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# CROSS-SECTOR GREEN SKILLED WORKFORCE TRAINING PLANNING MANAGEMENT MODEL BASED ON GTMIS-ESF

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**Abstract:** This study intends to create a web-based system product based on the management development model for planning skilled workforce training in green job area through Research and Development, by following the ADDIE model instructional design stages. The novelty resulting from this study is a conceptual model for green training planning management for a cross-sector skilled workforce based on gTMIS-ESF. The model development consists of governance: green training facilitator planning management, green training program curriculum planning management, green training infrastructure planning management, green training community planning management, green training financing planning management, green trainee planning management. The results of the physical development have been tested for feasibility by experts in their fields and practitioners at training institutions, and empirical tests have been conducted on green training participants through group trials. The results of the feasibility test for media and IT experts, language and communication, and training practitioners are Valid for dissemination. The results of the satisfaction level in the group trial, namely prospective trainees, are with an overall average percentage of 89.6%. Based on the N-Gain calculation, an average of 0.72 is obtained, indicating that the treatment provided is very effective in increasing beginner-level green knowledge for skilled workers across sectors.

**Keywords:** Planning Management, Green Training, Skilled Workforce, Cross-Sector, ADDIE.

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## INTRODUCTION:

Green Jobs are decent jobs that contribute to environmental conservation in a green circular economy in both conventional and renewable industries [1], offering adequate wages, safe working conditions, career prospects with specific tasks and skills in implementing environmentally friendly decision-making processes [2], which produce environmentally friendly products and services through sustainable methods, while Green Skills are transversal skills in the green transition [3], covering the knowledge, abilities, values and attitudes needed to support sustainability, with (1) technical knowledge, (2) expertise, and (3) the ability to use effective technology to facilitate environmentally friendly decision-making [4].

The differences between non-green and green jobs are generally seen in specific skill areas, indicating that most existing skills can be enhanced through retraining, involving the same scope as transitioning existing jobs to a culture of sustainability [5]. Green workforce training and development has been shown to significantly influence sustainability behaviour and substantially increase commitment to growth and development within the organization [6]. The implementation of green training and development initiatives is also significantly aligned with the vision and mission of sustainable business excellence [7]. Therefore, there is a link between green training and career growth of the green workforce [8].

In Indonesia, job opportunities requiring green skills are 1.8 million - 4.4 million until the year 2030 [9], and the demand for green talent per year is predicted to be around 250-650 thousand [10]. The Deputy for Population and Manpower of the Ministry of National Development Planning/Bappenas added that by 2045 there will have been 15.3 million new jobs for the green economy sector at the Indonesia's Green Jobs Conference in 2023. In fact, the number of working people in Indonesia who have participated in certified training recorded by type of work or position in 2017-2020, the smallest percentage is around 7.5% which comes from the type of work in agriculture, forestry, and fisheries, so it is not in line with the projection of the largest job opportunities in Indonesia to support Indonesia's economic transformation through a green economy strategy [11]. Based on the projection of labour needs by sector and position for 2025-2029 [12], the need for labour occupied by service workers, sales workers, and skilled workers in the agricultural sector is estimated to remain dominant, so that it is necessary to adjust employment strategies, like formal education, vocational training, upskilling and reskilling programs.

The socialization of the action program for green skills training to address green job opportunities in Indonesia was carried out in 20245, through a webinar entitled "Go Green Get Skilled: Answering Green Job Opportunities" by the Coordinating Ministry for Economic Affairs

of the Republic of Indonesia, where the Indonesian government's partner workforce training institutions were invited to attend the activity. The expert who was the Manager of Public Sector Economic Development for Pre-Employment, stated that job training providers are expected to adapt quickly to the needs of sustainable jobs within the circular economy in Indonesia. They should support training for green skills by using the labour market and research to identify new industry needs, thereby ensuring job training remains relevant and successfully addresses sustainability requirements. The Executive Director of the Pre-Employment Card Program Management stated that there is a significant impact on the expansion of green job opportunities in Indonesia, in line with the need for green talent with a focus on five industrial function areas in Indonesia. The Director of Manpower, Ministry of National Development Planning/Bappenas added that there are still significant challenges in Indonesia for the workforce group to absorb new skills, due to the low formal educational background of the workforce, and access to workforce training is still low.

Indonesia's Green Job Conference 2025: Turning Vision into Action was held in 2025 by the Ministry of National Development Planning/Bappenas of the Republic of Indonesia, the launching conference of the "Indonesian Green Workforce Development Roadmap", where green jobs are seen as a solution to face the impacts of climate change from an economic, social and environmental perspective, green jobs are designated as a national priority program to encourage increased green work, productivity and economic competitiveness. The Deputy Minister of the Indonesian National Development Planning Agency explained that the green economy is one of the very top pillars for Indonesia's transformation in the economic sector believed to encourage community welfare in sustainability according to its goal of net zero emissions by 2060, green workforce development is one of the national priorities, and some conventional jobs will be transformed into green jobs so that increasing green skills through reskilling and upskilling becomes crucial.

The Green Jobs Green Future Talk show: Keren Job Opportunities in the Energy Transition Era, held by the Indonesian Ministry of Manpower in 2025, was attended by a wide range of audience, including job seekers, job providers, educational and training institutions partnered with the Indonesian Government. The Head of PKET, the Renewable Energy Skills Center, explained that training provided for the workforce must be adjusted to the SKKNI, so that it can answer the needs of the industry, where synergistic collaboration is needed between the private sector, government, and institutions providing education and training for the workforce.

To follow up on the outreach and development activities of the Indonesian government's partner training institutions towards a green transition in the green economy, a needs analysis was conducted in a grand tour to strengthen the needs of the real context and the basis for this research.

The grand tour was conducted through observations and group forum discussions at Arsikei Consulting (A.C.), and The British Institute (T.B.I.) in Jakarta. The informants include the management and implementing practitioners from training institutions partnered with the Indonesian government in Jakarta and the alumni of the trainees. Both of these organizations have been Indonesian government partners since 2020. They implement workforce training programs designed to boost competency for the Pre-Employment Card program, delivering courses remotely and in a hybrid format through specific platform partners across Indonesia.

The group forum discussion results disclosed that (1) a collaboration with related parties is needed to promote green skills, green jobs for the implementation of appropriate green training, (2) the need for management functions in planning to identify the beneficiaries of green ecosystems formation and action plans, (3) the need for a comprehensive management system to support decision making by providing appropriate and accurate information, allowing institutions to make training plan decisions based on data. The results of interviews with alumni trainees revealed (1) a gap in knowledge, skills and attitudes of green culture, so that alumni stated that they often miss job opportunities that require green jobs, (2) alumni do not know the difference between training for green jobs and not. So, in overcoming this gap, a planning system is needed to help prospective trainees provide direction and motivate them in achieving the objectives of training results for future green job readiness.

In a practical matter, green workforce training and development governance shall begin with needs analysis, beneficiary identification, training validation, training implementation, and training evaluation and reporting [13]. Green training governance could be implemented through the establishment of centres of excellence in education and training to enhance sustainable innovation [14]. Effective policy interventions can increase sustainability awareness in the economy, society, government, and the environment for the workforce [15]. Governance shall be implemented by mapping the conceptual structure of the required green human resource management [16]. Thus, improving soft skills for the transition to future jobs and green workforce training can impact intellectual stimulation [17].

Developing an effective education and training information system by adopting an integrated information system has been proven to assist decision-makers in predicting problems and proposing realistic and effective actions [18]. An integrated education and training information management system can support governance in the administration of report preparation, systematization, report capture, and automatic report generation in required formats [19]. With the help of information system output products, monitoring and quality management in education and training programs

can be carried out effectively and efficiently [20]. The use of information systems in the big data era can build effective education and training decision-making models (Forrester, 2019) and decision support for education and training management [21].

Based on the field context during grand tour and review of previous relevant research, the researcher is interested in developing a management model for skilled workforce training planning in the cross-sector green jobs area. This Research and Development study, a web-based media system product, developed a training planning management model to support the governance of skilled workforce training planning for cross-sector green jobs. This research followed the ADDIE model instructional design stages and was conducted at private job training institutions partnered with the Indonesian government in Jakarta.

The focus of this research is the development of a skilled worker training planning management model in the cross-sector green job area. The sub-focus of the research is (1) Development of a skilled worker training planning management model in the cross-sector green job area, including: (a) green trainees, (b) green training facilitators, (c) green training program curriculum, (d) green training community, (e) green training facilities and infrastructure, (g) green training finance, (2) Reconstructing and implementing the development of a skilled worker training planning management model in the cross-sector green job area at a private job training institution partnering with the Government of the Republic of Indonesia in Jakarta, (3) Testing and evaluating the effectiveness of the application of the development of a skilled worker training planning management model in the cross-sector green job area at a private job training institution partnering with the Government of the Republic of Indonesia in Jakarta with the implementation of web-based management system product support.

This research offers (1) scientific and practical contributions in the development of a skilled workforce training planning management model in the cross-sector green jobs area, (2) a form of practice for communication and campaign initiation initiated by KEMNAKER (2025) to disseminate knowledge to increase public understanding of green jobs, green skills, green training, (3) answering the need for green talent in Indonesia based on the idea of ISED & BAPPENAS (2022) regarding the socialization of occupational maps to the world of work, especially skilled workers in the cross-sector green jobs area.

**METHODOLOGY:**

This is a Research and Development study, which is industry-based because the findings are used for designing new products or procedures [22]. It is a systematic study encompassing the

design, development, and evaluation processes to establish an empirical basis for the creation of instructional tools and refined models [23]. A number of qualitative and quantitative approaches are applied in several relevant steps to guide the researchers in producing valid and empirically tested products. This research uses the ADDIE model development stages: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation. This is a composite model approach that demonstrates the relationship between front-end analysis and post-project implementation, evaluation, and lifecycle maintenance processes [24]. It adopts the Input-Process-Output paradigm with a layered concurrent approach [25].

The purpose of the analysis phase is to identify gaps by validating between the expectations and reality, defining instructional objectives, confirming beneficiaries, identifying resources, and developing a project plan. The final result is an analysis summary [25]. At this stage, the literature review and fieldwork produce a factual model, while the needs analysis produces a design model. The purpose of the design phase is to verify desired performance and appropriate testing methods by conducting an inventory, compiling performance data, and generating a testing strategy. The result is a design summary [25]. This stage aims to produce a cross-sector green workforce training planning governance development model and a web-based system output prototype design by determining the success indicators defined in the model development.

The purpose of the development phase is to produce supporting system prototype content, select supporting media for the stated objectives, develop a guide for beneficiaries, conduct formative revisions, and conduct a pilot test. The output is all resources for the entire process [25]. At this stage, the model design produces a prototype of the development model and its supporting system. This is followed by an expert validation, continued with a brainstorming session with potential system users and a revision review, resulting in the creation of a hypothetical model.

The purpose of the implementation phase is to prepare the environment and involve beneficiaries. The outcome of this phase is an implementation strategy [25]. At this stage, the hypothetical model is tested in a small group, then revised, followed by a large group trial and revision review, resulting in final revision and model. This evaluation phase aims to assess the quality of both the product and the process, covering the period before and after implementation. The main procedure is to determine evaluation criteria for all aspects of the process and select or create all the evaluation tools that will be needed to complete the entire ADDIE process [25].

This research was conducted at a private workforce training provider institution partnered with the Indonesian Government in Jakarta, namely the Institution (A.C.), the Institution (T.B.I.), implemented from January 2025 to October 2025. The factual model produced at the analysis stage

contains (1) qualitative data types, (2) with data collection techniques, namely literature study, observation, interviews, documentation, (3) with instruments, namely observation sheets, interview guidelines, group discussion guide sheets, (4) data analysis, namely qualitative descriptive (data tabulation, thematic analysis). The hypothetical model produced at the development stage contains (1) quantitative data types, (2) data collection techniques, namely questionnaires, (3) instruments, namely questionnaires, and (4) data analysis, namely descriptive statistics. The final model at the product trial and evaluation stage (1) includes qualitative and quantitative data types, (2) with data collection techniques, namely questionnaires, observation, and interviews, (3) with instruments, namely questionnaires, interview guidelines, (4) data analysis, namely descriptive statistics, and data triangulation.

### RESULTS AND DISCUSSION:

**Stage 1 – Analysis**

1. Summary of Findings from Webinars, Conferences, and Talk Shows

   Documentation from three national activities—(1) Go Green Get Skilled: Responding to Green Jobs Opportunities (Coordinating Ministry for Economic Affairs, 2024), (2) Indonesia's Green Job Conference 2025: Turning Vision into Action (Bappenas, 2025), and (3) Green Jobs Green Future Talk Show: Cool Job Opportunities in the Energy Transition Era (Ministry of Manpower, 2025)—produced the following insights:

   a. Strengths

      1) Sustainability has become a prevailing value and organizational culture across Indonesia.

      2) Growing national demand for green talent aligns with the rapid expansion of green jobs.

      3) Industries increasingly integrate sustainability from upstream to downstream within the circular economy framework.

      4) Green jobs offer environmental benefits, decent wages, and flexible training modes (online/offline).

      5) Green jobs are a national priority in RPJMN 2025–2029.

      6) The Indonesian Green Workforce Development Roadmap (Bappenas, 2025) guides the preparation of skilled and inclusive green workers.

      7) Collaborative action involves ministries, industries, associations, and development partners.

      8) Technology and digitalization strongly support Indonesia's green economic transition.

b. Weaknesses

    1) Workforce educational attainment remains low (BPS).

    2) Access to job training is still limited (BPS).

c. Opportunities

    1) Green job creation can increase national economic growth by 5–7% annually.

    2) Institutions can support green skills through labor market research.

    3) Indonesia's youth show high climate awareness.

    4) Green skills are applicable across sectors through sustainable task transformation.

    5) The agricultural sector remains the largest labor absorber.

    6) Information systems can connect job seekers and employers.

    7) Need for integrated databases and improved reskilling/upskilling programs.

    8) Sustainable development requires upstream–downstream policy planning.

    9) Training must align with Indonesian National Work Competency Standards.

    10) Government encouragement of research collaboration ensures downstream output.

    11) Apprenticeships provide practical exposure to Green Jobs.

    12) Penta-Helix Strategy (academia–business–government–community–media) is essential for synergy.

d. Threats

    1) No standardized indicators to assess green job feasibility.

    2) Lack of standardized regional needs mapping.

    3) Workforce placement challenges during green economic transition.

    4) Limited public awareness of green jobs and skills.

2. Needs Analysis (Interviews, Observations, Document Review)

Data were collected through structured/unstructured interviews, field observations, and document review. Informants came from Institutions (A.C.) and (T.B.I.), including operational directors, academic managers, facilitators, administrators, and alumni. Interviews were recorded, transcribed, and analyzed using thematic content analysis.

Key Interview Findings

a. Training Programs (Item 1)

A.C. specializes in service and sales workforce training for domestic placement, while T.B.I. provides foreign language training for cross-sector domestic and overseas workforce placement.

b. Adult Learning Approach (Item 2)

Both institutions apply andragogy principles—engagement, experience-based learning, relevance, and problem solving—supported by activity-based strategies and discussions.

c. Methods and Techniques (Item 3)

Training methods are adapted to adult learners' psychological characteristics and aligned with labor market needs.

d. Learning Technology (Item 4)

Both institutions use LMS, digital platforms, and ICT tools to improve learning effectiveness.

e. Synchronous–Asynchronous Learning (Item 5)

Blended learning modes enable flexible access for trainees.

f. Learning Media (Item 6)

Institutions actively use interactive digital media.

g. Role of Facilitators (Item 7)

Facilitators guide, instruct, monitor progress, and ensure learner-centered sessions.

h. Knowledge Management (Item 8)

Knowledge management exists but faces challenges such as resistance to change, outdated knowledge, technological gaps, and unclear processes.

i. Training Needs Analysis (Item 9)

Needs analysis is conducted at the individual level to identify competency gaps.

j. Sustainable Training and Green Workforce (Item 10)

Institutions recognize the need for strong governance systems, green skills recognition, a green economy-based curriculum, and organizational sustainability culture.

k. Management Information System (Item 11)

There is a need for an integrated system enabling data-based analysis, real-time monitoring, tactical–strategic planning, and upstream–downstream integration.

l. Management Functions (Item 12)

Institutions require systems ensuring compliance, resource planning, hybrid management, adaptive strategies, and input–process–output alignment to support sustainable economic outcomes.

3. Observation Findings

Observations of training sessions in A.C. and T.B.I. show:

a. Facilitators

Apply andragogy, engage in two-way interaction, master content, provide feedback,

highlight learning objectives, and conclude sessions effectively.

b. Facilities & Infrastructure

1) Training uses blended learning (synchronous–asynchronous).

2) Digital platforms are accessible across devices.

3) Audio-visual materials are high quality.

## Stage 2 – Design

The rationale for developing a cross-sector green skilled workforce planning model is grounded in Indonesia's national agenda, where green jobs are designated as a priority program to strengthen productivity and competitiveness under the RPJMN 2025–2029 (Presidential Regulation No. 12/2025). The Indonesian Green Workforce Development Roadmap (Bappenas, 2025) further reinforces the need for coordinated action among ministries, training providers, industry, associations, and development partners.

Model development rests on several assumptions:

1) skilled workers differ across sectors in roles, education, expertise, certification, experience, and career goals;

2) green job expansion increases demand for green talent and sustainability integration across value chains;

3) a web-based integrated training management system enhances planning efficiency and opportunity selection;

4) information systems connect job seekers and employers to support implementation beyond policy;

5) knowledge management supports sustainable green learning;

6) training needs analysis must align individual needs with organizational strategy;

7) standardized training service requirements—programs, facilitators, infrastructure, financing, and community—enable rapid gap identification and service quality improvement.

The need for upstream–downstream sustainable governance motivates the model, emphasizing efficient resource use and effective goal achievement. Training management functions encompass planning, finance, information governance, student management, programs, curriculum, and evaluation [26]. Planning is defined as goal-oriented analysis and opportunity selection [27], requiring accountability [28], future orientation [29], and attention to demographic and technological change (Zainal et al., 2018). Effective training planning aligns strategies [30] with data mapping [31], supports career-oriented transformation [32], and strengthens talent acquisition

and sustainability [33], [34], [35].

The resulting product—the Green Training Management System (gTMIS)–ESF: Green Buddies & Green Partner—is a web-based model supporting cross-sector skilled workforce planning. gTMIS–ESF Green Buddies provides remote access for beneficiaries through:

1. Green Knowledge Management

2. Green Training Needs Analysis Management

Green Knowledge Management promotes accessible, entry-level green learning and collaborative knowledge sharing. Content covers introductions to green jobs, skills, and training. Green knowledge management supports sustainability [36], green innovation [37], and performance [38]. Its dimensions—acquisition, sharing, storage, application, creation—follow [39]. Green knowledge acquisition also impacts technological innovation [40] and environmental sustainability [41]. Content development draws from research on green jobs [42], the Bappenas Roadmap (2025), green skills [43], [44], and green training [45], [46], [47], [48].

Green Training Needs Analysis Management includes mapping foreign language proficiency (based on CEFR: Council of Europe, 2001), communication skills via performance tasks, beneficiary profiles (education, certifications, experience, goals), and green skill needs. Training needs analysis enhances sustainability performance [49], aligns individual and organizational strategies [50], and supports effective professional development [51]. Skill needs mapping identifies gaps and supports targeted, career-oriented development.

The gTMIS–ESF Green Partner supports institutions through planning management for facilitators, curriculum, infrastructure, financing, and community development. Facilitator standards align with PP No. 57/2021 and Regulation No. 56/2022, requiring appropriate educational qualifications, competency tests, and professional, social, and personal competencies. Mapping includes certification details (BNSP ToT, assessor, professional certification), experience, teaching portfolios, and administrative documents.

Curriculum planning maps target groups, training modes (webinar, blended, LMS), types (upskilling, reskilling, cross-skilling), models (project-based, problem-based, contextual, cooperative), and methods (lecture, discussion, simulation, case study). Approaches follow adult learning principles [52] and methodologies such as Kolb's Learning Cycle [53]. Labor market alignment refers to KBJI 2014/2021, IndoTaSK 2020, SKKNI, and KKNI. Competency aspects include cognitive, affective, and psychomotor domains [54], expressed through ABCD-based objectives.

Implementation planning includes session flow, synchronous/asynchronous components,

demonstrations, and assessments (pre/post-test, quizzes, performance, reflection) aligned with [55]. Infrastructure planning covers e-learning systems, knowledge management, practice tools, and supporting facilities. Financing planning maps investment, operational, and additional costs. Community planning includes alumni, career development, and industry networks to support field practice and employment pathways.

**Stage 3 – Development**

The development stage focuses on creating and validating the gTMIS–ESF, a web-based system designed to support governance of cross-sector green skilled workforce training. The system underwent structured feasibility validation prior to field trials with prospective green trainees.

1. Media & Information Technology Expert Validation

    Feasibility was assessed by qualified media and IT experts [P1–P3], all holding master's degrees in information technology, computer science, or engineering. Assessment covered:

    a. Visualization (graphics, video, color, sound, interface; items 1–16)

    b. Presentation (ease of use and flow; items 17–24)

    c. Net Benefits (positive impact; items 25–27)

    d. Service Quality (reliability; items 28–30)

    Validity was measured using Aiken's V (Aiken, 1985). Validity criteria ranged from Very Low (0–0.19) to Very High (0.8–1). The feasibility results indicated Very High validity, with a maximum score of 15, a scale of 5, a score range of 0.9, 17 valid components (56.7%), and an Aiken value of 0.772 (High validity interval 0.6–0.79).

2. Language & Communication Expert Validation

    A second validation was conducted by language and communication experts [P1–P2], qualified with master's degrees and foreign-language certifications. Assessment aspects included:

    a. Linguistics (accuracy, communicative clarity, suitability; items 1–12)

    b. Material (completeness, flexibility, depth; items 13–15)

    c. Presentation (coherence, relevance; items 16–18)

    d. Supporting Elements (questions, glossary, bibliography; items 19–22)

    Results showed Very High validity, with a maximum score of 10, score range 0.9, 13 valid components (59.1%), and an Aiken value of 0.813 (interval 0.8–1).

3. Practitioner Validation

    The final validation involved practitioners from institutions (A.C.) and (T.B.I.)—including

heads of units, academic coordinators, and facilitators [P1–P15], all holding bachelor's or master's degrees. Assessed aspects included:

a. Usefulness (system utility for green training governance; items 1–5)
b. Ease of Use (operational simplicity; items 6–10)
c. Visualization (graphics, video, sound, color; items 11–23)
d. Presentation (usage and flow; items 24–31)

Results again indicated Very High validity, with a maximum score of 75, a score range of 0.9, 18 valid components (58.1%), and an Aiken value of 0.853 (interval 0.8–1).

4. Final Model Output

The final gTMIS–ESF-based Cross-Sector Green Skilled Workforce Training Planning Management Model is a refined version of the hypothetical model, developed using the ADDIE approach. The finalized web-based model supports the planning governance of:

a. Green trainees
b. Green training curriculum
c. Green facilitators
d. Green training facilities and infrastructure
e. Green training financing
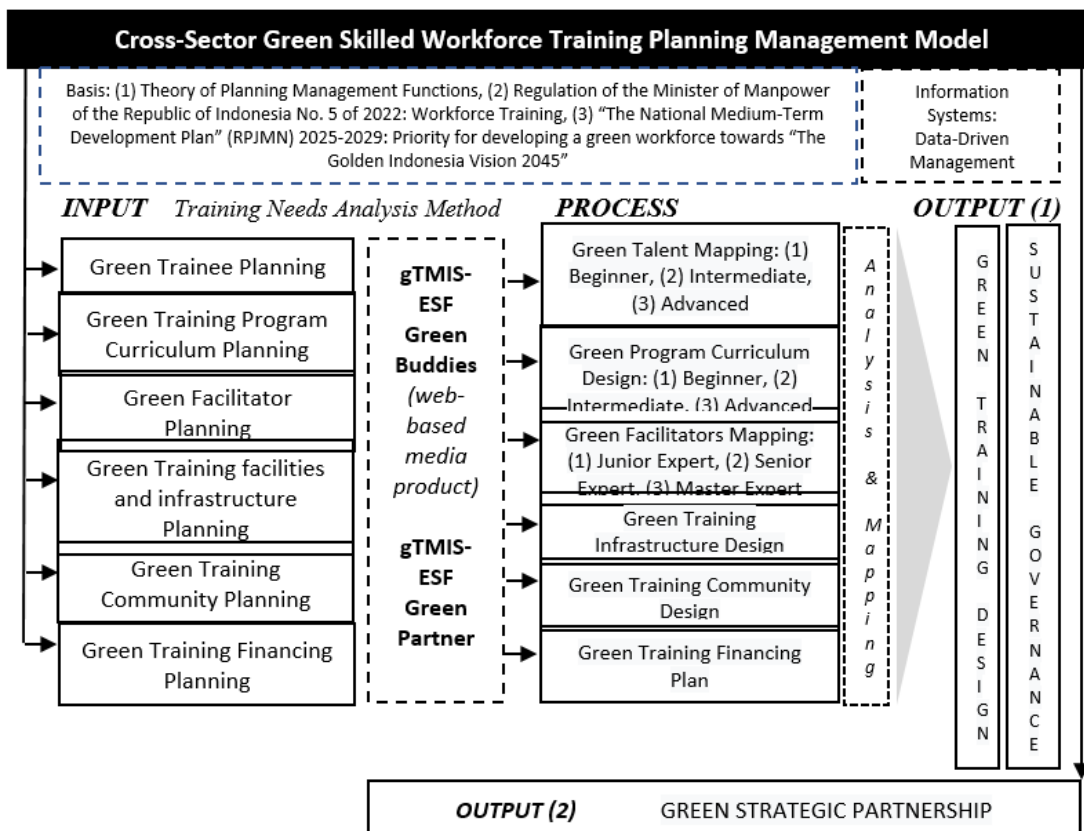f. Green training community



Figure 1. Model development of the cross-sector green skilled worker training planning management based on gTMIS-ESF

Figure 2. The physical form of web-based media products supporting green training planning management activities: gTMIS-ESF

**Step 4 – Implementation**

The field group trial was conducted remotely through the web-based gTMIS–ESF system. Participants were alumni of workforce training from institutions (A.C.) and (T.B.I.) who had previously joined government-supported distance or hybrid training programs. The implementation activities included:

1) socialization of gTMIS–ESF Green Buddies;

2) virtual beginner-level green knowledge presentations via the platform;

3) virtual green training needs analysis consisting of:

    a) communication skills mapping,

    b) foreign language proficiency mapping,

    c) green skill needs mapping,

    d) beneficiary profile mapping;

4) participant satisfaction evaluation.

A total of 30 participants joined the trial: 60% female and 40% male. Most originated from West Java (60%), followed by Banten (7%), DKI Jakarta (13%), Central Java (3%), East Java (17%), and West Sumatra (3%). Cities represented included Bekasi, Blora, Bojonegoro, East Jakarta, Karawang, Bogor, Sukabumi, South Tangerang, Tasikmalaya, Tigaraksa, and Pasaman Barat.

Educational background was dominated by secondary education (46%), followed by Bachelor's level (43%), Diploma-3 (7%), and Diploma-1 (3%). Occupations were mainly from Major Group (5) Service and Sales (43%), Major Group (4) Administration (33%), and Major Group (8) Machine Operators (3%), covering security services, administration, creative and marketing roles, sales,

freelancers, daily laborers, machine technicians, and job seekers.

Foreign language mapping generated proficiency categories based on CEFR: A1–A2 (Basic Users), B1–B2 (Independent Users), and C1–C2 (Advanced Users). Communication skills mapping through independent performance tasks produced beginner, intermediate, and advanced levels.

A closed questionnaire assessed baseline green knowledge before the socialization using the question: "What was your baseline knowledge of the green knowledge materials before the gTMIS–ESF event?" with options ranging from already know (100%) to totally don't know (0%). Participants completed an initial multiple-choice test on beginner-level green knowledge, followed by a final test after the socialization session.

Another closed questionnaire assessed green skills needs based on Green Competencies (BAPPENAS, 2019). Participants rated their need for competency development across 13 areas, including:

1) environmental awareness and sustainable development;
2) adaptability to eco-technologies;
3) teamwork;
4) resilience;
5) communication and negotiation;
6) entrepreneurial skills for low-carbon innovation;
7) occupational safety and health;
8) analytical and systems thinking;
9) coordination and business management;
10) marketing of eco-friendly products;
11) consulting on green solutions;
12) information technology networking and language skills;
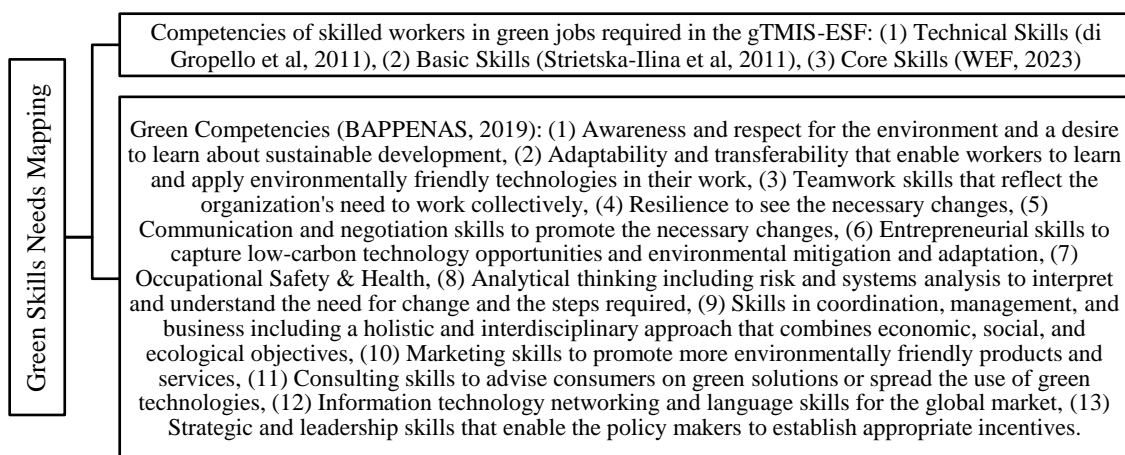13) strategic and leadership skills for policy development.



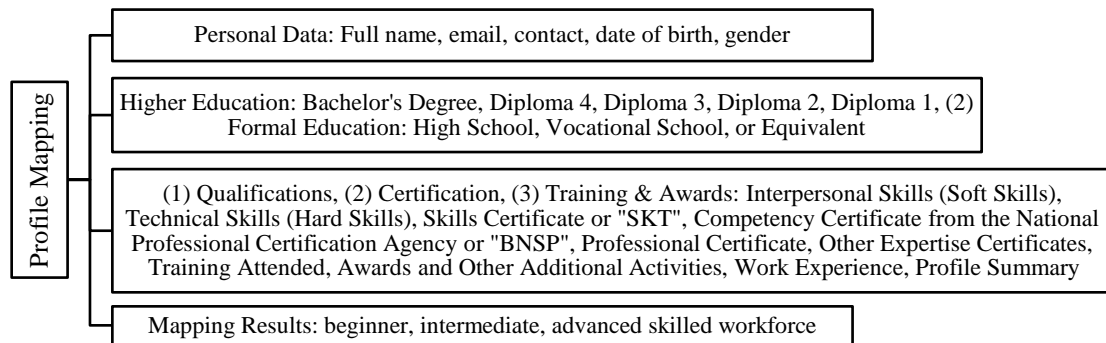Figure 3. Concept of the flow for mapping green skills needs in Green Buddies gTMIS-ESF

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Profile Mapping

- Personal Data: Full name, email, contact, date of birth, gender
- Higher Education: Bachelor's Degree, Diploma 4, Diploma 3, Diploma 2, Diploma 1, (2) Formal Education: High School, Vocational School, or Equivalent
- (1) Qualifications, (2) Certification, (3) Training & Awards: Interpersonal Skills (Soft Skills), Technical Skills (Hard Skills), Skills Certificate or "SKT", Competency Certificate from the National Professional Certification Agency or "BNSP", Professional Certificate, Other Expertise Certificates, Training Attended, Awards and Other Additional Activities, Work Experience, Profile Summary
- Mapping Results: beginner, intermediate, advanced skilled workforce

Figure 4. Concept of the flow for mapping prospective green trainees in Green Buddies gTMIS-ESF

Communication Skills Mapping

- Performance tasks (long-distance independent presentations): Task 1 - general work context, Task 2 - green work context
- Assessment: (1) organization of ideas, (2) systematicity, (3) logicality, (4) accuracy of information, (5) fluency, (6) intonation, (7) appearance, (8) grammar, (9) word usage, (10) diction and style Mapping
- Results: (1) Beginner, (2) Intermediate, (3) Advanced

Figure 5. Concept of the flow for mapping communication skills in Green Buddies gTMIS-ESF

Foreign Language Skills Mapping

- (1) Listening, reading, writing, speaking ability test (Engish language ability mapping diagnostic test using simulation), (2) other language test
- Assessment with CEFR criteria: self-assessment grid description (Council of Europe, 2001)
- Mapping Results: A1-A2 (Basic User), B1-B2 (Independent User), and C1-C2 (Advanced User) for language learners (Council of Europe, 2001)
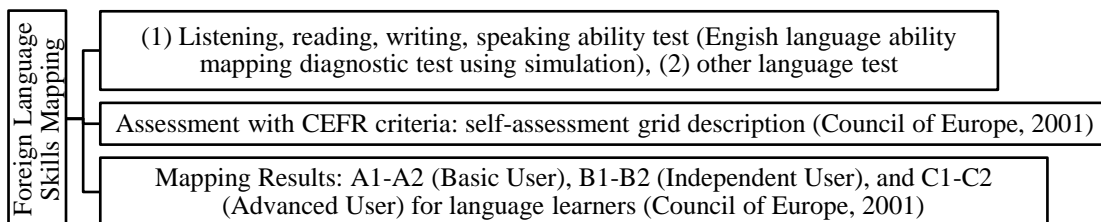
Figure 6. Concept of the flow for mapping Foreign Language skills in Green Buddies gTMIS-ESF

**Stage 5 – Evaluation**

The final draft of the physical development results was subjected to feasibility testing by experts in the field and practitioners at educational and training institutions. Empirical testing was conducted on green trainees through trials in group one and two. The evaluation stage aimed to determine feedback or satisfaction by designing a questionnaire that measured respondent reactions and encouraged written comments [56]. The effectiveness aspects contained in the evaluation questionnaire were adopted from the D&M IS Success Model [57] and Lund's USE questionnaire

(2001). To measure user satisfaction, the questionnaire required prospective trainees in the first trial group to indicate their level of agreement or disagreement with the provided statements: (1) system usefulness in items 1-8, (2) system ease of use in items 9-11, (3) user satisfaction in items 12-17, (4) system information in items 18-20, and (5) system service in items 21-22.

The results of the instrument validity and reliability tests are as follows: (1) it is known that there are 18 valid questions, and 4 invalid questions. Question no: 6,11,14, 16 are invalid. Therefore, the invalid questions are omitted. Furthermore, as seen in Figure 7, the r value of the validity test in the high category is 11 questions with a percentage of 50%, the medium category is 7 questions with a percentage of 32%, the low category is 3 questions with a percentage of 14%, and the very low category is 1 question with a percentage of 5%. (2). Based on Figure 8, the total variance value is 21.90, the total variance value of the items is 3.81, and the instrument reliability value is 0.874. Therefore, as seen in Figure 9, the interpretation of the r value of 0.874 is included in the Very High category.

As seen in Figure 10, the results of the satisfaction level in the group trial were (1) system usability with a total score of 125, a maximum score of 136, and a percentage of 92%, (2) system ease with a total score of 122, a maximum score of 136, and a percentage of 89%, (3) user satisfaction with a total score of 122, a maximum score of 136, and a percentage of 89%, (4) system information with a total score of 120, a maximum score of 136, and a percentage of 88%, and (5) system service with a total score of 122, a maximum score of 136, and a percentage of 90%. And the overall average percentage was 89.6%.

Table 1. Interpretation of the r Value of the Instrument Validity Test

| No | Interval | | | F | % | Validity Criteria |
|----|------|---|-----|----|----|------------------|
| 1 | 0,8 | - | 1 | 0 | 0 | Very High |
| 2 | 0,6 | - | 0,8 | 2 | 9 | High |
| 3 | 0,4 | - | 0,6 | 16 | 73 | Medium |
| 4 | 0,2 | - | 0,4 | 3 | 14 | Low |
| 5 | 0 | - | 0,2 | 1 | 5 | Very Low |

Table 2. Instrument Reliability Test

| | |
|---|---|
| $S^2_{total}$ | 21,90 |
| $\sum S^2_{item}$ | 3,81 |
| Instrument reliability | 0,874 |

Table 3. Interpretation Category of r Value

| No | Interval | | | Validity Criteria |
|----|------|---|------|-------------------|
| 1 | 0,8 | - | 1 | Very High |
| 2 | 0,6 | - | 0,8 | High |
| 3 | 0,4 | - | 0,6 | Medium |
| 4 | 0,2 | - | 0,4 | Low |
| 5 | 0 | - | 0,2 | Very Low |

Table 4. Results of satisfaction levels in group field (n=30)

| Indicator | Total score | Score max | Percentage |
|-----------|-------------|-----------|------------|
| System usability | 125 | 136 | 92 % |
| System convenience | 122 | 136 | 89 % |
| User satisfaction | 122 | 136 | 89 % |
| System information | 120 | 136 | 88 % |
| System services | 122 | 136 | 90 % |

Table 5. Satisfaction level formula in group field

| Result = (Total score obtained / Score maximum) x 100% |
|---|

A Normality Test was performed on the pre-test and post-test scores for beginner-level green knowledge collected from 30 participants in Group One through gTMIS-ESF to verify if the residual values followed a normal distribution. The Sig. value of $0.200 > 0.05$ means $H_0$ is accepted. Thus, it can be concluded that the data is normally distributed. The results of the Paired Sample T-Test obtained a Sig. (2-tailed) value of $0.000 < 0.05$, so $H_0$ is rejected and $H_1$ is accepted. Thus, it can be concluded that there is a significant difference between the pre-test and post-test scores, which means the approach given has a significant effect on increasing beginner-level green knowledge. Based on the N-Gain calculation, an average N-Gain of 0.72 was obtained, which is included in the High Gain category. The findings clearly show that the approach was highly effective in boosting beginner-level green knowledge among skilled workers.

Meanwhile, the open-ended questions were to encourage written comments as follows: (1) Do you think that the advantages of the gTMIS-ESF system designed to support the planning governance activities of skilled workforce training in cross-sector green jobs? (2) How can the designed gTMIS-ESF system help you with the green knowledge needs of new employees? (3) How can the designed gTMIS-ESF system help you in planning green training needs? (4) Do you

feel that the process of planning trainees with the gTMIS-ESF system is more difficult than the usual trainee planning process? (5) What challenges and difficulties did you encounter when using the gTMIS-ESF system designed to support the planning governance activities of skilled workforce training in cross-sector green jobs?.



Figure 7. Normality Test Results (n=30)



Figure 8. Paired Sample T-Test (n=30)



Figure 9. N-Gain (n=30)

Table 6. Interpretation of N-Gain Categories

| Average N-Gain | | | Category |
|---|---|---|---|
| 0,7 | G > | | High |
| 0,3 | G > | 0,7 | Medium |
| | G < | 0,3 | Low |

### CONCLUSIONS

The gTMIS-ESF implementation guide was developed to help institutions adopt the model effectively. Two guides—Green Partner and Green Buddies—provide background, objectives, and both general and specific operational instructions. The Green Partner guide covers governance for: (1) facilitator planning, (2) curriculum planning, (3) infrastructure planning, (4) community planning, and (5) financing planning.

Meanwhile, the Green Buddies guide supports beneficiaries in using Green Knowledge Management and Training Needs Analysis, and provides institutions with reference procedures for beneficiary facilitation. Specific guidance includes foreign language mapping, communication skills mapping, green talent profiling, and green skills needs identification. Each guide includes a system illustration, feature overview, user flow map, and system link.

The model is designed to provide practical and adaptive solutions to strengthen green training planning governance across sectors, enabling sustainable, data-driven management and strategic partnerships. The gTMIS-ESF-based planning management model was validated by experts and practitioners and field tested with training participants, confirming its feasibility.

This research offers several novelties, including:

1) a conceptual model for green skilled workforce training planning developed using ADDIE, covering facilitator planning, curriculum planning, infrastructure planning, community planning, financing planning, trainee planning, and beginner green knowledge management;

2) institutional and beneficiary implementation guidelines;

3) independent beginner-level green learning materials (videos and e-modules);

4) a web-integrated training management system capable of remote access, data mapping, and analysis for sustainable governance.

Built on a data-driven approach aligned with management theory and the practical needs of sustainable workforce development, this research provides theoretical contributions to training planning and practical benefits for institutions and trainees. Institutions can use the model to design roadmaps and effective training plans, while trainees benefit from reduced knowledge gaps regarding green jobs, green skills, and green training—supporting the development of a stronger green workforce ecosystem.

Future research should consider:

1) expanding field trials on a larger scale,

2) extending experimental research, and

3) developing green training models for advanced occupations aligned with KBJI 2014 & 2021.

**Acknowledgment**

**References:**

[1]     ILO, "Green Jobs Becoming A Reality Progress And Outlook 2013." Geneva: International Labour Organization, 2023.

[2]     BAPPENAS, "The Development Of Green Jobs Roadmap In Indonesia. Innovation and Investment for Inclusive Sustainable Development (ISED) - Project Phase II." Jakarta: ISED, 2023.

[3]     ETF, "ETF Policy Briefing: Skilling For The Green Transition." European Training Foundation, 2022.

[4]     UNCC, "Why Are Green Skills Important for Youth?" Department for International Development. United Nations Climate Change, 2023.

[5]     A. Bowen, K. Kuralbayeva, and E. L. Tipoe, "Characterising green employment: The impacts of 'greening'on workforce composition," *Energy Econ.*, vol. 72, pp. 263–275, 2018.

[6]     S. D. Purba, H. D. Wiranatha, and E. Sulistyaningsih, "Increasing commitment through the effect of green training and development and green behavior in State-Owned bank employees," *Binus Bus. Rev.*, vol. 15, no. 3, pp. 261–270, 2024.

[7]     B. Barakat *et al.*, "Assessing the impact of green training on sustainable business advantage: exploring the mediating role of green supply chain practices," *Sustainability*, vol. 15, no. 19, p. 14144, 2023.

[8]     X. Xie, Q. Zhu, and G. Qi, "How can green training promote employee career growth?," *J. Clean. Prod.*, vol. 259, p. 120818, 2020.

[9]     BAPPENAS, "Peta Okupasi Nasional Green Jobs dalam Kerangka Kualifikasi Nasional Indonesia (KKNI) Area Fungsi Lintas Sektor, Pertanian, Manufaktur, Konstruksi, Jasa (Pariwisata)." Jakarta: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, 2022.

[10]    Prakerja, "Mengenal Green Skills: Kunci Masa Depan Kerja Ramah Lingkungan." 2024.

[11]    KEMNAKER, "Proyeksi Kebutuhan Tenaga Kerja Menurut Sektor Dan Jabatan Tahun 2021 – 2024." Kementerian Ketenagakerjaan RI: Badan Perencanaan Dan Pengembangan

Ketenagakerjaan Pusat Perencanaan Ketenagakerjaan, 2021.

[12] KEMNAKER, "Proyeksi Kebutuhan Tenaga Kerja Menurut Sektor Dan Jabatan Tahun 2025-2029." Kementerian Ketenagakerjaan RI: Badan Perencanaan Dan Pengembangan Ketenagakerjaan Pusat Perencanaan Ketenagakerjaan, 2024.

[13] J. Murdiono and R. Bovanantoo, "Green Training in Green Human Resources Management: A Study on PT Celebes Railway Indonesia.," *Libr. Progress-Library Sci. Inf. Technol. Comput.*, vol. 44, no. 3, 2024.

[14] A. Shamzzuzoha, P. C. Chavira, T. Kekäle, H. Kuusniemi, and B. Jovanovski, "Identified necessary skills to establish a center of excellence in vocational education for green innovation," *Clean. Environ. Syst.*, vol. 7, p. 100100, 2022.

[15] N. S. Yassin, D. T. Akel, and H. M. A. Rabou, "Green management training program and its effect on staff nurses' organizational citizenship behavior," *BMC Nurs.*, vol. 24, no. 1, p. 563, 2025.

[16] S. Ndiango, L. R. Mwagike, and I. A. Changalima, "Mapping the conceptual structure of green and sustainable human resource management in supply chain management research," *Discov. Sustain.*, vol. 6, no. 1, p. 348, 2025.

[17] B. F. M. Alharbi, "Project management green commitment in PMI, Saudi Arabia: how green intellectual capital, green HRM, green training and innovativeness influence project performance," *J. ECOHUMANISM Учредители Transnatl. Press London*, vol. 4, no. 1, 2024.

[18] M. Skittou, M. Merrouchi, and T. Gadi, "Development of an early warning system to support educational planning process by identifying at-risk students," *IEEE Access*, vol. 12, pp. 2260–2271, 2023.

[19] A. Echeverría *et al.*, "A framework for the design and integration of collaborative classroom games," *Comput. Educ.*, vol. 57, no. 1, pp. 1127–1136, 2011.

[20] M. S. Logachev, N. A. Orekhovskaya, T. N. Seregina, S. Shishov, and S. F. Volvak, "Information system for monitoring and managing the quality of educational programs," *J. Open Innov. Technol. Mark. Complex.*, vol. 7, no. 1, p. 93, 2021.

[21] B. Peng and X. Pei, "A Decision Support System Model for Middle School Education Management Based on Sparse Clustering Algorithm," *Mob. Inf. Syst.*, vol. 2022, no. 1, p. 4807395, 2022.

[22] M. D. Gall, W. R. Borg, and J. P. Gall, *Educational research: An introduction*. Longman Publishing, 1996.

[23] R. C. Richey and J. D. Klein, "Design and development research," in *Handbook of research on educational communications and technology*, Springer, 2013, pp. 141–150.

[24] B. Hokanson and A. S. Gibbons, *Design in educational technology*. Springer, 2014.

[25] R. M. Branch, *Instructional Design: The ADDIE Approach*. New York: Springer, 2010. doi: 10.1007/978-3-319-15347-6_300893.

[26] G. Preddey, "An overview of contemporary TVET management practice," *Int. Handb. Educ. Chang. World Work Bridg. Acad. Vocat. Learn.*, pp. 1003–1025, 2006.

[27] S. C. Certo, S. T. Certo, and S. Malhotra, "Modern management-concepts and skills," 2011.

[28] X. Luo[1], J. Tian[1], Y. Wang, and H. Liu, "PDCA-Based Management of Corporate Research Integrity and Ethics," in *Proceedings of the 2023 3rd International Conference on Enterprise Management and Economic Development (ICEMED 2023)*, Springer Nature, 2023, p. 89.

[29] Lovely Professional University, "Educational Management. Lovely Professional University." New Delhi: USI Publications, 2012.

[30] C. Bailey, D. Mankin, C. Kelliher, and T. Garavan, *Strategic human resource management*. Oxford university press, 2018.

[31] V. R. Zainal, H. M. Ramly, T. Mutis, and W. Arafah, "Manajemen sumber daya manusia untuk perusahaan dari teori ke praktik," 2019.

[32] F. Rauner and R. Maclean, *Handbook of technical and vocational education and training research*, vol. 49. Springer, 2008.

[33] A. L. Jimoh, "The effect of employee engagement and job satisfaction on job performance: the role of perceived organizational support," *J. Manag. Dev.*, vol. 44, no. 5, pp. 700–710, 2025.

[34] S. M. Alkhozaim, F. A. Alshiha, E. M. Alnasser, and A. A. Alshiha, "How Green Performance Is Affected by Green Talent Management in Tourism and Hospitality Businesses: A Mediation Model," *Sustainability*, vol. 16, no. 16, p. 7093, 2024.

[35] S. Ogbeibu, C. J. Chiappetta Jabbour, J. Burgess, J. Gaskin, and D. W. S. Renwick, "Green talent management and turnover intention: the roles of leader STARA competence and digital task interdependence," *J. Intellect. Cap.*, vol. 23, no. 1, pp. 27–55, 2022.

[36] A. H. Al-Faouri, "Green knowledge management and technology for organizational sustainability: The mediating role of knowledge-based leadership," *Cogent Bus. Manag.*, vol. 10, no. 3, p. 2262694, 2023.

[37] A. Alioune, "The Impact of Green Knowledge Management on Sustainable Development

Goals and Green Innovation in French Economic Firms: A Structural Analysis," *Croat. Reg. Dev. J.*, vol. 5, no. 2, pp. 111–128, 2024.

[38] J. Abbas and S. M. Khan, "Green knowledge management and organizational green culture: an interaction for organizational green innovation and green performance," *J. Knowl. Manag.*, vol. 27, no. 7, pp. 1852–1870, 2023.

[39] E. Yua, J. Raymond-Yakoubian, R. A. Daniel, and C. Behe, "A framework for co-production of knowledge in the context of Arctic research," *Ecol. Soc.*, vol. 27, no. 1, 2022.

[40] S. Sahoo, A. Kumar, and A. Upadhyay, "How do green knowledge management and green technology innovation impact corporate environmental performance? Understanding the role of green knowledge acquisition," *Bus. Strateg. Environ.*, vol. 32, no. 1, pp. 551–569, 2023.

[41] I. Ulhaq, R. Nayak, M. George, H. Nguyen, and H. Quang, "Green knowledge management: a bibliometric analysis, research trends and future directions," *VINE J. Inf. Knowl. Manag. Syst.*, 2024.

[42] M.-R. Stanef-Puică, L. Badea, G.-L. Șerban-Oprescu, A.-T. Șerban-Oprescu, L.-G. Frâncu, and A. Crețu, "Green jobs—A literature review," *Int. J. Environ. Res. Public Health*, vol. 19, no. 13, p. 7998, 2022.

[43] R. Mayr, J. Morris, and S. Montanari, "The phonetics and phonology of early bilinguals," 2024.

[44] O. Strietska-Ilina, C. Hofmann, M. D. Haro, and S. Chŏn, *Skills for green jobs: A global view, synthesis report based on 21 country studies*. ILO, 2011.

[45] P. Deshpande, A. Srivastava, M. Kulkarni, and R. M. Lenka, "Impact of green transformational leadership on employee green behavior: A PLS-SEM approach," *Prabandhan Indian J. Manag.*, vol. 17, no. 2, pp. 24–43, 2024.

[46] A. Sult, J. Wobst, and R. Lueg, "The role of training in implementing corporate sustainability: A systematic literature review," *Corp. Soc. Responsib. Environ. Manag.*, vol. 31, no. 1, pp. 1–30, 2024.

[47] M. S. Newaz and A. Appolloni, "Worldwide E-waste Management Models: Delving into Pros and Cons and the Way Forward," *Electron. Waste Manag. Policies, Process. Technol. Impact*, pp. 33–51, 2023.

[48] P. Ortega Carrasco, F. Iannone, V. Ferrón Vílchez, and F. Testa, "Green public procurement as an effective way for sustainable development: A systematic literature review and bibliometric analysis," *Sustain. Dev.*, vol. 33, no. 2, pp. 2364–2391, 2025.

[49]  J.-C. Chang and H.-Q. Lu, "Competency and Training Needs for Net-Zero Sustainability Management Personnel," *Sustainability*, vol. 17, no. 7, p. 3244, 2025.

[50]  J. Nunes *et al.*, "Energy Efficiency in Portuguese Traditional Cheese Industries: A Comprehensive Case Study," *Energies*, vol. 18, no. 3, p. 562, 2025.

[51]  A. Markaki, S. Malhotra, R. Billings, and L. Theus, "Training needs assessment: tool utilization and global impact," *BMC Med. Educ.*, vol. 21, no. 1, p. 310, 2021.

[52]  M. London, *The Oxford handbook of lifelong learning*. Oxford University Press, 2011.

[53]  H. Basri and Rusdiana, *Manajemen Pendidikan & Pelatihan*. Bandung: Pustaka Setia, 2015.

[54]  Fasokun, "Challenges of adult education." 2010.

[55]  E. Moeheriono and D. M. Si, *Pengukuran kinerja berbasis kompetensi*. Jakarta: Raja Grafindo Persada, 2012.

[56]  F. G. Kirkpatrick, *Community: A trinity of models*. Wipf and Stock Publishers, 2008.

[57]  W. H. DeLone and E. R. McLean, "The DeLone and McLean model of information systems success: a ten-year update," *J. Manag. Inf. Syst.*, vol. 19, no. 4, pp. 9–30, 2003.