Development Of Micro Credential Design For Project Management To Improve The Quality Of Engineering Practices

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Keywords	ABSTRACT
Micro Credentials, Project Management, Quality Engineering Practices.	*The integration of engineering practices with project management responsibilities is commonplace in the field, offering an effective solution for executing engineering projects. However, the unique discipline of project management poses a challenge, revealing a limitation in the quality of human resources with expertise in both engineering and project management. This study aims to address this gap by developing a Project Management Micro-Credential Design to formally recognize engineers possessing project management competencies. Employing the Rapid Assessment Process (RAP) integrated with the Regional Model Competency Standard (RMCS), the research outlines a comprehensive design for the development of a micro-credential in engineering project management. Key components of the design include a competency-based skill set development model, an instructional design system for quality assurance, an outcome-based learning and teaching delivery structure (OBLT), a competency-based assessment (CBA) development framework, and an operational structure for micro-credential implementation. This designed framework is adaptable for application within Professional Organizations and Professional Education of Engineers, accommodating both integrated and packaged formats, such as the Indonesian Student Micro-Credential (KMMI). The study contributes to bridging the gap in project management expertise among engineers, presenting a structured approach to enhance their competencies and recognition within the engineering profession.*

INTRODUCTION

The quality of engineering practices is an essential aspect of national and international development programs. The quality of engineering practices is critical to ensuring public safety and infrastructure reliability and engineering project design, so it can be ensured that project design and execution meet strict safety and quality standards (Alter, 2018). In an era that is increasingly concerned about the environment, engineers need to consider sustainability factors in their practice, which involve the use of environmentally friendly technologies and materials as well as long-term thinking about the environmental (Ahmad et al., 2023; Roldán & Cabrales, 2021)). The quality of engineering practices can also have a direct impact on project cost efficiency, which can reduce resource wastage and optimize the use of project budgets (Sudha et al., 2019).

The Micro-Credential in project management is an essential acknowledgment of an engineer's ability to manage and lead projects (Shanahan & Organ, 2022). By having this credential, an engineer can prove his ability to manage projects well, which includes planning, executing, controlling, and completing projects ((" Project Management Professional (PMP) Handbook," 2018) By applying proper project management principles, engineers can improve efficiency in project execution, avoiding delays,

overspending, and other problems that can interfere with project success (Go & Hart, 2016). The European Union (ETF, 2022) defines micro-credentials as records of learning outcomes that learners obtain after a small volume of learning. These learning outcomes will be assessed based on transparent and clear criteria. Learning experiences leading to micro-credentials are designed to provide learners with specialized knowledge, skills, and competencies that respond to social, personal, cultural or labor market needs(Alsobhi et al., 2023; Rienties et al., 2023). Learners, shareable and portable, own micro-credentials. They may stand alone or be combined into more considerable credentials. They are supported by quality assurance following agreed standards in the relevant sector or field of activity.

Project management is essential in assisting in the planning, controlling, and supervision of the project as a whole, as well as ensuring that the project is running on schedule, on budget, and with the expected quality (Baker & Clegg, 2023; Rocha et al., 2023). In complex engineering projects, coordination between different teams and disciplines is essential, so project management helps in coordinating the work of various teams in order to achieve project objectives effectively (Pedersen et al., 2019). Project management also involves identifying, evaluating, and mitigating risks in the project. This helps in addressing problems that may arise during the implementation of the project (Akatov et al., 2019).

However, there are several problems in developing the quality of engineering practice, including Limited quality of engineering human resources in engineering project management, namely: Lack of Adequate Education and Training in the management of engineering practice projects, Lack of project management experience, Lack of Soft Skills/employability skills; Lack of Awareness of Customer Needs (Hassan et al., 2000)(Xu et al., 2020).

Micro-Credential Development also faces several issues that include Strict Requirements: Obtaining a credential such as PMP (Project Management Professional) can be a very demanding taskn("Project Management Professional (PMP) Handbook," 2018); Training and Certification fees for obtaining credentials can be expensive. This may be an obstacle for those with budget constraints and the Availability of project management consistency standards. Standardization: Micro-credentials can come from different education or training providers, and some have different standards, making it challenging to recognize and benchmark credentials (ETF, 2022) Accountability and Transparency: Micro-credential holders and providers must operate with transparency and accountability to ensure the credentials have appropriate value (Palmer, 2021).

The development of Project Management in Engineering Practice also addresses problems, including Project complexity is very complex and involves many technical details and coordination between different disciplines (Cristóbal, 2017)(Sujova, 2017). Engineering projects can involve many different stakeholders, including technical teams, management, and project owners, so conflicts and communication problems can arise if not appropriately managed (Roeder tres, 2013).

This project management micro-credential design development study aims to produce skill set designs, competency standards, instructional design and micro retentions to improve the quality of engineering practice.

METHODS

The method used in this study is the Rapid Assessment Process (RAP), which is integrated with the Regional Model Competency Standard (RMCS) 2016, the Indonesian National Qualifications Framework (KKNI), and the ASEAN Qualifications Reference Framework (AQRF). RAP is a qualitative research method derived from the traditional ethnography (Beebe, 2005). this study employed the Rapid Assessment Process (RAP) method, known for its efficiency in rapidly generating research results compared to other time-consuming methods. The two fundamental concepts of intensive cooperation and data collection triangulation distinguish RAP from traditional ethnography, emphasizing the use of multiple data sources and qualitative information. The method involves collaborative data analysis,

incorporating semi-structured interviews, direct observations, and a variety of participatory and non-participatory techniques.

The benefits of the RAP method include active participant engagement, integration of scientific work with immediate action, and the promotion of collaborative activity and teamwork for initiating change in training. The holistic application of RAP to specific stakeholders involves mapping functional areas, identifying job descriptions, and determining core competencies within the engineering practice.

Furthermore, the study emphasizes the development of micro-credentials following the principles of standardization. These principles include relevance to organizational needs, validity as a reference, acceptability to stakeholders, flexibility in implementation, and traceability to national and international competency standards. The main objective of the study, conducted over three months, was to develop a project management micro-credential design focusing on skill set design, competency standards, instructional design, and micro-retention to enhance the quality of engineering practice. The collaborative efforts aimed at developing a micro-credential model applicable to professional organizations and Professional Education, producing a skill set for project managers in engineering practice, designing quality assurance instructional protocols, and implementing micro-credentials.

RESULTS

A. Design Micro Credential Development Project Management Engineering Practice

The author trying to find the most appropriate design for Micro-Credential Development Project Management Engineering Practice can be a difficult task. This is because the design of the Engineering Practice Project Management Micro-Credential Development must meet the principles of learning and competency-based assessment principles and a reliable quality assurance system. From the results of the Rapid Assessment Process (RAP) method, the Design of Micro-Credential Development of Engineering Practice Project Management can be formulated, namely competency-based skill sets, competency-based instructional design, OBLT (Outcome Based Learning and Teaching), Formative Competency-based Assessment, Micro-Credentials, and evaluation for continuous improvement, which are illustrated in the figure below.
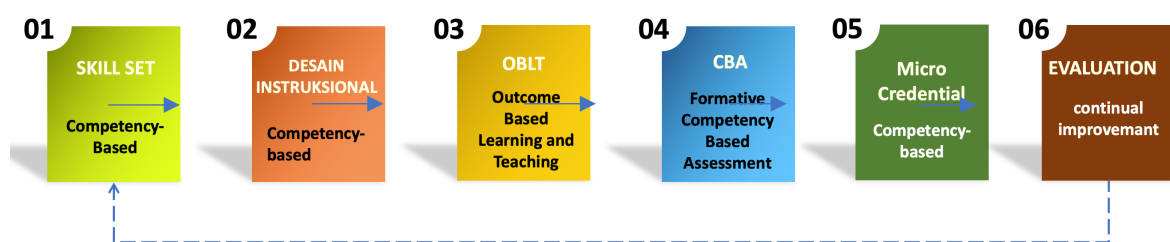

Figure 1. Design Of Micro Credential Development Project Management Engineering Practice

1. Development of competency-based skill sets.

This skill set will vary depending on the micro-credentials required by a job role, as each has a different skill focus. This skill set can be a cluster of work roles related to licensing or regulatory requirements or defined industry needs (Stanwick & Siekmann, 2019). The main objective of professional organizations or engineering education is to prepare engineers or prospective engineers with practical skills they can use in engineering practice work. Therefore, skill sets in professional or educational organizations are designed to meet the needs of engineering practices in the business and industrial world in Indonesia. The steps for developing a skill set can be described below.
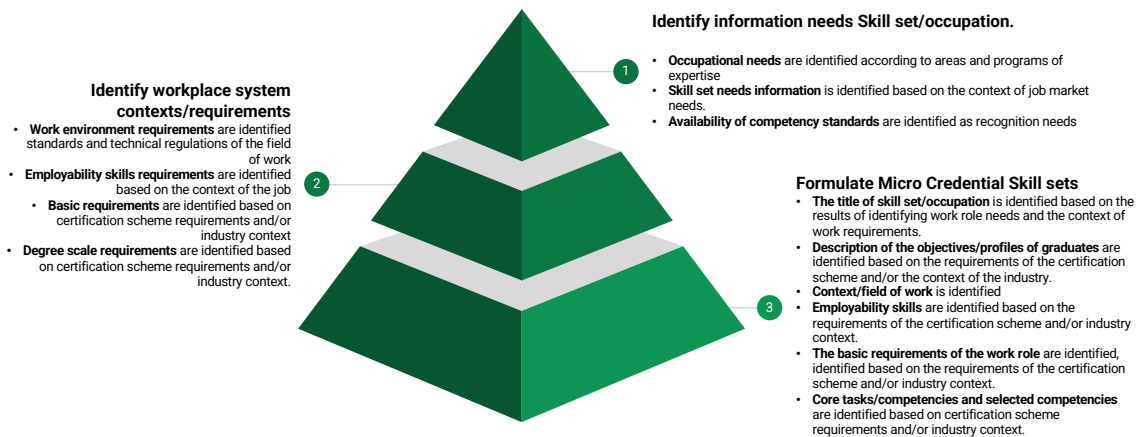
Figure 2. Competency-based micro-credential skill set development model

a. Development of competency-based skill sets.

Competency-based skill sets are developed based on occupational needs according to the field and program of expertise, information on skill set needs according to context and availability of competency standards (Metilda & P.C., 2016) An interface model was developed between the Skillset structure, competency-based recruitment, occupational maps within the qualification framework, and certification schemes to identify occupational needs for micro-credentials. Based on the alignment or matching analysis, an interface between the 4 structures was identified which can be illustrated as below.

Table 1. Model interface between Skill set structure, competency-based recruitment, occupational map within qualification framework and certification scheme

No.	Competency-Based Recruitment	Occupational Map Within The Framework Of Qualifications	Structure Skill Set	Competency Certification Scheme
1.	Job title (vacancy)	Job title	Title of vocational training package and Vocational learning outcomes	Occupation scheme title
2.	Job discription	Job description	Definition/Scope of learning	Description
3.	scope of work	Field of work	Workplace context	Scope of use
4.	Accountability	Employability skills/soft skills	Managerial and cultural competence	Employability skills/ soft skills
5.	Responsibility	Responsibility	Job responsibilities	Responsibility
6.	Requirement	Requirement	Entry behavior line	Requirement
7.	Tasks	Tasks	Basic competencies and expertise	Occupational packaging
8.	BenefitS	-	-	-
9.	-	-	-	Certification process
10.	-	-	Class hours	-
11.	-	-	Credit units	-

b. Identify the context / requirements of the workplace system.

Identification of the context of workplace system requirements is a process used to identify and understand the factors and requirements that affect the environment and sound work systems (Good Practices) in a particular workplace. This is an essential step in

understanding how specific jobs or tasks are well organized, how workers interact with their work environment, and what is needed to improve efficiency, productivity, product quality and safety in the workplace (FAO, 2016) Essential factors in the identification of this context are a) The context of competency needs identified according to workplace system requirements, which may include Good Practices (such as GMP, GCP, GFP), safety requirements, and quality systems. b) Employability skills requirements are identified based on the context of the job, which may include communication, teamwork, problem solving, planning and organizing, self-management, initiative entrepreneurship, technology, and learning. c) Basic requirements identified based on the requirements of the certification scheme and industry context, which may include qualifications/education and experience in previous roles. d) Degree scale requirements are identified based on certification scheme requirements and industry context, which may include time, time, and competency dimensions.

c. Micro-Credential Operational Curriculum Skill Set Formulation

Based on the interface model between the Skillset structure, competency-based recruitment, occupational maps within the qualification framework and certification schemes, a project manager micro-credential skill set can be developed, which includes the Micro-Credential package title, learning definition/scope, workplace context, managerial and cultural competencies, role responsibilities, entry behavior line, and skill competencies (Palmer, 2021) as below.

Table 2. Sill Set – Project Manager Microcredential Operational Curriculum

| SKILL SET – OPERATIONAL CURRICULUM EXPERTISE: PROJECT MANAGER ENGINEERING PRACTICE	
a. **Package title : Credentials and Instructional Goals** *determined based on national occupational map/ competency-based recruitment/ occupational standards/ national certification standards and workplace context.*	Micro Credential Occupational Title: Engineering Practice Project Manager Instructional Goal: Participants are able to act as engineering project managers in accordance with the context of the engineering sector / field in five dimensions of competence
b. **Definition/Scope of learning** *determined based on national occupational standard descriptions/maps and workplace context*	An Engineering Practice Project Manager is a professional who is responsible for planning, managing, and supervising technical projects within the engineering field. The main task is to ensure that the projects are completed successfully, in accordance with the established goals of time, budget and quality.
c. **Workplace context** *determined based on national occupational standard descriptions/maps and workplace context*	These Project Managers work in a variety of sectors, including civil engineering, electrical engineering, mechanical engineering, chemical engineering, and other engineering fields.
d. **Kompetensi manajerial dan kultural** *determined based on employability skills on national occupational standards/maps and workplace context*	Employability Skills: 1. Komunikasi 2. Work in teams 3. Troubleshoot problems 4. Self-management 5. Initiative and entrepreneurship 6. Planning and organizing 7. Technology 8. Learning
e. **Tanggungjawab peran kerja**	The engineering project manager's job responsibilities include: Project Planning, Team

		Determined based on workplace context and according to occupational standard responsibilities	Coordination, Risk Management, Budget Management, Quality and Safety, Evaluation and Reporting, Communication, and Problem Solving.
f.	**Entry behavior line** *determined based on employability skills on national occupational standards/maps and workplace context*		The basic requirement of this micro-credential is that participants have graduated with a bachelor's degree in engineering.
g.	**Kompetensi keahlian** *determined based on employability skills on national occupational standards/maps and workplace context*		1. Apply the Engineer's code of ethics in project management. 2. Managing Engineering Practice Projects 3. Manage project scope 4. Manage project time 5. Manage project quality 6. Manage project finances 7. Manage project HR 8. Manage project information and communication 9. Managing project risk 10. Manage project procurement 11. Managing Project Stakeholder Engagement 12. Contribute to developing, implementing, and maintaining the organization's WHS management system.

B. Competency-based Instructional Design as a quality assurance system

Instructional design is a systematic approach to designing, developing, and managing effective and efficient learning processes. Indonesia has provided a reference for the development of instructional design through the Higher Education Curriculum Preparation Guide in the Industrial Era 4.0 to support Independent Learning-Independent Campus (Junaidi et al., 2020) In addition, the Indonesian National Work Competency Standard (SKKNI) has also published a Competency Unit for Designing Instructional Design (Kemnaker, 2020) Both references adapt the Dick and Carey model with the aim of creating learning experiences that focus on achieving learning objectives by considering the needs of participants, material characteristics, and appropriate learning methods and strategies (Dick et al., 2015).

Instructional design can be categorized as a learning plan based on instructional design approaches and principles that include designing, developing, and managing effective and efficient learning processes. So this instructional design can be a reliable learning plan for developing reliable micro-credentials.

However, the development of the Dick and Carey model instructional design requires a long time of time Reiset and development, although Borg and Gall (2015) have provided guidelines in conducting research and development of the Dick and Carey model instructional design. This study identifies an opportunity to accelerate the development of Dick and Carey's instructional design model, namely Competency-based Instructional Design Development. This approach is an approach in instructional design that focuses on developing concrete and measurable competencies or abilities as learning objectives. This approach places a strong emphasis on achieving specific outcomes or competencies by participants, rather than focusing solely on theoretical understanding or graduation based on specific times. For this debate, competence as a measure of learning objectives is obtained from competency units in competency standards which are the result of development and consensus from stakeholders. With the existence of competency standards, almost all stages and components of instructional design can be supported and supplied by integrated competency standards as shown below.
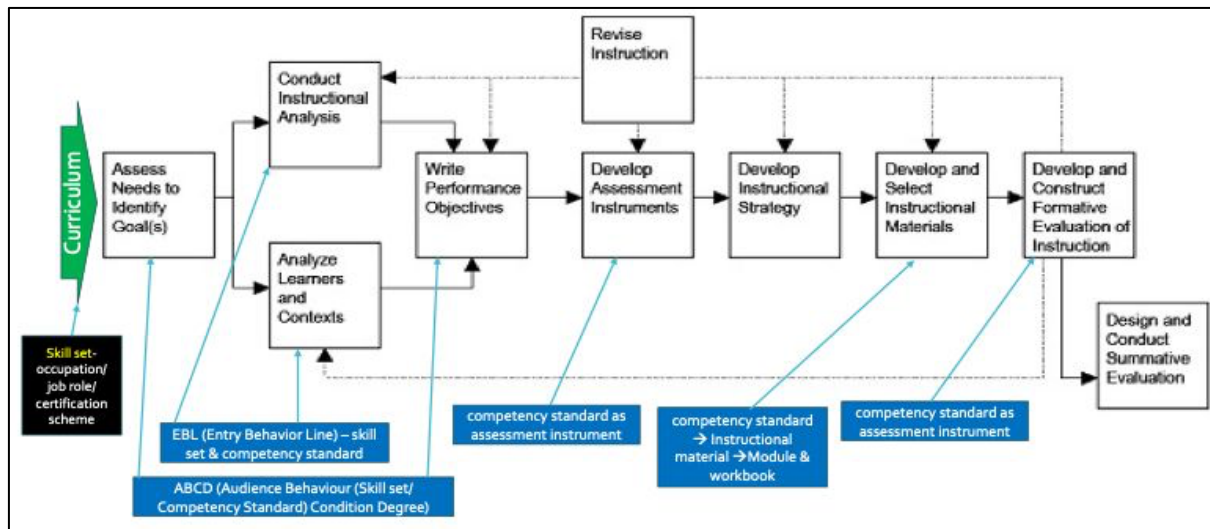
Figure 3. Competency-Based Instructional Design Model

With the support of Competency Standards, this Competency-Based Instructional Design has guarantees of relevance, validity, acceptability, flexibility, and traceability that can be ensured in its application. This is because the formulation of competency standards has the principles of relevance, validity, acceptability, flexibility, and traceability (Kemnaker, 2016)

C. Delivery of outcome-based learning and teaching (OBLT=Outcome Based Learning and Teaching).

Outcome-Based Learning and Teaching (OBLT) is an approach in education that emphasizes the achievement of clear and measurable learning outcomes according to the skill set as the main focus in the learning and teaching process. This approach aims to ensure that learners achieve certain understandings, skills, and knowledge that have been set as learning objectives (Junaidi et al., 2020)

However, teachers must also pay attention to and manage the problems that are critical points of learning delivery: engagement of learning objectives with students, collection of quality evidence and levels of achievement, concepts of educating to competence (personalization of learning), and formative assessment and continuous improvement. Critical point management can be done as follows: identification of potential risks, determination of critical limits, corrective actions, and verification of corrective actions.
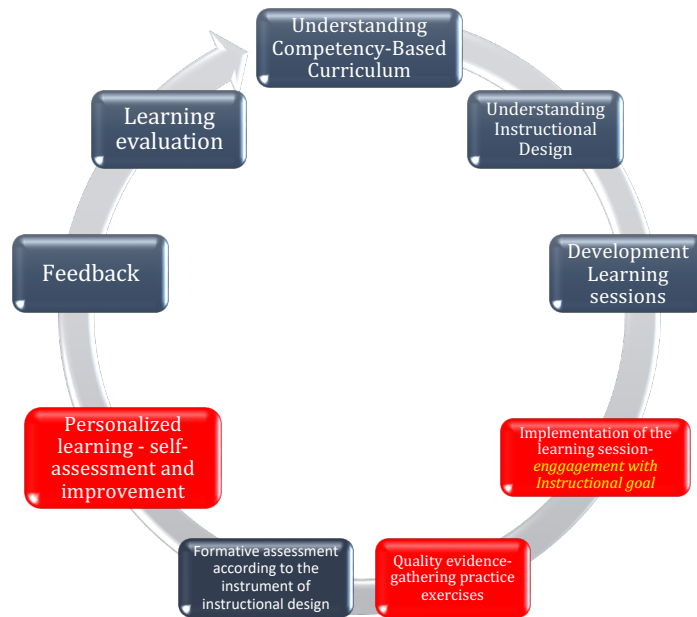
Figure 4. Delivery Flow of outcome-based learning and teaching

D. Development of competency-based assessment (CBA)

Competency-based assessment is critical in the Learning Process, namely in: ensuring assessment focuses on Practical Skills in real situations, so that they are more relevant to the world of work; Measure Actual Ability and providing an accurate picture of what learners have mastered; encouraging active Learning in learning and strive to achieve expected results; and became the Base for Further Improvement and Development (Arora et al., 2018).

In its application, teachers, instructors, or experts responsible for teaching and training students are the parties who carry out assessments. They have the responsibility to design, implement, and evaluate estimates.

The steps in conducting competency-based assessments in the framework of micro-credentials include: Establishing and maintaining an assessment environment, collecting quality evidence, supporting candidates, making assessment decisions, recording and reporting assessment decisions, and reviewing the assessment process.
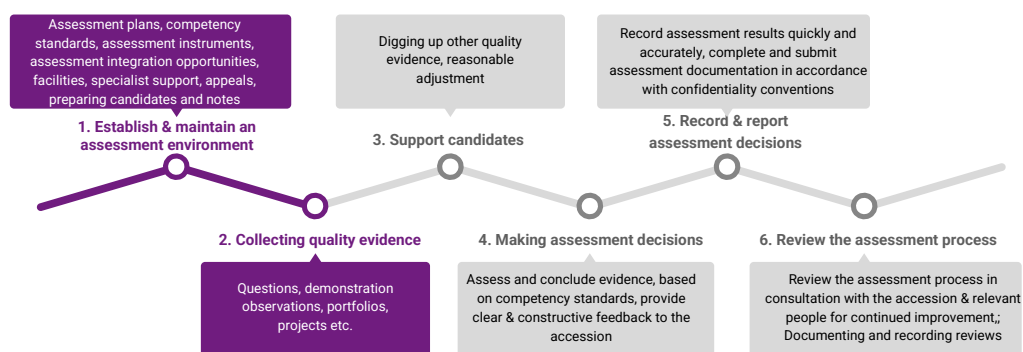

Figure 5. Implementation Structure of competency-based assessment

E. Micro Credential Deployment

There are several types of credentials in vocational education, namely certificates /diplomas of educational institutions, certificates of competence from professional certification bodies, licenses / registrations from professional organizations or authorities, and micro-credentials from academic institutions or professional organizations internally. To meet the needs of work role

qualifications that continue to rapidly develop in accordance with the speed of change and technological progress, a recommendation model for education graduates is needed who also have the flexibility to follow the development of technological advances. This model is identified as being on the Micro Credentials model. Wheelahan et al (2022) confirm that micro-credentials contribute to 'disciplining' education in two ways: first by establishing a closer link between education and workplace requirements (rather than the entire job), and through ensuring education is more 'responsive' to employer demands in a competitive market crowded with other types of providers. This model requires a credible standard, and the ILO RMCS (Regional Model Competency Standard) competency standard can help in this regard (ILO, 2006) The implementation of Micro Credentials is managed and the application of quality assurance by professional organizations or educational institutions. The microcredential management steps identified include the structure illustrated below.
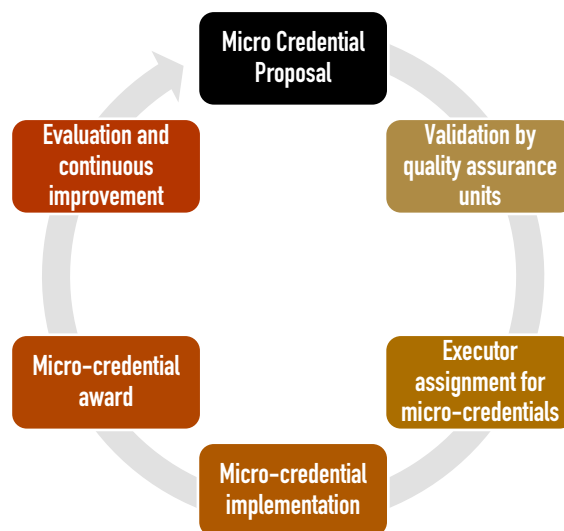
Figure 6. Competency-Based Micro-Credential deployment structure.

CONCLUSION

The development of the Project Management microcredential design represents a comprehensive framework aimed at enhancing the quality of engineering practices. The design incorporates key components such as a competency-based skill set model, instructional design for quality assurance, and an outcome-based learning approach. Practical elements include competency-based assessment and the operational deployment of the Microcredential. This design is not just theoretical but can be applied by professional organizations, notably by entities like the Indonesian Engineers Association, to elevate the competence and professionalism of engineers. Its adaptability extends to Professional engineering education, encompassing both integrated and packaged formats. Further research and engineering efforts are crucial for the operationalization of this initiative, focusing on the development of competency standards such as the National Work Competency Standards (SKKNI) and Special Competency Standards for the Indonesian Engineers Association. This holistic approach aims to uplift standards and practices within the engineering profession, fostering continuous improvement and development.

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