AI-CAS: AI CAPABLITY ASSESSMENT SYSTEM

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(Received: January 28, 2026; Revised: February 12, 2026; Accepted: March 11, 2026)

DOI: 10.31130/ud-jst.2026.24(3).069E

Abstract - The ability to use artificial intelligence (AI) tools at work is gradually becoming an inevitable requirement for workers. The key question is how to assess an individual's ability to use AI and identify areas where they need improvement to meet the job requirements of a specific field. This paper presents a solution to build an AI application capacity assessment tool and makes recommendations on supplementing an individual's weaknesses in a certain field. The proposed system includes an AI competency framework, assessment questions, competency evaluation and Curriculum Vitae (CV) analysis software, and an output integration engine to generate results. The returned results include determining the level of AI application of individuals and recommendations for improvement to enhance capacity. The system has been tested on software engineering students and alumni and has given satisfactory results, consistent with the evaluation of lecturers and employers.

Key words - Artificial Intelligence; Competency Assessment; Competency Framework; Skills Evaluation; Education Technology

1. Introduction

Artificial intelligence (AI) is a field of computer science. It focuses on creating systems that can perform tasks that normally require human intelligence. The first areas that AI addresses include “learning, reasoning, problem solving, natural language understanding, and image recognition” [1]. According to John McCarthy, AI is defined as follows: “AI is the science of making machines do things that would require intelligence if done by people” [2]. AI is often divided into three main levels [3]: 1) Narrow AI: This type of AI is designed to perform a specific task (e.g. facial recognition, chatbots, recommendation systems); 2) General AI: Capable of performing any intellectual task that humans can do; 3) Super AI (Artificial Super Intelligence): Surpassing human intelligence (not yet existing, hypothetical). AI includes many technologies, the most popular and widely applied of which include: Machine Learning (ML) - a system that can learn from data to improve performance over time; Deep Learning (DL) - a branch of ML that uses deep neural networks to handle complex tasks; Natural Language Processing (NLP) - helps machines understand and create human language; Computer Vision - helps machines "see" and analyze images and videos.

AI has been widely adopted across various sectors, including industry, education, healthcare, and business administration. This adoption of AI helps organizations streamline operations and improve efficiency across these domains.

How is AI impacting the workplace? The impact of AI on the workplace has attracted widespread public attention and discussions have been common over the years. The presence of AI in the workplace generates excitement about its potential to dramatically enhance productivity and management efficiency, as well as concerns regarding job displacement. The demand for AI skills in today's workplace is growing rapidly and has become one of the most important skills in many industries. Microsoft has conducted surveys on the demand and state of AI applications in the workplace and the results are shown in Table 1.

Table 1. *Survey Results on the Demand and Status of AI Applications in the Workplace [4]*

Survey content	Result
Using AI in the Workplace	75%
Started using AI within the last six months	46%
Companies are looking to adapt to AI	75%
Number of employees applying AI in marketing and advertising	37%
Business leaders find it difficult to attract enough talent to manage AI solutions	68%
Business leaders embrace AI in the workplace	41%
Workers claim they used ChatGPT at work	65%

Source: “2024 Work Trend Index Annual Report” from Microsoft and LinkedIn

The results above show that the proportion of employees and companies that are using AI is quite high, and others are ready and preparing to apply AI to their work. However, the problem is how to assess an individual's AI competency in a specific field. If it is possible to assess the competency and point out the gaps that need to be filled, it will be immensely helpful for employees to improve their AI competency for their work. Currently, there are a number of AI competency frameworks for a group of subjects, for example, the UNESCO AI competency framework for teachers and students [5], [6] is "collaborative project between Concordia University and Dawson College to co-construct an AI competency framework that supports the creation of success pipelines for learners from college to university to lifelong learning". Current AI competency frameworks focus on 02 main groups of subjects: teachers and students. Assessing AI capabilities for different audiences in various professions still encounters significant limitations and lacks effective assessment tools.

This study focuses on building a system named AI-CAS (AI Capability Assessment System) to support the assessment of the capacity of any individual based on answering a set of competency assessment questions and analyzing the content of their CV (if available). The system includes an AI competency framework, a set of competency assessment questions and software tools. This system has been tested on students and alumni of Software Engineering at The University of Danang - University of Technology and Education and has given results consistent with reality. The paper's main contribution is to systematically research and present the AI competency framework, competency assessment methods and build a practical system to support competency assessment.

2. Literature review

This literature review encompasses three principal areas: competency framework, AI competency framework, competency assessment, and competency assessment support system. Based on the presentation and analysis of existing results, we state the issues that need to be focused on solving within this study's framework.

2.1. Competency framework

A competency framework (also known as a competence framework) is a structured system that outlines the skills, knowledge, behaviors, and abilities required for an individual to perform a job in a specific field/organization effectively [7]. It is commonly used in HR, talent development, and organizational planning.

According to this definition, the main components of the Competency Framework include core elements and can be categorized as [8], [9]: Competencies; Levels of Proficiency; Descriptors; Job or Role Mapping.

Competency frameworks are designed to fulfill essential purposes, including recruiting and selecting employees, evaluating performance, training, and developing human resources, and building career paths and succession plans [10], [11].

To gain a clearer understanding of a competency framework, let us explore the OECD competency framework in detail [12]. Here, the focus is on building a core competency framework. Core competencies are a combination of characteristics related to behaviors, attitudes, and attributes. These characteristics lead to effective and successful performance in the workplace [13]. They include observable behaviors. These behaviors focus on doing, rather than knowing, and are typically developed through experience.

In summary, current competency frameworks provide a solid foundation for driving organizational culture and performance that aligns with the mission of each organization. However, their effectiveness depends on how well they are implemented, adapted, and integrated into broader HR strategies. Competency frameworks need to strike a balance between consistency and flexibility and ensure regular evaluation and stakeholder engagement [14], [15].

2.2. AI Competency framework

The AI Competency Framework is a system designed to identify, classify, and assess the knowledge, skills and attitudes required for people (individuals, organizations, workforces) to understand, develop, apply, and manage AI responsibly and effectively [16].

The AI Competency Framework is a structure that helps identify: What an individual needs to know and do to work with AI; Proficiency levels at diverse levels (such as basic, intermediate, advanced); Role classification: AI user, AI developer, AI manager, etc. The AI Competency Framework is like professional competency frameworks in other fields such as IT, education, healthcare but is customized for the AI field [17], [18].

In addition to UNESCO's AI competency framework, we can find some other AI competency frameworks such as AI4K12… [19], [20]. However, these competency frameworks do not meet the requirements for assessing AI application competencies in the current practical context.

2.3. Competency assessment

Competency-based assessment is “a method of assessing an individual's knowledge, skills, and abilities based on specific competencies or job requirements”. It focuses on “measuring an individual's ability to perform a task or function and their potential for success in a particular role” [21].

Competency-based assessment typically involves identifying the key competencies required for a particular job or role. It also helps design assessments or assessments to measure an individual's proficiency in these areas. This can include various methods, such as performance-based assessments, simulations, and observations of job-related tasks. The benefits of using competency-based assessments include greater objectivity, reliability, and validity in assessing an individual's potential for success in a particular role. Competency-based assessments can also help individuals identify areas for growth and improvement and can be used to guide training and professional development plans. Approaches to competency assessment can vary. There may still be some colleges and universities that may ask about how to conduct competency assessments.

2.4. Competency assessment support system

Competency assessment support system is a set of tools, platforms, or methods that helps measure, monitor, and analyze the competency level of an individual or group against established standards [22].

Through research on existing capacity assessment support tools and platforms, we see that most capacity assessment support systems often include the following basic components and roles as shown in Table 2.

There are several tools available that support AI-based competency assessments. A prime example is TestGorilla (https://www.testgorilla.com/). TestGorilla is a platform that facilitates skills-based hiring by offering a variety of standardized tests, allowing companies to assess candidates more objectively than through resumes alone. It

offers various assessments, including skills tests, cognitive ability tests, and personality tests. The goal is to evaluate candidates' abilities in a fair and standardized manner. The platform evaluates specific job skills, like programming and digital marketing, alongside general skills such as critical thinking.

***Table 2**. Components and Roles in the Competency Assessment Support System*

Components	Roles
Competency Framework	A set of standards for skills and knowledge required for assessment.
Assessment Tools	Surveys, tests, case studies, self-assessment, peer assessment.
Assessment Process	The main steps include preparation, implementation, analysis, feedback, and development planning.
Assistive Technology	Software, e-learning platform, AI automatic assessment, dashboard analyzing results.

In summary, there are currently several platforms that support competency assessment, but they are not comprehensive and have a limited scope. In particular, the tools focus heavily on students and recruiting companies. There is no in-depth assessment of workplace AI competency for highly specialized fields.

3. The aim and objectives of the study

The aim of this research is to evaluate an individual's AI competency. To achieve this aim, the specific objectives of the research include:

- Building an AI competency framework that can be easily adapted to each specific career field;

- Building a system to support the assessment of AI competency;

- Building a system to advise an individual on the deficiencies that must be filled in after assessing that person's competency.

4. Materials and methods

To achieve the above aim and objectives, we propose a general architectural model of AI-CAS as shown in Figure 1.

Based on the model described above, the system consists of the following components:

1) *AI competency framework*: this is a competency framework built to serve the assessment of individual AI competencies.

2) *Questions*: based on the AI competency framework, we need to build a set of questions to serve the assessment of competencies according to the defined criteria.

3) *AI Models*: this is a model created to serve the analysis of personal resumes. This model is created from ML and a database collected from the Internet. To build AI Models, we collected data related to recruitment, AI tools for work, documents related to AI applications, ... and from there applied ML to create AI models to serve CV assessment [23], [24].

4) *CV Analyzer*: is a software that allows analyzing an individual's CV based on an AI model to indicate the ability to meet AI capacity needs and the deficiencies that need to be filled [25].

5) *Capability Analyzer*: is a software that allows evaluating the user's answers when performing "Capability testing".

6) *Results*: are the results received after analyzing the CV and the results of answering questions related to AI capacity. This result includes two main contents: the level of meeting the AI capacity framework and recommendations for additional content related to AI application.

7) *CV*: users (can be job applicants, employees, ...) upload their CV as a PDF or DOC file.

8) *Capability Testing*: users answer questions raised by the system.

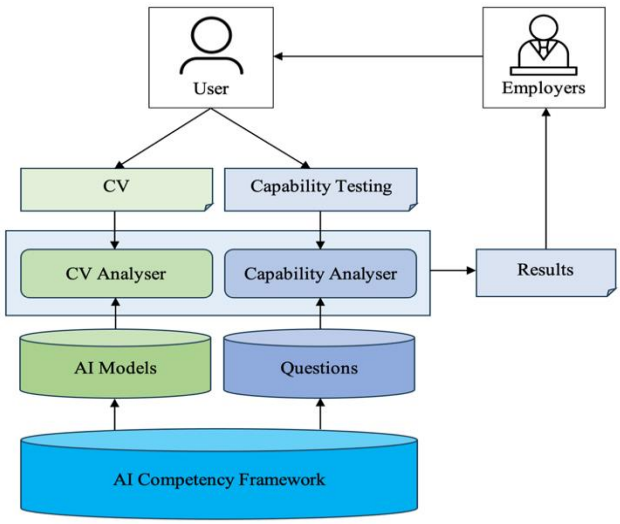

***Figure 1.** General Architectural Model of AI-CAS*

5. Results

5.1. AI Competency Framework

We have proposed an AI competency framework with 06 criteria groups and 03 levels as shown in Table 3.

5.2. Question Set

Based on the proposed competency framework, we have built a set of questions to test the user's competency. For testing, we built a set of questions to test for work as a programmer. This set of questions includes 360 questions (6 criteria groups x 03 levels x 20 questions), 20 questions for one assessment criterion at each level.

To expand the set of questions to other fields, we only need to adjust the questions in two criteria, "AI Use Cases" and "AI Tools" because these questions are specific to each field. Other questions can be used for all industries.

When evaluating candidates, the "Capability Analyzer" software will mix and automatically create test questions. Each test will contain between 50 and 100 questions, depending on the specific assessment requirements.

5.3. Main Software Packages

In this system, there are three main software packages. The first is the Web interface to interact with users (upload their CV, answer questions and receive results). The second is the software to analyze the candidate's CV. This

software includes modules on building a data warehouse (collecting, cleaning, building models using ML and analyzing candidate CVs). Finally, the software to analyze competencies, including modules on evaluating the results of answering candidates' questions, integrating with CV analysis data to return results to users.

Table 3. *AI competency framework*

Basic	Intermediate	Advanced
	Fundamental	
- Understand and present commonly used terms in AI such as training data, model training, language models, algorithms, generative AI, ML, DL, big data, ... - Understand and distinguish between conventional programs and AI	- Identify key stages, key techniques, and processes in developing an AI system - Understand key AI scientific, policy, or project literature and summarize findings	- Explain the role of data and algorithms in building and exploiting ML models - Evaluate the strengths, weaknesses, and best use cases for different AI algorithms
	Data	
- Understand the role of data in building AI systems - Identify data collection sources and clean data	- Assess data collection (completeness, consistency, timeliness, accuracy, and relevance of data) - Apply tools to clean, standardize, and analyze data at a basic level	- Apply tools like Tableau, Power BI or Python libraries to design and visualize data - Analyze to make decisions about collection, processing, analysis, labeling, etc. in the process of building an AI system
	Critical Thinking	
- Analyze to identify sources of information collected and evaluate the reliability of the information - Know how to compare and evaluate diverse sources of information	- Compare and contrast results and interpretations from different AI tools - Analyze and contrast methods used to fact-check AI-generated results with other methods	- Use specialized tools and databases to check the results of the AI system itself, ensuring the accuracy and validity of the information - Analyze the results and contribute ideas or clarify issues related to AI
	AI Use Cases	
- List examples of how AI is used in various fields such as engineering, healthcare, education, business, finance, etc. - Identify the benefits and challenges that AI poses in each field	- Describe the underlying AI technologies or methodologies for each use case - Describe potential pitfalls or challenges in implementing AI in specific scenarios	- Evaluate the suitability of an AI solution for a specific problem or domain - Evaluate the long-term sustainability and feasibility of AI solutions in real-world scenarios
	sAI Ethics	
- List the types of risks that arise from AI applications, such as algorithmic bias, privacy concerns, the spread of misinformation, and job displacement - Identify and explain ethical principles related to AI, such as fairness, transparency, accountability, and privacy	- Evaluate the level of risk associated with specific AI implementations, considering both immediate and long-term impacts - Evaluate the advantages, limit ethical use cases of AI, and provide warnings	- Contribute to the development of policies and guidelines within the organization or community to ensure AI activities are consistent with ethical standards - Guide, advise and influence colleagues and decision makers to establish a culture of ethical use of AI
	AI Tools	
- List different AI tools and platforms used in each specific domain - Identify the potential benefits and limitations of using AI tools in each specific domain	- Describe the theories and principles when integrating AI into a specific work environment - Test and evaluate different AI tools and make appropriate choices	- Propose new use cases or scenarios where AI can improve efficiency and quality of work - Evaluate results from AI tools to make recommendations on accessibility and adaptability
	Future of Work	
- Identify tasks and roles most vulnerable to AI-driven change, both in terms of automation and augmentation - Recognize the fundamental benefits and challenges that AI brings to the workplace, such as improved efficiency or the potential for job displacement	- Review past technological changes in the workplace to draw parallels to current AI-driven impacts - Propose appropriate upskilling or reskilling interventions to prepare the workforce for an AI-enhanced environment	- Evaluate the broader impacts of AI on work - Develop an organizational strategy to adapt to the changing nature of work, creating an AI-driven work ecosystem

5.4. Experiment and Discussion

To test and evaluate the system, we invited 50 people to participate in the system competency assessment. These 50 people included 10 first-year students, 10 second-year students, 10 third-year students, 10 fourth-year students and 10 alumni. All these students and alumni majored in software engineering.

The test results were shown in Table 4.

Table 4. *Test Result on AI-CAS*

Testers	Basic	Intermediate	Advanced
1st year students	80%	20%	0%
2nd year students	70%	30%	0%
3rd year students	50%	40%	10%
4th year students	50%	40%	20%
Alumni	10%	60%	30%

These results have been sent to the leaders and lecturers of the Faculty of Digital Technology, The University of Danang - University of Technology and Education and businesses with alumni participating in the assessment for comments. The general opinion is that this competency assessment system gives satisfactory results, accurately reflecting the actual capacity of the people surveyed. The results show that the readiness to apply AI in work is not high and solutions need to be quickly found to improve. In addition, these results also help the faculty and businesses to more easily adjust training and development programs to improve the AI capacity of students and alumni.

6. Conclusion

Along with the strong development of information technology, digital transformation in general and AI in particular, the requirement for human resources to know how to effectively use AI in work is inevitable. AI is applied in most fields and the ability to use AI is one of the mandatory competencies for workers. Therefore, how to measure the ability to use AI is very necessary and meaningful.

This article presents the results of research to build a system to support the assessment of an individual's ability to use AI in a specific field of work. The system is built including an AI competency framework, a set of questions for competency testing, CV analysis software and test results to generate results. This result includes determining the level of AI application of individuals and recommendations for improvement to enhance capacity. The initial results meet the requirements for assessment and recommendations for capacity improvement for individuals and organizations.

The next development direction is to continue to perfect the proposed competency framework to gradually adapt to the actual needs and rapid changes of AI and its applications in practice. The second is to continue to build and perfect sets of questions to support competency assessment for each specific field. Finally, apply innovative technologies to improve CV assessment software and integrate CV analysis results with competency assessment results to generate results.

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