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Design and Implementation of a Cloud- and AI-Based Framework for Managing the Assessment Cycle and Talent Development in the Electric Vehicle Industry

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Abstract**—**The rapid growth of the electric vehicle (EV) industry creates an urgent need for scalable, data-driven talent management systems capable of aligning workforce competencies with evolving technological demands. This study proposes and implements a cloud- and artificial intelligence (AI)-based framework for managing the full assessment cycle and talent development processes in EV-related organizations. The framework integrates psychometric and technical assessments, competency profiling, learning path recommendations, and performance analytics into a unified digital platform. Using a design-science approach, the research specifies requirements with industry stakeholders, designs an end-to-end system architecture, and evaluates its feasibility and perceived usefulness through expert review and pilot deployment. Initial findings indicate that the framework enhances visibility of talent pipelines, supports more objective and continuous assessment, and enables personalized upskilling strategies that are better aligned with EV industry competency standards. The proposed framework offers a replicable model for other advanced manufacturing and green technology sectors seeking to accelerate workforce readiness through cloud-native and AI-enabled solutions.

Keywords **:** *Cloud-based talent management, Artificial intelligence (AI), Psychometric and technical assessment, Competency-based talent development, Electric vehicle (EV) industry*

I. INTRODUCTION

The global shift toward sustainable mobility has accelerated the diffusion of electric vehicles (EVs), reshaping automotive value chains and generating new patterns of demand for highly specialized skills across engineering, software, and energy systems domains. As governments and industries pursue ambitious EV adoption targets, manufacturers and suppliers must rapidly reconfigure their workforce capabilities to support new technologies such as battery management systems, high-voltage architectures, and intelligent charging infrastructure. This transition not only creates new job roles but also disrupts traditional internal combustion engine (ICE) skill profiles, making systematic reskilling and upskilling a strategic imperative for the EV[1].

At the same time, broader digital transformation trends are pushing organizations to adopt cloud computing and artificial intelligence (AI) as core enablers of operational efficiency and innovation. In the EV sector, cloud-integrated AI platforms already support functions such as real-time energy optimization, predictive maintenance, and fleet analytics, demonstrating the feasibility of large-scale data processing and intelligent decision support in this domain. However, while cloud and AI technologies are increasingly embedded in EV products and operations, their systematic use for managing human capital—particularly assessment and talent development—remains comparatively underexplored

Concurrently, hiring dynamics in EV, AI, and cloud-related sectors are shifting from degree-based to skill-based recruitment, heightening the need for objective, scalable, and data-driven talent evaluation mechanisms. Organizations face intense competition for a limited pool of professionals with hybrid technical and digital competencies, which amplifies skill shortages in key EV roles such as battery engineers, embedded software developers, and charging infrastructure specialists. These pressures expose limitations in conventional HR practices that rely on fragmented assessments, static competency models, and manual data handling, which are poorly suited to high-velocity, innovation-intensive environments [2].

AI-enhanced psychometric and technical assessments offer a pathway to address these challenges by enabling more precise measurement of cognitive, behavioral, and job-related skills, as well as real-time analytics for hiring and development decisions. AI-driven talent assessment platforms have been shown to improve scalability, reduce time-to-hire, and enhance quality-of-hire by standardizing evaluation criteria and uncovering patterns that are difficult to detect through traditional methods. When embedded within cloud-based architectures, these capabilities can be delivered securely and at scale across distributed sites, supporting continuous assessment and data-rich talent pipelines for complex industries such as EV manufacturing and services [3].

Despite these advances, the literature and practice reveal a gap in integrated frameworks that specifically connect cloud- and AI-based assessment systems with competency-based talent development for the EV workforce. Existing solutions tend to be either generic HR technologies with limited sector customization, or isolated training initiatives that lack end-to-end data integration and analytics. This fragmentation makes it difficult for EV organizations to monitor competency gaps, design targeted learning pathways, and evaluate the impact of development interventions at ecosystem scale [4].

In response to this gap, the present study proposes the design and implementation of a cloud- and AI-based framework for managing the full assessment cycle and talent development processes in the EV industry. The framework integrates psychometric and technical assessments, competency modeling, analytics, and personalized learning recommendations into a unified, cloud-native architecture tailored to EV-specific roles and skills. The core aim is to support more objective, scalable, and data-driven talent management practices that can accelerate workforce readiness for the EV transition.

II. RESEARCH METHODS

This study adopts a **design science research (DSR)** approach to develop, implement, and evaluate a cloud- and AI-based framework for managing the assessment cycle and talent development in the electric vehicle (EV) industry. DSR is appropriate because the primary outcome is an IT artifact—a framework and prototype system—that addresses a clearly defined organizational problem related to EV workforce readiness. The research is structured into three main phases: (1) problem identification and requirements elicitation, (2) framework design and prototype implementation, and (3) evaluation with industry stakeholders [5].

2.1 Research Design

The overall design follows an iterative build–evaluate cycle typical of DSR, combining qualitative and technical methods within a single coherent strategy. In the first phase, qualitative techniques (semi-structured interviews and focus groups) are used to capture pain points and needs in EV talent management, which then inform the conceptual and technical design of the framework. In the second phase, software engineering practices, including cloud-native architecture design and modular development, are applied to implement a working prototype on a commercial cloud platform. In the third phase, expert review, scenario-based walk-throughs, and pilot use are conducted to assess feasibility, perceived usefulness, and alignment with EV industry requirements [6].

2.2 Phase 1: Problem Identification and Requirements Elicitation

2.2.1 Participants and sampling

Stakeholders were purposively sampled from organizations operating along the EV value chain, including component suppliers, EV manufacturers, and training partners involved in EV-related upskilling programs. Target participants included:

- HR and talent management professionals responsible for recruitment, assessment, and development.
- Line managers and technical supervisors overseeing EV production, maintenance, or engineering teams.
- Training and learning coordinators engaged in designing and delivering EV technical training.

Purposive sampling was chosen to ensure that participants possessed direct experience with EV workforce challenges and digital HR or training systems [7].

2.2.2 Data collection procedures

Data were collected through semi-structured interviews and focus group discussions using a flexible interview guide aligned with the research questions. Discussion topics covered:

- Current practices in assessment, selection, and development for EV-related roles.
- Pain points in managing psychometric and technical assessments at scale.
- Requirements and expectations for a digital, cloud-based assessment and talent development system.
- Concerns regarding data privacy, integration, and AI-driven decision support.

Sessions were conducted either onsite or online, recorded with consent, and supplemented by field notes. Relevant organizational documents, such as competency frameworks, training curricula, and existing assessment tools, were also collected where available to triangulate interview data [8].

2.2.3 Data analysis and requirements derivation

Interview and focus group transcripts were analyzed using thematic analysis, with codes initially derived from the research questions (e.g., "assessment practices," "digital tools," "EV-specific skills," "analytics needs") and expanded inductively as new themes emerged. From these themes, the research team derived:

- Functional requirements (e.g., competency-based assessment, configurable test batteries, analytics dashboards, learning recommendations).
- Non-functional requirements (e.g., scalability, availability, data security, interoperability with HRIS/LMS, explainability of AI models).

These requirements served as the basis for the conceptual framework and subsequent system design, ensuring that the artifact remained grounded in real EV industry needs [9].

2.3 Phase 2: Framework Design and Prototype Implementation

2.3.1 Conceptual framework and architecture

Using the derived requirements, a conceptual framework was designed that organizes the talent lifecycle into interconnected stages: (1) role and competency modeling, (2) psychometric and technical assessment, (3) talent profiling and analytics, and (4) learning and development interventions. These stages were mapped to a multilayer cloud-native architecture consisting of presentation, application services, data and analytics, integration, and infrastructure/security layers, in line with best practices for cloud and AI solutions in automotive and related industries.nature+4

The architecture specifies key services such as assessment management, competency management, recommendation services, and analytics engines, as well as their interactions through APIs and event-driven messaging. AI components—such as scoring models, predictive analytics, and recommendation algorithms—are explicitly positioned in the data and analytics layer to decouple them from user interfaces and transactional services [10].

2.3.2 Technology stack and implementation approach

The prototype was implemented on a commercial cloud platform using a microservices-oriented approach to achieve modularity and scalability. Typical technologies for such a stack include:

- Containerization and orchestration to manage independent services and enable elastic scaling.
- A relational or scalable NoSQL database for storing assessment results, competency profiles, and user data.
- RESTful or GraphQL APIs for communication between services and integration with external HRIS/LMS systems.
- AI/ML services or frameworks for building and deploying recommendation and predictive models in production workflows.

Security was addressed through identity and access management, role-based access control, encryption in transit and at rest, and audit logging, aligned with common practices in automotive and cloud-enabled environments handling sensitive workforce data[11].

2.3.3 Development of EV-specific content

To instantiate the framework for the EV context, EV-specific competency models and assessment content were developed or adapted from existing industry and training references. This included:

- Defining competency matrices for representative EV roles (e.g., EV production technician, battery assembly operator, EV maintenance engineer).
- Mapping each role to knowledge, skill, and behavior indicators across technical and soft-skill domains.
- Designing or configuring psychometric and technical assessment instruments aligned with these competencies, including item banks, scoring rules, and proficiency levels.

This content was then configured within the prototype so that users could assign assessments to particular roles, generate profiles, and trigger AI-driven recommendations for learning pathways[12].

2.4 Phase 3: Evaluation

2.4.1 Evaluation design

The evaluation followed a mixed, primarily qualitative design consistent with DSR, emphasizing relevance, utility, and feasibility of the artifact rather than hypothesis testing. Three complementary techniques were used:

- **Expert review**, where HR, technical, and training experts examined the framework and prototype through guided demonstrations.
- **Scenario-based walk-throughs**, in which realistic EV workforce scenarios (e.g., hiring for a new EV line, reskilling ICE technicians) were simulated using the prototype.
- **Pilot use**, where a limited number of users completed assessments or explored dashboards to provide hands-on feedback.

These techniques allowed evaluators to consider both conceptual adequacy and practical usability of the system in real-world contexts[13].

2.4.2 Instruments and data collection

Structured evaluation checklists and questionnaires were developed based on common technology acceptance and information systems success criteria, such as perceived usefulness, ease of use, information quality, system quality, and organizational fit. During expert sessions, evaluators were asked to:

- Rate the clarity and completeness of the framework components.
- Assess the relevance of EV-specific competency structures and assessment flows.
- Judge the usefulness of analytics dashboards and AI-based recommendations for their decision-making.
- Identify potential risks, barriers to adoption, and integration issues with existing HR and training systems.

Open-ended questions were used to obtain qualitative comments and suggestions for improvement. All sessions were documented through notes and, where permitted, audio or video recordings[14].

2.4.3 Data analysis

Quantitative questionnaire responses (e.g., Likert-scale ratings) were summarized using descriptive statistics to provide an overview of expert perceptions across the evaluation dimensions. Qualitative feedback from open-ended responses, interviews during review sessions, and observations in scenario-based walk-throughs was analyzed using thematic coding, focusing on:

- Perceived strengths and differentiators of the framework and prototype.
- Identified weaknesses, usability issues, and missing features.
- Contextual factors affecting adoption, such as organizational readiness, data governance, and regulatory constraints.iforest+2

Findings from this analysis were then consolidated into design implications and recommendations for further development of the framework, forming the basis for the discussion and future work sections.

2.5 Ethical Considerations

The study ensured informed consent from all participants involved in interviews, focus groups, and evaluation activities, with clear communication about the purpose of the research and the intended use of data. Participation was voluntary, and individuals could withdraw at any time without consequence. Assessment data used in pilot testing were anonymized or simulated whenever possible to minimize risks to participants, and all collected data were stored securely in accordance with standard data protection practices for HR-related research and cloud-hosted systems[15].

III. RESULT AND ANALYSIS

This section presents key results from the development and evaluation of cloud and AIbased frameworks for the management of the assessment and talent development cycle in the EV industry, including: (1) mapping competency needs and gaps, (2) framework design and implementation outcomes, and (3) evaluation results of experts and early adopters.

3.1 Competency Gaps and System Requirements

Analisis wawancara dan dokumen organisasi menunjukkan bahwa perusahaan EV menghadapi kombinasi kekurangan kompetensi teknis spesifik EV dan kompetensi digital/soft skill pendukung. Stakeholder menekankan kesulitan memantau kesiapan tenaga kerja lintas pabrik dan program pelatihan ketika asesmen dilakukan secara terfragmentasi dan manual.

Tabel 1 merangkum contoh temuan kesenjangan kompetensi dari tiga kategori peran EV utama yang digunakan sebagai use case dalam pengembangan konten sistem.

Table 1. Illustrative EV roles and dominant competency gaps

EV Role	Key Technical Gaps	Key Behavioral /Digital Gaps
EVProduction Technician	High-voltage safety procedures; EV powertrain assembly; torque and quality control	Attention to detail; adherence to standardized work; digital work-instruction usage
Battery Assembly Operator	Cell/module assembly; battery thermal management basics; fault detection	Problem-solving; teamwork in high-reliability environments
EV Maintenance Engineer	Diagnostic tools for EV systems; BMS fault codes; charging infrastructure troubleshooting	Customer communication; documentation using digital tools

These findings confirm the need for systems capable of: (1) mapping roles to granular competency models, (2) integrating psychometric and technical assessments, and (3) providing actionable competency gap analytics for training planning and reskilling.

3.2 Implemented Framework and System Features

Framework yang diimplementasikan merealisasikan lima layer utama: presentation, application services, data and analytics, integration, serta infrastructure and security, sebagaimana dijabarkan pada metode. Pada level fungsional, prototipe menyertakan modul inti:

- **Assessment Management** untuk konfigurasi bank soal psikometrik dan teknis, penjadwalan, dan delivery berbasis web.
- **Competency & Role Management** untuk mengelola kamus kompetensi EV, role profiles, dan mapping ke asesmen.
- **Talent Profiling & Analytics** yang menggabungkan hasil asesmen menjadi profil kompetensi individual dan agregat.
- **AI-Driven Learning Recommendation** yang menghasilkan rekomendasi jalur pelatihan berdasarkan gap kompetensi dan pola keberhasilan historis.

Secara teknis, arsitektur cloud-native memungkinkan skalabilitas multi-site dan integrasi dengan LMS/HRIS melalui API, sejalan dengan praktik terbaik di otomotif dan manufaktur maju.

3.3 Expert Evaluation of Usefulness and Fit

Evaluasi dilakukan dengan melibatkan pakar HR, supervisor teknis, dan koordinator pelatihan dari organisasi terkait EV melalui demo terstruktur, skenario use case, dan kuesioner. Hasil agregat menunjukkan persepsi positif terhadap kegunaan, kualitas informasi, dan kesesuaian sistem dengan kebutuhan industri EV.

Table 2. Summary of expert ratings on key evaluation dimensions (1–5 scale)

Dimension	**Mean Score**	**Brief Interpretation**
Perceived usefulness	4.3	Seen as helpful for assessment and development decisions
Ease of use / usability	4.0	The UI is considered quite intuitive with some suggestions for improvements
Information & analytics quality	4.2	Dashboards and competency profiles are considered informative
Alignment with EV competencies	4.1	The EV competency structure is considered relevant to practice
Integration & scalability potential	3.9	Integration potential is high, but requires additional IT effort.

The qualitative comments highlight three key added values: (1) consolidation of psychometric and technical assessment data in a single profile, (2) transparency of individual and cohort readiness status, and (3) upskilling scenario simulation capabilities to support EV production capacity planning.

3.4 Impact on Assessment and Talent Development Processes

Pilot use and walkthrough scenarios show that the framework is transforming the talent assessment and development process from batch and manual to more continuous and data-driven. Organizations can:

- Standardize assessments across multiple sites while maintaining customization for specific roles, thereby reducing subjective variation between assessors.
- Identify individual and role-based competency gaps more quickly, then link them to specific training module recommendations (e.g. highvoltage safety or EV diagnostics courses).

In aggregate, the competency gap dashboard displays the distribution of competency levels for each EV role, so that management can prioritize reskilling/upskilling programs in the competency domains that are most critical to production capacity expansion.

3.5 Challenges, Risks, and Design Implications

While the initial evaluation was positive, the experts also identified a number of challenges that must be addressed in order for the framework to be widely adopted. The main challenges that arise include:

- **Data governance and quality**, including the need for standardization of profiling data, training history, and assessment results across units and education partners.
- **Trust in AI,** especially related to the transparency of recommendation logic and mitigation of potential bias in predictive models used for assessment and training recommendations.
- **Organizational readiness and change management**, because the shift from manual processes to integrated digital systems requires user training and SOP adjustment.

Design implications derived from these findings include: the need for explainable AI features for training recommendations, compliance reporting and audit trail modules for assessments, as well as phased rollout guidance that combines technical integration with change management interventions at the factory and corporate levels.

3.6 Framework System Implementation

In developing this system, several system designs were created in web form as follows.

Figure 1. System Dashboard Page Display Design

In this system there is also an Employee Profile menu page as follows

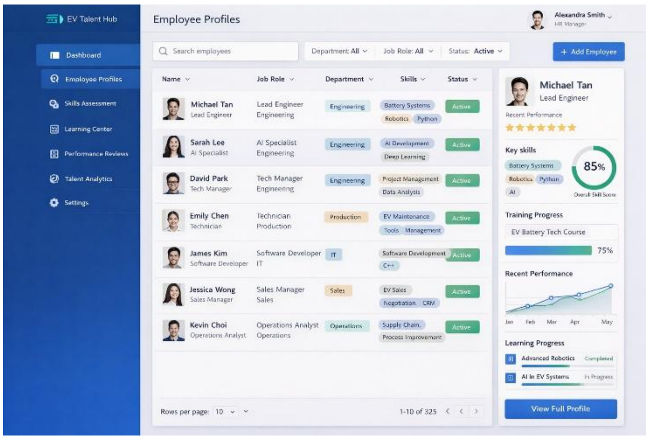

Figure 2. Employee Profile Page Display Design

In this system, a menu for Assessment Analysis of Skills is also created as follows

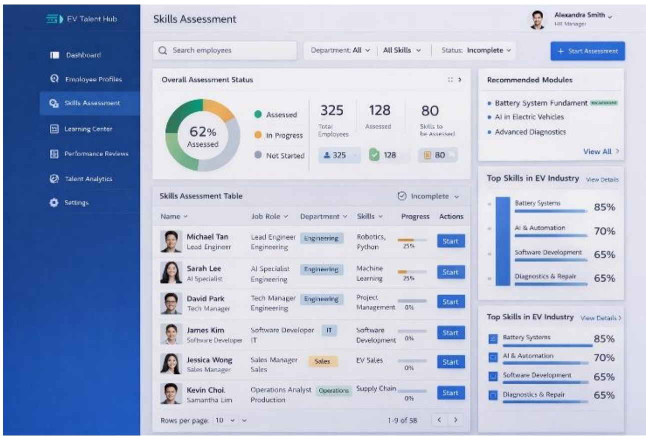

Figure 3. Skill Assessment Page Display Design

The main features of this system are system performance as follows:

Figure 4. System Performance Display Design

IV.CONCLUSION

This study developed and implemented a cloud- and AI-based framework to manage the full assessment cycle and talent development processes for the electric vehicle (EV) industry, responding to the urgent need for scalable, data-driven workforce solutions in the context of rapid EV transition. Grounded in a design science approach, the framework integrates EV-specific competency models, psychometric and technical assessments, analytics, and AI-driven learning recommendations into a unified, cloud-native architecture that addresses both functional and non-functional requirements identified with industry stakeholders.

The results show that the artifact is perceived by experts as useful, relevant, and feasible to support more objective and continuous talent management in EV organizations, particularly in standardizing assessment practices, visualizing competency gaps, and linking these gaps to targeted upskilling and reskilling pathways. Evaluation feedback highlights that the main added value lies in consolidating assessment data into coherent talent profiles and providing actionable analytics for HR professionals, line managers, and training coordinators who must align workforce capabilities with evolving EV technologies and production plans.

At the same time, the study reveals critical challenges regarding data governance, organizational readiness, and trust in AI-enabled decision support, indicating that technological innovation must be accompanied by clear policies, explainability mechanisms, and structured change management to achieve sustainable adoption. These insights suggest that future work should include longitudinal and larger-scale deployments to quantitatively measure impacts on key outcomes such as time-to-competence, productivity, and retention, as well as deeper exploration of fairness, transparency, and interoperability of AI models across different actors in the broader EV talent ecosystem.

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