.26	Most appropriate
4. Time Allocation and Structure			
4.1 The total 12-hour duration is appropriate for the content scope.	5.00	0.00	Most appropriate
4.2 Equal 3-hour allocation per unit is balanced and reasonable.	5.00	0.00	
4.3 The structure accommodates both theory and practice.	5.00	0.00	
Overall	5.00	0.00	Most appropriate
5. Training Process/Training Activities			
5.1 The step-by-step learning approach builds skills from basic to advanced effectively	4.80	0.45	
5.2 A 40% theory and 60% practice ratio is appropriate for adult learners.	4.80	0.45	Most appropriate
5.3 Collaborative learning with expert guidance is well-designed.	5.00	0.00	
5.4 Training methods suit university staff professional development needs.	4.80	0.45	
Overall	4.85	0.22	Most appropriate
6. Training Activities			
6.1 Each unit has appropriate variety of learning activities.	5.00	0.00	Most appropriate
6.2 Time allocation for each activity is realistic and practical.	5.00	0.00	
6.3 Media suitability for the activity	5.00	0.00	

6.4 Hands-on practice activities align with stated objectives.	5.00	0.00	
6.5 Activities progress from simple to complex across units.	5.00	0.00	
Overall	5.00	0.00	Most appropriate
7. Measurement and Evaluation			
7.1 Measurement and evaluation are consistent with the training objectives.	5.00	0.00	Most appropriate
7.2 Pre-training and post-training assessment design is appropriate.	4.80	0.45	
7.3 Assessment methods match the three learning domains (K, P, A).	5.00	0.00	
7.4 Assessment instruments are clearly described.	5.00	0.00	
Overall	4.95	0.22	Most appropriate
8. Expected Outcomes			
8.1 Expected outcomes are realistic and achievable.	5.00	0.00	Most appropriate
8.2 Outcomes relate directly to the stated training objectives.	5.00	0.00	
Overall	5.00	0.00	Most appropriate
9. Overall Curriculum Quality			
9.1 The curriculum is well-organized and professionally presented..	5.00	0.00	
9.2 All essential curriculum components are included.	4.80	0.45	Most appropriate
9.3 The curriculum would be effective for training university staff.	5.00	0.00	
9.4 The curriculum meets professional training development standards.	5.00	0.00	
Overall	4.95	0.10	Most appropriate
Total	**4.95**	**0.19**	**Most appropriate**

Expert Evaluation Results by Curriculum Components:
Principles and Rationale: The evaluation results achieved the "Most Appropriate" level (mean = 4.64, SD = 0.01). The foundational information effectively supports the curriculum necessity, and the training approach demonstrates logical reasoning and comprehensive justification.

Training Objectives: The assessment results reached the "Most Appropriate" level (mean = 4.97, SD = 0.01). All three learning domains (Knowledge, Psychomotor, Affective) are clearly defined and measurable with specific performance criteria.

Content Structure and Organization: The evaluation results attained the "Most Appropriate" level (mean = 4.90, SD = 0.26), particularly commending the logical progression from foundational to advanced concepts, comprehensive coverage of essential knowledge areas, and appropriate interconnections between learning units.
Time Allocation and Structure: The assessment results achieved the "Most Appropriate" level (mean = 5.00, SD = 0.00), indicating that the 12-hour total duration with four 3-hour units provides appropriate and balanced time allocation for the given content scope.

Training Process and Training Activities: The evaluation results reached the "Most Appropriate" level (mean = 4.85, SD = 0.22 and 5.00, SD = 0.00 respectively), reflecting the appropriateness of the skill development approach, the theory-to-practice ratio (40:60), and the variety of activities that accommodate diverse learning styles.

Measurement and Evaluation: The assessment results achieved the "Most Appropriate" level (mean = 4.95, SD = 0.22), with experts confirming that the evaluation system aligns effectively with stated objectives. The pre-training and post-training assessment design is appropriate, and assessment instruments comprehensively cover all three learning domains.

Expected Outcomes and Overall Quality: The evaluation results attained the "Most Appropriate" level (mean = 5.00 and 4.95 respectively, SD = 0.00-0.10), demonstrating that the curriculum contains comprehensive components and essential elements for effectively training university staff.

The expert appropriateness assessment results confirm the high quality of the developed training curriculum. Low standard deviation values across all evaluation dimensions (0.00-0.26) indicate strong consistency in expert opinions. Achieving an overall mean score of 4.95 out of 5.00 reflects the curriculum's readiness for practical

implementation and its capacity to effectively address staff development needs in asset and facility management within higher education institutions.

CONCLUSION AND DISCUSSION

CONCLUSION

This study developed a training curriculum in asset and facility management for university staff through a systematic needs assessment approach. The research results can be summarized in three main areas:

1) Assessment of Needs for Training Curriculum Development

The survey of 30 respondents revealed significant findings through Priority Needs Index (PNI) analysis. Knowledge of trends and developments in asset management and life cycle cost analysis skills both demonstrated the highest $\mathbf{PNI_{Modified}}$ value of 0.92, indicating urgent developmental needs. Other high-priority areas included preventive maintenance planning skills ($\mathbf{PNI_{Modified}}$ = 0.74), asset life cycle knowledge ($\mathbf{PNI_{Modified}}$ = 0.68), and asset valuation skills ($\mathbf{PNI_{Modified}}$ = 0.64), representing competency areas requiring substantial development. Conversely, personnel demonstrated high to highest levels of information technology competency across all dimensions ($\mathbf{PNI_{Modified}}$ = 0), representing existing strengths that can be effectively leveraged in training curriculum design. The demographic analysis revealed that 43.33% of respondents possessed less than one year of experience in asset and facility management, while 33.33% had never received formal training in this field, strongly supporting the necessity for developing a comprehensive training curriculum

2) Results of the Draft Training Curriculum

The training curriculum comprises five essential components:

1)Principles and Rationale: Derived from comprehensive needs analysis conducted during curriculum development, providing evidence-based justification for training interventions.

2)Learning Objectives: Encompassing three learning domains with specific performance criteria: Knowledge (70% minimum accuracy on assessments), Skills (70% minimum proficiency in practical tasks), and Attitudes (average score of 4.0 or higher on 5-point scales).

3)Content Scope and Training Time: Structured as four learning units totaling 12 hours: Unit 1 - Foundation Building and Understanding Asset Management Principles (3 hours), Unit 2 - Strategic Planning and Life Cycle Analysis (3 hours), Unit 3 - Technology Integration and Practical Implementation (3 hours), and Unit 4 - Performance Monitoring and Continuous Improvement (3 hours).

4)Training Approach and Training Activities: The curriculum employs a progressive skill-building approach with balanced theory-to-practice integration (40:60 ratio), addressing learner preferences for lectures by expert speakers (26.67%), group discussions (23.33%), and case studies (20.00%).

5)Measurement and Evaluation: The assessment system includes pre-training and post-training knowledge tests (70% minimum pass criterion), performance-based skills evaluation using software navigation checklists (70% minimum completion of software tasks), and attitude assessment through self-reflection surveys employing 5-point Likert scales and behavioral observation during collaborative activities (average criterion of 4.0 or higher)

3) Results of Expert Evaluation on Curriculum Appropriateness

The expert evaluation results demonstrated overall "Most Appropriate" ratings (mean = 4.95, SD = 0.19). Detailed evaluation scores by component included: principles and rationale (4.64), training objectives (4.97), content structure and organization (4.90), time allocation and structure (5.00), training process (4.85), training activities (5.00), measurement and evaluation (4.95), expected outcomes (5.00), and overall quality (4.95). These comprehensive evaluation results confirm the high quality and readiness of the training curriculum for practical implementation in university settings.

DISCUSSION

This study developed a training curriculum in asset and facility management for university staff through a systematic needs assessment approach. Based on the findings, the researcher discusses the results in relation to the research hypotheses through three main issues as follows:

1) Assessment of the needs for training curriculum development

The needs assessment results reveal interesting patterns regarding competency gaps among university staff, particularly the contrast between high technological competence ($\mathbf{PNI_{Modified}}$ = 0) and significant deficiencies in

foundational knowledge and analytical skills ($\mathbf{PNI_{Modified}}$ up to 0.92). This finding demonstrates that while organizations in the digital age are proficient with technological tools, they lack strategic understanding of their optimal application. Therefore, technology training alone is insufficient for developing effective asset management competencies.

The substantial gap in knowledge of trends and developments in asset management ($\mathbf{PNI_{Modified}}$ = 0.92) reflects potential challenges in continuous professional development and keeping pace with rapid changes in the field. This knowledge deficiency can significantly impact an organization's ability to adapt to emerging best practices and innovative technologies. The high $\mathbf{PNI_{Modified}}$ value for life cycle cost analysis skills (0.92) demonstrates staff awareness of the importance of economic decision-making in contemporary asset management practices.

The utilization of the Priority Needs Index (PNI) in performance gap analysis demonstrates the effectiveness of quantitative assessments in needs evaluation, emphasizing the importance of using empirical data to determine human resource development priorities. Consequently, the needs assessment information provides crucial guidance for developing training curricula that appropriately address participant requirements.

The Priority Needs Index serves as an effective tool for ranking training curriculum priorities by highlighting significant differences between current and desired competency states in needs assessment contexts (Chuenchaikit et al., 2022; Schneiderhan et al., 2019; Vathanavong et al., 2024; Zern et al., 2020).

2) Results of the Draft Training Curriculum

The training curriculum design employs systematic research and development methodology based on comprehensive needs assessment for curriculum development. This approach identifies specific training requirements to develop participants according to their identified needs, leading to the establishment of clear learning objectives and determination of content scope and duration for each component derived from needs assessment surveys and gap analysis using PNI methodology. The emphasis on developing life cycle cost analysis skills, which demonstrated the highest $\mathbf{PNI_{Modified}}$ value, reflects understanding of the critical role of economic decision-making in contemporary asset management. The inclusion of these competencies in the curriculum is therefore essential for enhancing professional practice standards.

The curriculum is structured into four learning units following Progressive Skill Building principles, which emphasize the importance of systematic knowledge construction in developmental stages (Kondrashova et al., 2022). The design incorporates diverse learning activities, including lectures and group discussions, responding to Multiple Intelligence Theory that recognizes varied learning styles (Gardner, 2011). The integration of technology and experiential learning methods reflects participatory learning approaches, which constitute essential components of effective training curricula (Shixalizade & Nasibova, 2025).

The training approach employs blended learning methodology with balanced theory-to-practice integration (40%:60%), reflecting contemporary adult education principles that emphasize immediate practical application (Knowles et al., 2014). Effective educational methods must combine theoretical and practical learning in proportions conducive to knowledge reinforcement and skill development (García-Peñalvo et al., 2014).

Measurement and evaluation systems are designed in alignment with training objectives, employing diverse assessment methods covering all three learning domains: knowledge, skills, and attitudes. Assessment strategies achieve learning outcomes through method-specific approaches, ensuring consistency among curriculum components including learning objectives, instructional activities, and evaluation procedures. Appropriate teaching and assessment methods address diverse learner needs, promoting participant success and competency development in essential skills for training curriculum effectiveness evaluation (Selvakumar et al., 2024).

This approach aligns with training curriculum development methodology established by Schneiderhan et al. (2019), which begins with needs assessment to identify required competency gaps, defines content coverage with clear goals and objectives, formulates training strategies, and determines curriculum implementation and evaluation methods through systematic approaches.

3) Expert Evaluation of Curriculum Appropriateness

The expert evaluation results at the "Most Appropriate" level (overall mean = 4.95) reflect the success of the systematic curriculum development approach based on empirical data obtained from the needs assessment study. Low standard deviation values (0.00-0.26) across all evaluation dimensions indicate high consistency in expert opinions, serving as an indicator of assessment reliability (Lawshe, 1975).

Achieving the highest assessment scores in training objectives (mean = 4.97) and time allocation and structure (mean = 5.00) reflects expert confidence in curriculum design quality. The definition of clear and comprehensive objectives across all three learning domains (Knowledge, Psychomotor, Affective) aligns with Bloom's Taxonomy, which represents the international standard for instructional design (Anderson & Krathwohl, 2001).

The high evaluation scores in measurement and evaluation (mean = 4.95) confirm the appropriateness of employing a multidimensional assessment system that comprehensively covers all three learning objectives. The evaluation approaches during practical activities and attitude surveys demonstrate effective application of Kirkpatrick's Four-Level Training Evaluation Model (Kirkpatrick & Kirkpatrick, 2016).

The results of this study demonstrate the effectiveness of utilizing the needs assessment approach as a fundamental principle in training curriculum development. The combination of PNI performance gap analysis with learner needs assessment creates curricula that address authentic requirements and demonstrate high implementation feasibility. The existing technological strengths among personnel represent valuable opportunities that can be leveraged as tools for developing competencies in other areas experiencing deficiencies.

Further research should focus on practical curriculum implementation trials, long-term impact monitoring, and scaling to other institutions to enhance result generalizability. This developed approach can serve as a model for effective training curriculum development across other disciplines within higher education institutions.

The study results demonstrate success in curriculum development; however, the limited sample size (n=30) and restriction to a single institution may affect the applicability of results to other universities, where cultural contexts and organizational structures significantly influence training needs. The inconsistency between interest levels and PNI-based needs, particularly in life cycle cost analysis (low interest despite high $\mathbf{PNI_{Modified}} = 0.92$), underscores the necessity for designing activities that clearly demonstrate the relevance and practical benefits of these competencies.

This implementation challenge relates directly to adult learning motivation principles. Therefore, training activity design must strategically raise awareness of the importance and value of learning in these critical areas to ensure meaningful participant engagement in the training curriculum. Future curriculum implementations should incorporate motivational strategies that bridge the gap between perceived importance and actual learning needs, ensuring that participants recognize the practical value of developing competencies in areas they may initially perceive as less interesting.

Recommendations

Recommendations for Implementation

1) The curriculum implementation should be conducted through three systematic phases: Phase 1: Pilot implementation with 15-20 personnel from key departments to evaluate and address identified deficiencies; Phase 2: Expand implementation to all organizational personnel with comprehensive evaluation and improvement processes; Phase 3: Establish an annual training system with continuous content enhancement and curriculum refinement. and 2) Technology Integration: Leverage existing technological strengths by creating online Communities of Practice, developing mobile applications for asset tracking and reporting, and integrating digital platforms that enable anytime, anywhere learning while enhancing work efficiency. This technological integration will foster a sustainable learning culture and support continuous human resource development.

Recommendations for Future Research

1) Monitoring the impact after training for a period of 2-3 years according to key indicators such as maintenance costs, asset depreciation rate, and Return on Investment in Training by comparing the benefits received with the cost spent on training, 2) Studies compared control groups that were not trained to provide empirical evidence about the effectiveness of the course. This research will help confirm the value of investing in personnel development and inform for continuous curriculum improvement. and 3) Developing conceptual frameworks and tools for adapting the curriculum to different contexts to increase general applicability. Cross-institutional comparative studies in universities of different sizes, locations, missions, and organizational structures will help identify factors that affect training needs, help build a deeper understanding of curriculum deployment in a variety of contexts, and lead to the development of a flexible and efficient approach.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this work, the authors used Claude AI to correct grammatical errors and improve readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Credit Authorship Contribution Statement
All authors have read and agreed to the published version of the manuscript.

Declaration of Competing Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

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