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Analysis of competencies of the Engineering Research and Development for Technology alumni of the University of the Philippines Los Baños

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ABSTRACT. In the context of local and global workforce and people skills competitiveness, this study sought to determine whether the Engineering Research and Development for Technology – University of the Philippines Los Baños (ERDT-UPLB) alumni are competent in their chosen employment fields. Using the Likert scale of measurement, the skills, knowledge, and attitude competencies of engineering graduates were compared to the preferred competencies of employers and potential employers. Results showed no significant difference between the existing competencies of the ERDT alumni and the preferred competencies of prospective employers. Moreover, employers and potential employers have indicated a positive and favorable response to the current set of competencies of the alumni. Employers tend to have high expectations for the competencies of their employees, and they are satisfied to employ ERDT alumni based on their current skills, knowledge, and attitude competencies. The study also identified rooms for improvement of existing skill and knowledge competencies. Additionally, the current academic programs and the ERDT program can address the learning outcomes or the desired competencies for their graduates.

Keywords: *ERDT alumni, competencies, gap analysis*

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INTRODUCTION

The Philippine Statistics Authority in 2013 reported that 10% of the household population of 82 million were academic degree holders. Furthermore, 27% are holders of Business Administration degrees, 19% Teacher Training and Education Sciences, and 14% Engineering and Engineering Trades Programs. The Commission on Higher Education (CHED) Memorandum No. 01 Series of 2014 dated 9th of January 2014 listed engineering as one of the priority college courses. The top five courses in the list are Agriculture, Engineering, Science and Math, Information Technology and Teaching Education, respectively.

Competency encompasses the knowledge, skills, abilities, traits, and behaviors that allow an individual to perform a task within a specific function or job (Vathanophas & Thai-ngam, 2007). Competent employees are considered an asset of an organization considering that 'people capital' or the human resource is the key driver to realize value out of the existing resources. It can also be a measure of success in the workplace if competent skills, attitudes, and behaviors can be used in a job that meets its needs (Abas & Imam, 2016). Based on this, it can be said that assessing and knowing the competency of an employee will help ensure that high-quality service to clients will be consistently maintained. Thus, knowing the competency level of applicants is vital to companies during recruitment periods. With the Industry 4.0, in which the human factor plays an important role, the study of Kowal et al. (2022) showed that both technical and soft skills in a highly technical industrial revolution are important. Consequently, the human factor remains crucial to the industrial processes in the foreseeable future.

As the country aims to become more globally competitive in terms of workforce and people skills, producing highly trained experts and professionals is essential to achieving this goal especially in the field of engineering. To meet this need, the Engineering Research and Development for Technology (ERDT) program was created. It aims to acquire a critical mass of researchers, scientists, and engineers (RSEs) with master's and doctorate degrees. The ERDT plans to address the lack of highly skilled and trained professionals and RSEs by implementing a continued human resource development (HRD) program and scholarship grants. Thus, allowing the Philippines to eventually attain the desired number of engineering graduates following the standards set by the UNESCO (Department of Science and Technology, 2012).

Through the ERDT, practicing Filipino engineers can be upgraded and be more competent with advanced studies and graduate degrees. The ERDT alumni are expected to be employed in line with their completed field of studies and are also required to render service in the country, preferably in their home region equivalent to the length of years of the scholarship. With this, it is important to analyze if the ERDT alumni are ready and competent for employment with the knowledge, skills, and attitude they acquired during their studies. In 2021, Gallardo et al. concluded that the University of the Philippines Los Baños – College of Engineering and Agro-Industrial Technology (UPLB-CEAT) has produced engineers with the highest technical capabilities, entrepreneurial, and networking skills in the country through its education program. They learned that UPLB-CEAT's alumni are highly employable, signifying the effectiveness of the training and competencies they acquired from UPLB.

This study sought to determine whether the ERDT-UPLB alumni are competent in their respective areas of specialization. In consideration of the Data Privacy Act, all personal data collected were treated with utmost confidentiality and were used solely for this study. The profiles of the ERDT alumni were collected together with their competency level in terms of knowledge, skills, and attitudes at work. Preferred level of competencies of selected employers and potential employers representing different sectors were also collected. The data were compared and analyzed for differences and gaps in the existing competencies. Furthermore, the ERDT program was evaluated and strategies and recommendations to enhance its implementation are proposed in this study.

METHODOLOGY

This study used a descriptive method of research to evaluate the competencies of the UPLB ERDT alumni. Both qualitative and quantitative data were gathered through online e-survey questionnaires from the 9 batches of the ERDT alumni from 2009-2017. The 51 ERDT alumni were surveyed based on the expected learning outcomes of the graduates of the Institute of Agricultural Engineering (IAE) and Department of Chemical Engineering (DChE) of CEAT-UPLB. It was also based on the updated curriculum of the M.S. and Ph.D. Agricultural Engineering, M.S. Agrometeorology and M.S. Chemical Engineering degree programs. Interviews of engineering professors and employed engineers were conducted to obtain the set of competencies that will be used in the study. The Likert scale was used to obtain the respondent's perceptions on their knowledge, skills, and attitude competencies. Descriptive statistics such as

frequencies and percentages were used to describe the competencies of the ERDT alumni, and the competencies preferred by employers and potential employers. Sample size was limited to the 51 ERDT alumni respondents. However, only 41 ERDT alumni participated in this study (Table 1).

Table 1
ERDT graduate programs with corresponding number of ERDT alumni respondents

Graduate Degree Earned	Number of ERDT Alumni
M.S. Agricultural Engineering	33
M.S. Agrometeorology	9
M.S. Chemical Engineering	4
Ph.D. Agricultural Engineering	5
Total	51

Eight employers and potential employers of the ERDT alumni and engineering graduates were also surveyed and interviewed (Table 2). These institutions were selected based on accessibility and referrals by the scholars. Potential employers include academic and research institutions, and industries in manufacturing and agribusiness sectors. Examples are universities, research institutes, mining, mineral processing, semiconductor, electronics, and pharmaceutical companies.

Table 2
Employers and potential employers with their corresponding sector

Employer	Sectors				
	Academe	Industry	Research	Government Institution	Non-Government Institution
Employer #1			✓	✓	
Employer #2	✓			✓	
Employer #3	✓			✓	
Employer #4	✓				
Potential employer #1		✓	✓		✓
Potential employer #2	✓		✓	✓	
Potential employer #3	✓		✓		✓
Potential employer #4		✓			✓

Employer #1 hails from a government research institution. The institution he represents comprises several agencies, which engage in research and development. Employers #2, #3, and #4 hail from state universities and colleges (SUC). Potential employer #1 represents a privately-owned pharmaceutical companies, which is engaged in the manufacture and marketing of medical products. Potential employer #2 is from an SUC with graduate and research capability. Potential employer #3 is an administrator representing a private, non-sectarian research university. Lastly, potential employer #4 is a founder of a corporation dealing with agri-industrial machinery and small construction equipment.

The study used open-ended and closed-ended structured questionnaires, ranking scale questions, and interviews. The questionnaires were administered through Google e-survey form and were sent to the ERDT alumni's email addresses. Data gathered from the respondents were treated with utmost confidentiality in adherence to the Data Privacy Act. Furthermore, a high standard of data stewardship was applied throughout the study. The skill and knowledge competencies were based on the agricultural engineering, agrometeorology, and chemical engineering curricula. But because ERDT scholars also take some courses offered by the Institute of Agricultural Engineering, these courses were also evaluated. Lastly, engineering professors were interviewed regarding the existing engineering curricula to come up with the list of competencies. Based on these consultations, a final set of competencies were prepared and used (Tables 3, 4, and 5).

The competencies that were considered in this study were divided into three subgroups, namely skills, knowledge, and attitude. The rank or level of competencies achieved by the ERDT alumni was determined and compared with the preferred rank of the employers and potential employers. Tables 3 to 7 list the different skills, knowledge, and attitudes, respectively, with their corresponding codes. The agricultural engineers and agrometeorologists used the set of competencies for agricultural engineer and agrometeorologist (Tables 3 and 5) while the chemical engineers used the set of competencies for chemical engineers (Tables 4 and 6). All of them used the set of attitude competencies in Table 7.

The measures of central tendency were used to describe the data obtained from this study. A Likert scale measurement was primarily used in the questionnaires to obtain participant's preference or degree of agreement with a set of statements. It was used to gather data from the ERDT alumni and employers/potential employers. The obtained data was analyzed to determine if there are gaps in the existing competencies of the

Table 3
List of agricultural engineer/agrometeorologist skill competencies with their corresponding codes (SA1-SA16)

Code	Skill Competencies*
SA1	Analyzing needs and product requirements to create a design
SA2	Techniques for planting, growing, and harvesting food products for consumption, including storage/handling techniques
SA3	Design and analyze processes to produce useful and desirable products from less valuable raw materials
SA4	Design and testing of agricultural machinery
SA5	Repairing machines or systems using the needed tools
SA6	Performing routine machine maintenance
SA7	Driving agricultural and farm machineries
SA8	Design and drying, storage and preservation of cereal and forage crops
SA9	Modeling agricultural process equipment, system simulation, economic analysis of process system
SA10	Conduct tests and inspections of products, services, or processes to evaluate quality
SA11	Design, operation, and efficient safe use of pesticide application equipment for crops
SA12	Design and operations of systems for drying and storage, material handling and refrigeration
SA13	Drying and dehydration of agricultural crops
SA14	Water irrigation management
SA15	Analysis of water and air quality
SA16	Weather forecasting

Note. *Adapted from the IAE course catalog, brochure, and outline

Table 4
List of chemical engineer skill competencies with their corresponding codes (SC1-SC10)

Code	Skill Competencies*
SC1	Monitor and oversee overall production process
SC2	Conduct tests and inspections of products, services, or processes to evaluate quality
SC3	Develop efficient processing techniques that minimize waste and improve output quality
SC4	Design specifications for chemical process systems
SC5	Good in problem solving and analytical skills
SC6	Test new ways to develop products in the laboratory
SC7	Develop methods to deal with by-products and waste materials
SC8	Biological wastewater treatment design
SC9	Physical and chemical wastewater treatment design
SC10	Ability to determine the composition of materials deemed hazardous, working either in a lab or in the field

Note. *Adapted from the DChE course catalog, brochure, and outline

Table 5
List of agricultural engineer/agrometeorologist knowledge competencies with their corresponding codes (KA1-KA14)

Code	Knowledge Competencies*
KA1	Applying principles, techniques, procedures, and equipment to the design and production of various goods and services
KA2	Theory of similitude and its application to engineering models
KA3	Principles of transport phenomena and application to agricultural, biological and food systems
KA4	Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming
KA5	Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models
KA6	Knowledge of design and operations of system for drying and storage
KA7	Issues in water resources planning
KA8	Quantitative and qualitative research methods; validity, reliability considerations in research design
KA9	Knowledge of mathematical, algebra, geometry, calculus, statistics, and their applications
KA10	Knowledge of machines and tools, including their designs, uses, repair, and maintenance
KA11	Water irrigation management
KA12	Soil and water conservation
KA13	Drainage engineering
KA14	Knowledge on frequency analysis, hydrologic models, flood estimation

Note. *Adapted from the IAE course catalog, brochure, and outline

Table 6
List of chemical engineer knowledge competencies with their corresponding codes (KC1-KC14)

Code	Knowledge Competencies*
KC1	Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of good
KC2	Knowledge on solid waste management
KC3	Distribution of components over immiscible phase and the importance of this distribution for many applications
KC4	Advances in biochemical engineering
KC5	Advanced chemical reaction engineering
KC6	Application of fluid dynamics in chemical engineering

Note. *Adapted from the DChE course catalog, brochure, and outline

Table 7
List of attitude competencies with their corresponding codes (A1-A8)

Code	Skill Competencies*
A1	Able to analyze information to address work-related issues and problems
A2	Being enthusiastic with work
A3	Able to produce results with the least wasted time and effort
A4	Being honest and ethical at work
A5	Willingness to take on responsibilities and challenges
A6	Being careful about detail and thorough in completing work tasks
A7	Willingness to lead, in-charge, and offer opinions and direction
A8	Able to accept criticism and dealing calmly and effectively with high stress situations

Note. *Adapted from online interviews of engineering professors and employers

ERDT alumni and the preferred competencies of the employers and potential employers. The total scores per competency were computed and interpreted from the Likert scale used in the original questionnaires. These scores were based on a 5-point rating scale ranging from poor to excellent (Table 8).

Table 8
Ranking scale used with the assigned scores

Rank	Assigned Scores
Excellent	1
Good	2
Average	3
Fair	4
Poor	5

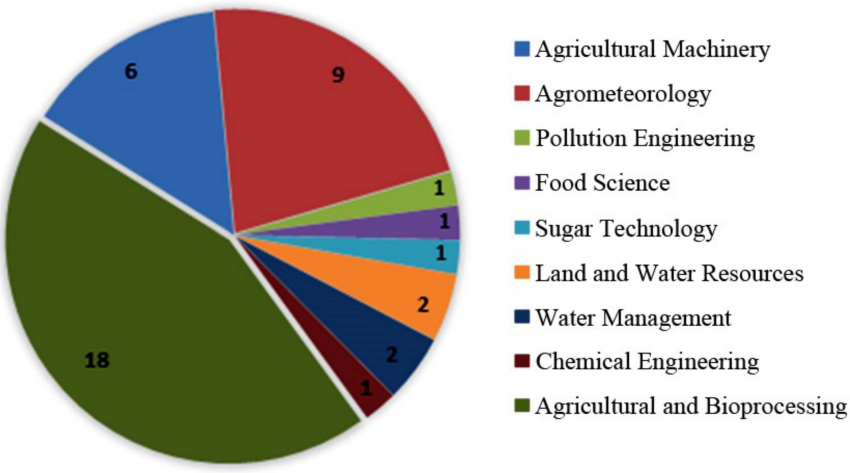
In relation to these and considering the number of respondents, the total scores were broken down into five groups for consistency. The five groups correspond to the different ratings, namely excellent, good, average, fair, poor. This was also conducted to consider the measurement of extremes which the usual mean, median and mode cannot express. The scores from the different groups were used to interpret the answers made by the respondents considering the difference in the number of respondents per competency and the respondent's "not applicable" answers that are not considered a rank or rating and can be assumed as an extreme answer. Also, the scoring made per group considers the possible minimum and maximum scores that can be obtained.

RESULTS AND DISCUSSION

Profile of the ERDT Alumni

Some 41 ERDT alumni participated in this study and the percentage distribution of their specialization is shown in Figure 1.

Figure 1
Distribution of specialization of the ERDT alumni respondents



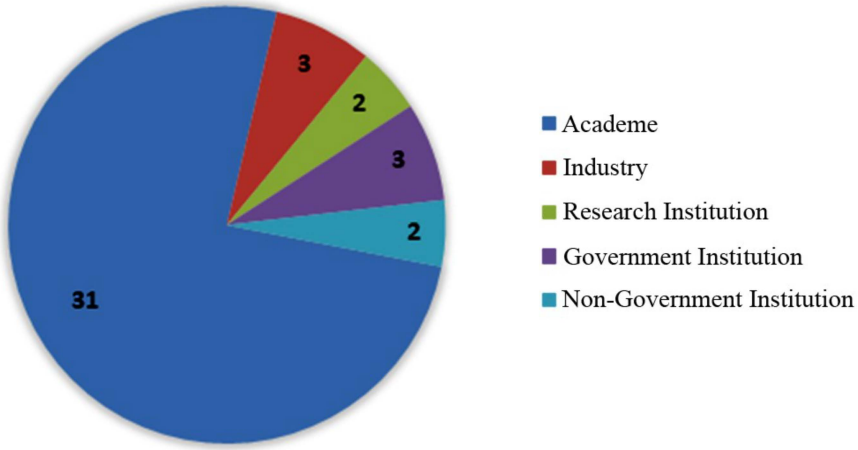
Forty-four percent of the ERDT alumni who participated in the study were Agricultural Engineering graduates with specialization in Agricultural Bioprocessing while alumni from the Land and Water Resource Engineering and Water Management comprised 5% each. About 15% and 22% of the alumni were graduates of the Agricultural Machinery and Agrometeorology programs, respectively.

Employment Profile of the ERDT Alumni

The majority (76%) of the respondents are in the academe (Figure 2). The rest work in the industry (7%), government (7%), research sector (5%), and non-government institutions (5%). Many of the ERDT scholars from the academe took their study leave for 2 years for MS and 3 years for PhD. On the other hand, alumni outside the academe resigned from their work to avail the scholarship. Upon earning their degrees, almost all fulfilled their return service obligations. Almost all of those from the

academe returned to teaching, a few chose to pursue further advancement, put up their own business, or engage in other worthy causes. Some scholars coming from outside the academic sector, chose to join the academic community. All these were done upon securing a clearance from the Department of Science and Technology - Science Education Institute (DOST-SEI).

Figure 2
Distribution of the ERDT alumni respondents



The ERDT alumni respondents in the academe currently serve as professors (74%), instructors (13%), researchers (10%), and administrator (3%). Promotion was not granted automatically following degree completion due to unavailability of teaching items and funds. Four alumni were instructors while 3 and 1 alumni currently serve as researchers and administrator, respectively. Noteworthy also is that a large majority (74%) have already achieved the rank of professor while a few are still instructors.

Employability of engineers can be attributed to fierce competition in the workplace, structural unemployment, as well as job-skill mismatches (Chanco, 2023). Another factor would be passing the licensure examination of the Professional Regulation Commission (PRC). Jobstreet.com (2023) posted an average of more than 1,700 engineering jobs available in the country. This can barely accommodate the average of around 50,000 engineering graduates per year in the Philippines (Habito, 2019).

The remaining ERDT alumni serving outside the academic sectors are researchers and engineers. Figure 3 shows the distribution of the researchers and engineers in other sectors. It also shows the absence of researchers and engineers in the industry that are doing research.

Graduates of agricultural engineering, agrometeorology, and chemical engineering degrees are highly qualified to work in the academe as teachers, researchers, and engineers. In the industry, they are also sought after as engineers and researchers in their respective fields of expertise. Figures 2-4 show that the current ERDT alumni respondents have matching jobs and profession corresponding to the degrees they have earned. One notable exception is the administrator working in the academe with an M.S. Agricultural Engineering degree. As an

Figure 3
Distribution of researchers and engineers in the different sectors

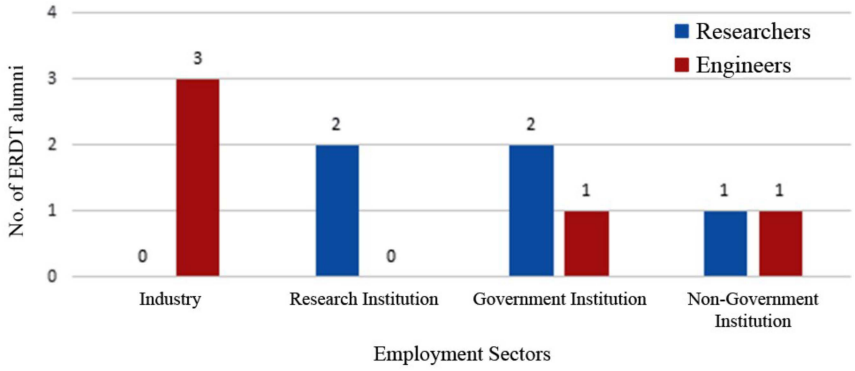
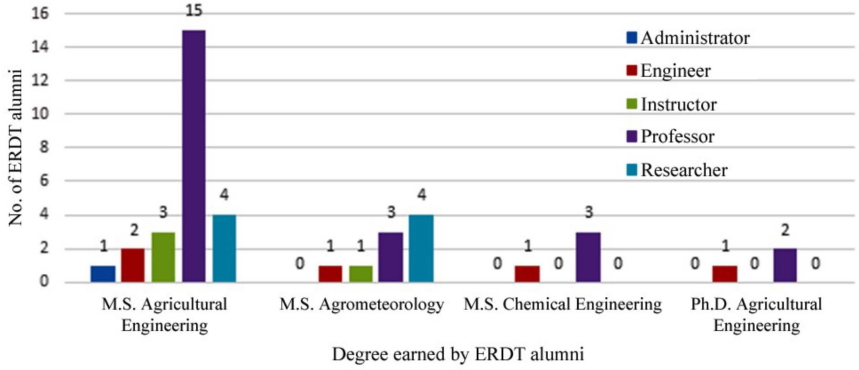


Figure 4
Distribution of degrees earned with corresponding profession of the ERDT alumni



administrator, most of the respondent's competencies are not fully utilized and applied. As an administrator, the respondent is more involved in management, planning, and operations. Nonetheless, the competencies that the respondent acquired prove beneficial in performing the tasks assigned to an administrator.

Preferred Competencies of the UPLB ERDT Alumni and Employers

The employers/prospective employers and the ERDT alumni have ranked most of the skills as excellent and good. The majority of the mode fall at the rank of excellent and good implying that there is strong conformity between the employees and employers. The Likert scale measurements show that ERDT alumni and employers with chemical engineering degrees ranked SC1, SC2, SC3, SC4, SC5, SC6, and SC10 as excellent as performance criteria for skill competencies (Table 9). On the other hand, alumni with degrees in agricultural engineering and agrometeorology and employers ranked SA1, SA2, SA3, SA5, SA8, SA9, SA10, SA11, SA12, and SA13, as good to excellent in terms of skill competency (Table 10). The findings indicate that these skill competencies are still being addressed by the current graduate programs offered by UPLB and that the need of employers or potential employers for these skills in their employees or potential employees is being satisfied. Additionally, the results suggest that these skill competencies are standards expected and recognized by both alumni and employers with degrees in engineering. According to the National Monitoring Council (2003), analyzing and selecting resources, processes, and systems to develop or design a plan using engineering specification, is among the performance criteria for competency in engineering.

A slight difference is observed in the ranking between the alumni and employers in terms of designing wastewater treatment specifications for biological and chemical processes and developing methods for treating by-products and waste materials, i.e., SC7, SC8, and SC9. Employers rated SC8 and SC9 to be good while alumni ranked them as excellent. This indicates that the alumni perceived that they are well equipped with skills related to the development and design of new products, methods, and chemical processes. However, the employers may perceive that these skills need to be improved or enhanced; hence, they scored lower. One of the competencies stated by the National Monitoring Council (2003) expected in engineering graduates or practitioners is to provide significant contributions to the science and practice of engineering through the development or application of new engineering principles, concepts, and engineering practices.

Table 9
Mode ranks for chemical engineers' skill competency set of the alumni and employers

Skill Competencies	Mode Ranks			
	ERDT Alumni	Percentage (%)	Employers /Potential Employers	Percentage (%)
SC1. Monitoring and overseeing of the overall production process	Excellent	50	Excellent	50
SC2. Conduct tests and inspections of products, services, or processes to evaluate quality	Excellent	50	Excellent	50
SC3. Develop efficient processing techniques that minimize waste and improve output quality	Excellent	50	Excellent	62.50
SC4. Design specifications for chemical process systems	Excellent	50	Excellent	37.50
SC5. Good in problem solving and analytical skills	Excellent	75	Excellent	62.50
SC6. Test new ways to develop products in the laboratory	Excellent	50	Excellent	50
SC7. Develop methods to deal with by- products and waste materials	Good	50	Excellent	50
SC8. Biological wastewater treatment design	Excellent	50	Good	37.50
SC9. Physical and chemical wastewater treatment design	Excellent	75	Good	37.50
SC10. Ability to determine the composition of materials deemed hazardous, working either in a lab or in the field	Excellent	50	Excellent	37.50

The alumni with degrees in agricultural engineering and agrometeorology and employers both rated the skills related to design, testing, handling, inspections, and operations (SA1, SA3, SA7, SA8, SA10, SA11, SA12, and SA13) as good. On the other hand, skills associated with maintenance (SA6), the study of air, water, and the weather (SA15 and SA16) were rated as good to average. This suggests that both the alumni and employers considered these skills to be inadequately or insufficiently acquired in the academic program or ERDT

Table 10
Mode ranks for agricultural engineers' and agrometeorologists' skill competency set of ERDT alumni and employers

Skill Competencies	Mode Ranks			
	ERDT Alumni	Percentage (%)	Employers /Potential Employers	Percentage (%)
SA1. Analyzing needs and product requirements to create a design	Good	41	Excellent	62.5
SA2. Techniques for planting, growing, and harvesting food products for consumption, including storage/handling techniques	Good	46	Excellent	37.5
SA3. Design and analyze processes to produce useful and desirable products from less valuable raw materials	Good	41	Excellent	50
SA4. Design and testing of agricultural machinery	Average	32	Excellent	37.5
SA5. Repairing machines or systems using the needed tools	Good	35	Excellent	37.5
SA6. Performing routine machine maintenance	Good	38	Good	62.5
SA7. Driving agricultural and farm machineries	Good	38	Good	37.5
SA8. Design and drying, storage and preservation of cereal and forage crops	Good	49	Excellent	50
SA9. Modeling agricultural process equipment, system simulation, economic analysis of process system	Good	32	Excellent	62.5
SA10. Conduct tests and inspections of products, services, or processes to evaluate quality	Good	51	Excellent	50
SA11. Design, operation and efficient safe use of pesticide application equipment for crops	Good	38	Excellent	37.5
SA12. Design and operations of systems for drying and storage, material handling and refrigeration	Good	43	Excellent	37.5
SA13. Drying and dehydration of agricultural crops	Good	35	Excellent	50
SA14. Water irrigation management	Average	32	Excellent	50
SA15. Analysis of water and air quality	Good	41	Average	50
SA16. Weather forecasting	Average	35	Average	37.5

program. Likewise, the ERDT alumni perceived that there is a need for improvement in these competencies, particularly in skills related to product analysis, agricultural techniques, and application (SA1 and SA2), designing, modeling, and repairing of agricultural machinery (SA4, SA5, and SA9), and pest and irrigation management (SA11 and SA14).

In terms of competencies relating to knowledge, the study found that the ERDT alumni ranked KC1, KC2, KC4, KC5 and KC6 (Table 11) as excellent. The alumni perceived that the current chemical engineering program still addresses the learning outcomes or competencies being expected or desired of its graduates. This finding also holds true for the alumni with degrees in agricultural engineering and agrometeorology and employers except for the knowledge in electronics and computer related applications (KA4) where the employers rated it average (Table 12). On the other hand, both have similar perceptions on applying principles,

Table 11
Mode ranks for chemical engineers' knowledge competency set of ERDT alumni and employers

Knowledge Competencies	Mode Ranks			
	ERDT Alumni	Percentage (%)	Employers /Potential Employers	Percentage (%)
KC1. Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of good	Excellent	50	Excellent	50
KC2. Knowledge on solid waste management	Excellent	50	Excellent	37.5
KC3. Distribution of components over immiscible phase and the importance of this distribution for many applications	Good	50	Excellent	37.5
KC4. Advances in biochemical engineering	Excellent	50	Excellent	25
KC5. Advanced chemical reaction engineering	Excellent	75	Excellent	25
KC6. Application of fluid dynamics in chemical engineering	Excellent	50	Excellent	37.5

Table 12
Mode ranks for agricultural engineers and agrometeorologist knowledge competency set of ERDT alumni and employers

Knowledge Competencies	Mode Ranks			
	ERDT Alumni	Percentage (%)	Employers /Potential Employers	Percentage (%)
KA1. Applying principles, techniques, procedures, and equipment to the design and production of various goods and services	Good	49	Good	62.5
KA2. Theory of similitude and its application to engineering models	Good	35	Good	37.5
KA3. Principles of transport phenomena and application to agricultural, biological and food systems	Good	41	Good	37.5
KA4. Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming	Good	38	Average	37.5
KA5. Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models	Good	51	Excellent	37.5
KA6. Knowledge of design and operations of system for drying and storage	Good	43	Excellent	50
KA7. Issues in water resources planning	Good	32	Excellent	50
KA8. Quantitative and qualitative research methods; validity, reliability considerations in research design	Good	49	Excellent	37.5
KA9. Knowledge of mathematical, algebra, geometry, calculus, statistics, and their applications	Good	65	Excellent	50
KA10. Knowledge of machines and tools, including their designs, uses, repair, and maintenance	Good	49	Excellent	50
KA11. Water irrigation management	Good	35	Excellent	50
KA12. Soil and water conservation	Good	38	Excellent	50
KA13. Drainage engineering	Good	32	Excellent	37.5
KA14. Knowledge on frequency analysis, hydrologic models, flood estimation	Good	43	Excellent	50

techniques, procedures, and theories to various engineering systems and applications (KA1, KA2, and KA3). The alumni also perceived that they can still improve on the other knowledge competencies even though the employers have assessed that the alumni already have excellent knowledge (KA5-KA14).

On the other hand, both alumni and employers/potential employers ranked attitude competencies as excellent (Table 13). This indicates that graduates of the academic programs under study have the capability to lead and promote ethical decisions (A4 and A7) and encourage professional development (A5 and A8). Employers and potential employers indicated that the current competencies are adequate for their current needs. Overall, the ERDT alumni, employers and potential employers are satisfied with the current set of attitude competencies acquired through the UPLB graduate academic program and the ERDT program.

Table 13
Mode ranks for the attitude competency set of ERDT alumni and employers

Attitude Competencies	Mode Ranks			
	ERDT Alumni	Percentage (%)	Employers /Potential Employers	Percentage (%)
A1. Able to analyze information to address work-related issues and problems	Excellent	56	Excellent	62.5
A2. Being enthusiastic with work	Excellent	59	Excellent	87.5
A3. Able to produce results with the least wasted time and effort	Excellent	54	Excellent	57
A4. Being honest and ethical at work	Excellent	68	Excellent	87.5
A5. Willingness to take on responsibilities and challenges	Excellent	66	Excellent	87.5
A6. Being careful about detail and thorough in completing work tasks	Excellent	63	Excellent	57
A7. Willingness to lead, in-charge, and offer opinions and direction	Excellent	49	Excellent	75
A8. Able to accept criticism and dealing calmly and effectively with high stress situations	Excellent	51	Excellent	75

Based on the results, the current CEAT academic programs and the ERDT program can address the learning outcomes or the desired competencies of their graduates. However, the program implementers should not be complacent about the performance of the graduates. They must ensure that engineering graduates gain extensive and diverse experience and should contribute to the profession and the community within their area of specialization through regular individual program reviews. In this study, it has been shown that alumni and employers perceived the lack of individual program reviews. Additionally, results showed that alumni and employers still perceived the lack of inadequate skills and knowledge competencies. The engineering graduates should also be able to demonstrate engineering leadership, manage projects or research, and be multi-disciplined in handling other tasks and responsibilities.

The result of the study found that there are no significant gaps in the existing skill and knowledge competencies of the ERDT alumni and the preferred competencies of the employers. Similarly, there is no difference in the existing attitude competencies of the ERDT alumni and the preferred attitude competencies of the employers.

CONCLUSION AND RECOMMENDATIONS

There are no significant gaps in the existing competencies of the ERDT alumni and the preferred competencies of employers and potential employers. The employers and potential employers of ERDT alumni indicated a positive and favorable response in the current set of competencies of the ERDT alumni. The knowledge and skills acquired by the ERDT alumni during their graduate studies had helped them to be competent employees. Thus, the current curriculum used in UPLB graduate school is suitable in imparting the skills, knowledge, attitude, and behavior needed by its graduates.

The ERDT program is expected to deliver its mandate to attain a critical mass of MS and PhD engineering graduates that are highly qualified and globally competitive. Overall, the ERDT program was able to advance the qualifications of practicing engineers, deliver high impact research, and develop a culture of research and development. This study advanced strategies to enhance the implementation of ERDT programs to address the needs of employers. For the first strategy, a review and evaluation of the graduate course curriculum in agricultural engineering, agrometeorology, and chemical engineering can be done every 5 years to ensure alignment with the needs of employers and potential employers.

This can be done by specifying the competencies and learning outcomes of each program and conducting a course mapping to review the content and structure of each program.

Second, the Career Incentive Program (CIP) with DOST-SEI may be extended to the ERDT alumni who are willing to change their work preference. Meetings and consultations among stakeholders may be held to review the CIP system and identify ways to improve employment placement. On the other hand, if the CIP cannot be extended to the ERDT alumni, a similar system may be created by engaging other organizations or agencies that are potential employers of ERDT graduates and securing their commitment through a memorandum of agreement.

Lastly, conduct of a SWOT analysis is also in the right direction. Similar to the gap analysis, it could also provide a framework for formulating other strategies and policy recommendations to improve the program. Furthermore, the results showed that most of the alumni are currently employed in the academe. With continuous funding, the ERDT program can eventually increase the number of practicing engineers outside the academe. New and advanced degree programs can be proposed and introduced by investing in training, post-doctoral fellowships, sandwich programs, and faculty development programs for higher education institutions. The current graduate curriculum used by UPLB graduate school for its agricultural engineering, agrometeorology, and chemical engineering program remains effective in meeting industry demand.

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APPENDICES

Appendix A. Preferred skill competencies of the different employment sectors

Skill Competencies	Employment Sectors				
	Academe	Industry	Research	Non-government Institution	Government Institution
1. Analyzing needs and product requirements to create a design	✓	✓	✓		✓
2. Techniques for planting, growing, and harvesting food products for consumption, including storage/ handling techniques	✓	✓	✓		✓
3. Design and analyze processes to produce useful and desirable products from less valuable raw materials		✓	✓		✓
4. Design and testing of agricultural machinery	✓	✓		✓	✓
5. Repairing machines or systems using the needed tools	✓	✓		✓	✓
6. Performing routine machine maintenance	✓	✓	✓		✓
7. Driving agricultural and farm machineries			✓		✓
8. Design and drying, storage and preservation of cereal and forage crops			✓		✓
9. Modeling agricultural process equipment, system simulation, economic analysis of process system					
10. Conduct tests and inspections of products, services, or processes to evaluate quality		✓	✓		✓
11. Design, operation and efficient safe use of pesticides	✓		✓		✓

Appendix A. Preferred skill competencies of the different employment sectors *(continued)*

Skill Competencies	Employment Sectors				
	Academe	Industry	Research	Non-government Institution	Government Institution
12. Design and operations of systems for drying and storage, material handling and refrigeration	✓				✓
13. Drying and dehydration of agricultural crops	✓		✓		✓
14. Monitoring and overseeing of the overall production process	✓	✓			✓
15. Water irrigation management	✓				✓
16. Analysis of water and air quality			✓		✓
17. Weather forecasting					✓
18. Conduct tests and inspections of products, services, or processes to evaluate quality	✓		✓		✓
19. Develop efficient processing techniques that minimize	✓	✓	✓		✓
20. Design specifications for chemical process systems	✓	✓	✓		✓
21. Good in problem solving and analytical skills	✓	✓	✓		✓
22. Test new ways to develop products in the laboratory	✓	✓			✓
23. Develop methods to deal with by-products and waste materials	✓	✓	✓		✓
24. Biological wastewater treatment design	✓		✓		✓
25. Physical and chemical wastewater treatment design	✓		✓		✓
26. Ability to determine the composition of materials deemed hazardous, working either in a lab or in the field			✓		✓

Appendix B. Preferred knowledge competencies of the different employment sectors

Knowledge Competencies	Employment Sectors				
	Academe	Industry	Research	Non-government Institution	Government Institution
1. Applying principles, techniques, procedures, and equipment to the design and production of various goods and services	✓	✓	✓		✓
2. Theory of similitude and its application to engineering		✓	✓		✓
3. Principles of transport phenomena and application to agricultural, biological and food systems	✓		✓		✓
4. Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming			✓		✓
5. Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models	✓		✓		✓
6. Knowledge of design and operations of system for drying and storage			✓		✓
7. Issues in water resources planning		✓	✓		✓
8. Quantitative and qualitative research methods; validity, reliability considerations in research design					✓
9. Knowledge of mathematical, algebra, geometry, calculus, statistics, and their applications		✓			✓

Appendix B. Preferred knowledge competencies of the different employment sectors *(continued)*

Knowledge Competencies	Employment Sectors				
	Academe	Industry	Research	Non-government Institution	Government Institution
10. Knowledge of machines and tools, including their designs, uses, repair, and maintenance			✓		✓
11. Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of good	✓		✓		✓
12. Knowledge on diffusion, drying, and distillation	✓	✓	✓		✓
13. Water irrigation management	✓		✓		✓
14. Soil and water conservation	✓	✓			✓
15. Drainage engineering	✓	✓	✓	✓	✓
16. Knowledge on frequency analysis, hydrologic models, flood estimation	✓	✓	✓		✓
17. Knowledge on solid waste management	✓		✓		✓
18. Distribution of components over immiscible phase and the importance of this distribution for many applications	✓		✓		✓
19. Advances in biochemical engineering	✓		✓		✓
20. Advanced chemical reaction engineering	✓		✓		✓

Appendix C. Preferred attitude competencies of the different employment sectors

Attitude Competencies	Employment Sectors				
	Academe	Industry	Research	Non-government Institution	Government Institution
1. Able to analyze information to address work-related issues and problems	✓	✓	✓	✓	✓
2. Being enthusiastic with work	✓	✓	✓	✓	✓
3. Able to produce results with the least wasted time and effort	✓	✓	✓		✓
4. Being honest and ethical at work	✓	✓	✓	✓	✓
5. Willingness to take on responsibilities and challenges	✓	✓	✓	✓	✓
6. Being careful about detail and thorough in completing work tasks	✓	✓	✓		✓
7. Willingness to lead, in-charge, and offer opinions and direction	✓	✓	✓	✓	✓
8. Able to accept criticism and dealing calmly and effectively with high stress situations	✓	✓	✓	✓	✓