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Perceived Importance and Demonstration of Generic Skills of BS Electro-Mechanical Technology (EMT) Program's Graduates from a State University in Northern Mindanao, Philippines: An Industry Perspective

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Abstract

To meet the 21st century skills demand of the industry, there is a need for alignment of the program curriculum for the graduates in every area of education. This study focuses on the perceived level of importance and demonstration of generic skills of BS Electro-Mechanical Technology (EMT) program's graduates at University of Science and Technology of Southern Philippines-Cagayan De Oro (USTP-CDO) campus. Understanding these skills is crucial for aligning educational outcomes with employer expectations. A descriptive research design was employed to assess the extent of these generic skills among 120 industry employers such as supervisors and/or direct superiors of the EMT graduates. Data was collected through a 26-item survey administered via Google Forms and Pen-Paper Survey with an expert validation established from prior pilot testing. Statistical analyses, including means, standard deviations were utilized to evaluate differences based on demographic data, skills importance level, and graduate's demonstration level. The findings revealed that the 13 generic skills (program outcomes) in EMT program were found to be important and evidently needed by the industries to possess by the graduates with a general assessment of M=4.18 (important skills). The top two highest skills rated approximately "4-Important" are: 1. effectively demonstrate knowledge and understanding of industrial automation and manufacturing management principles (M=4.33; SD=.78) and 2. function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multi-cultural teams using modern communication tools (M=4.30; SD=.75). Notably, none of the skills were found to be highly important in the curricular program. For the level of demonstration of skills of EMT graduates, the survey revealed a general assessment of M=3.44 interpreted as "Fair Performance" of Electro-Mechanical Technology skills in the industries. All the skills have been rated as "important" but one of the skills fell under fair level with M=3.43 indicated as low competence of graduates for this skill, and three of the generic skills were scored at poor level with M=2.49, M=2.44, and M=2.30, respectively. Generally, the demonstration of these skills was highly evident that the graduates' competence is at poor level which means they are

deficient in those skills, therefore creating some minor gaps. The study concludes that the level of importance of generic skills in EMT program was aligned and matched to the needs of the industry to possess by the graduates. However, the level of its demonstration of these generic skills generally at fair level indicating a low competence and low working performance of the graduates in the workplace with variations observed based on the ranking. These results underscore the need to improve and align the curriculum to the demands of the industry and focus on elevating graduates' skills to be effective and highly performing in the industry. Further, the research calls for a shift in educational paradigms to balance academic relevance in line with socio-economic demands aligning with employer expectations for future work-ready graduates in the technology industry.

Keywords: Electro-Mechanical Technology, Mechatronics, Curriculum, Competency, Skill, Technology Graduates, Classified Industries

Introduction

Employers are looking for individuals who can critically and analytically solve problems, communicate well, use information technology and work with others effectively, and are well equipped to assume the flexible and responsible roles which modern workplace need since the skills are vital for poverty reduction, economic recovery and sustainable development. Skills can be classified into soft skill and hard skill as two major groups. Soft skills include skill related to people such as communication skills, interpersonal skill and hard skills includes technical skill, problem-solving skills, decision making skills etc. Soft skills are vital and necessary for the 21st century's workforce development and effectiveness (Handley, 2017). The hard skills usually refer to more of the tasks, technical, and administrative aspects of a business while soft skills refer to individuals' attitudes, personal behaviors, and social/interpersonal habits (Ibrahim et al., 2017). The term soft or generic skills, used interchangeably with nontechnical skills, is defined as the "interpersonal, human, people or behavioral skills needed to apply technical skills and knowledge in the workplace" (Weber et al., 2009). Generic skills used in the study are captured in the 13 program outcomes as defined in the program curriculum and are manifested in the graduates' regardless of whether they acquire it or not. Program Outcomes (PO) are a set of characteristics that a graduate from an institution should have before graduating. The features of the PO are often connected to the training that the student has received. In other words, the PO would be made up of more specific program-level statements that illustrate what students should know and be able to do or achieve by the time they graduate. McKinsey Global Institute conducted a research that helps definitions take shape and could contribute to future-proof citizens' skills for the world of work. The study established a set of 56 fundamental skills that will benefit all citizens and demonstrated that better proficiency in them is already related with a higher likelihood of employment, higher wages, and job satisfaction in the 21st century labor force (Dondi et al., 2021). In the United States, due to rising demand for workers with transdisciplinary abilities, multiple groups, colleges and universities have integrated mechatronics into their current curricula, established thematic programs, and even additionally developed standalone mechatronics programs (Vanston et al., 2007). Among the researchers' recommendations to improve the marketability and the employability of the graduates they produce is a periodic review of curriculum by academic leaders, alumni, and industry representatives to ensure that graduates are equipped with the necessary knowledge and skills required in the industry (Albina & Sumagaysay, 2020). The research output will pave the way to a program assessment periodic review to

validate the technology program from industry perspective focusing on the skills sets acquired by the graduates to measure the extent to which the program learning outcomes are being attained relative to current industry needs and 21st century skills standards as an input to continuous improvement of the program.

To meet the 21st century skills demand from the industry, there is a need for knowledgeable skilled graduates in every area of education to meet the current need of the industry as there is rapid change in technology as well as the demand for new skills kept increasing, therefore professionals in technology education are particularly questioned to develop, adapt or redesign policy, and conceptual framework to attend to the needs of employers and the public. There is a need to determine and examine the current relevance and quality of the curricular program of study in terms of analyzing the skills importance and demonstration acquired by the graduates working from such industries to find out if it is indeed significant on the relevance and efficiency of the program.

Specifically, this study seeks to answer the following questions:

1. What is the perceived level of importance of generic skills needed by graduates of the Electro-Mechanical Technology (EMT) program from industry perspective?
2. What is the level of graduates' demonstration of skills as perceived by the industry?

Methodology

This study employed descriptive research design. The researchers conducted the study in the provinces of Northern Mindanao namely (Bukidnon, Camiguin, Lanao del Norte, Misamis Occidental, and Misamis Oriental) and its two highly urbanized cities (Iligan City and Cagayan De Oro City). This study will necessitate to cover the classified industries from the seven (7) geopolitical zones from which these technology graduates are employed. The researcher gathered data from 33 companies in 120 industry respondents to collect information from employers of classified industries (supervisors and/or direct superior of the technology graduates) in Northern Mindanao region using Google Form and Pen and Paper survey. Questionnaires were given out to each classified industries coded as cement and metals (CM), chemicals (C), electrical and power (EP), food and beverage (FB), manufacturing (M), port industry (PI), and sales and logistics (SL). The number of respondents will depend on the size of each companies and will be drawn as per convenience to the researcher from the list obtained from the dun & bradstreet business directory, the PHIVIDEC Industrial Authority webpage, the Department of Trade and Industry page, and the Philippine Statistics Authority webpage. The adopted instrument was re-validated by three (3) academic college experts under the College of Science and Technology and College of Technology at USTP-CDO campus. Informed consent was also secured. Means and standard deviations were the statistical tools used to describe the imbibed generic skills ranking and significant differences, and interpreted through Excel software to formulate graphs and tables.

Results and Discussion

1. Variable by Geographic Location

Table 1 summarizes the demographic distribution of the geographic locations of the participants per industry sector. A total of 33 industrial companies were visited and contacted comprising the 3 out of 7 geopolitical zones of Northern Mindanao. Out of all the employees of the companies, a sample of 150 was identified as potential participants for the study, of which 20 sample is from Bukidnon (BUK), 30 sample from Cagayan De Oro City (CGY), 100 sample from Misamis Oriental (MIS OR), and 0 for

other locations due to no prospect respondents. Questionnaires were returned by 7 respondents from Bukidnon (BUK), 29 respondents from Cagayan De Oro City (CGY), and 84 respondents from Misamis Oriental (MIS OR) of Northern Mindanao, totaling 120 respondents. Therefore, the response rates were highly populated in Misamis Oriental (MIS OR) province where N=51, composing at large the Food and Beverage (FB) sector (N=51; 47.50%) among the other sectors provided that the area has aboded a municipality with the industrial hub of the province. Followed by Manufacturing (M) sector (N=23; 19.17%) constituting high in Cagayan De Oro City (CGY) area where N=12, and Cement & Metals (CM) sector where N=12 in favor of Misamis Ori-ental (MIS OR) constituting (N=15; 12.50%) of the total sample.

Table 1. Number of Respondents per Industry Sector Distribution

Industry Sector	Bukidnon (BUK)	Cagayan De Oro City (CGY)	Misamis Ori-ental (MIS OR)	No. of Re-spondents	Percentage of Re-sponses
Cement & Metals (CM)	0	3	12	15	12.50%
Chemicals (C)	5	0	5	10	8.33%
Electrical and Power (EP)	0	0	2	2	1.67%
Food and Beverage (FB)	0	6	51	57	47.50%
Manufacturing (M)	1	12	10	23	19.17%
Port Industry (PI)	0	0	4	4	3.33%
Sales and Logistics (SL)	0	4	0	4	3.33%
Others	1	4	0	5	4.17%
Total No. of Respondents	**7**	**29**	**84**	**120**	**100.00%**
Total No. of Companies	**3**	**17**	**13**	**33**	
Total No. of Questionnaire	**20**	**30**	**100**	**150**	

The resulting data set, which as mentioned was analyzed as a single population sample, had the highest percentage of respondents from the Misamis Oriental (MIS OR) in Food and Beverage (FB) sector (N=57; 47.50%) among other locations. The lowest percentage evidently constitute to Electrical and Power sector (EP) (N=2; 1.67%) where EMT graduates were barely employed.

2. The Job Role of Respondents

The job role identified during the course of the survey in technology companies include the following positions listed in the table. The table shows that the respondents are mostly team lead / supervisor constituting 90.00% of the total sample. Very few are managers (N=12; 10.00%).

Table 2. The Job Role of Respondents

Job Role	Frequency (N)	Percentage of Responses
Manager	12	10.00%
Team Lead / Supervisor	108	90.00%
Total	**120**	**100.00%**

The survey shows that the respondents are mostly team lead / supervisor constituting 90.00% of the total sample with a very few in managerial positions (N=12; 10.00%).

3. Ratings of Importance of 13 Generic Skills (Program Outcomes) needed by Technology Graduates

For the importance level, table 3 revealed that the respondents rated all the 13 skills as important with a weighted means fell from range (M=3.98; SD=.94) the lowest, to (M=4.33; SD=.78), the highest important skill. The top two highest skills rated as "4-Important" are: 1. effectively demonstrate knowledge and understanding of industrial automation and manufacturing management principles (M=4.33; SD=.78) and 2. function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multi-cultural teams using modern communication tools (M=4.30; SD=.75).

Remaining skills were rated with "4-Important" by the respondents include: apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems (M=4.28; SD=.80); conduct investigation, analysis and interpret data of broadly-defined problems in industrial automation and manufacturing responsibly (M=4.27; SD=.84); demonstrate professional, social and ethical responsibilities in the application of diverse knowledge and multi-disciplinary competencies (M=4.26; SD=.75), and all other skills respectively. By these results, all the skills were rated as important or as interpreted as "Important Skill" by the respondents to be possess by the EMT graduates in the workplace. However, no job specific skills, cognitive skills, and management skills found in the curricular program were rated as "5-Very Important" or as interpreted as highly important or highly in demand by the respondents in terms of graduates' skill set.

Table 3. Ratings of Importance of 13 Generic Skills (Program Outcomes) needed by Technology Graduates

No.	Program Outcomes (PO)	N	Mean (M)	Standard Deviation (SD)	Interpretation
1	Apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems.	120	4.28	0.80	Important Skill
2	Identify research literatures and analyzes broadly-defined technology and engineering problems reaching substantiated solutions and conclusions using analytical tools.	120	4.03	0.86	Important Skill
3	Design solutions for broadly-defined industrial automation and manufacturing problems and contribute to the design of systems, components or processes.	120	3.98	0.94	Important Skill
4	Conduct investigation, analysis and interpret data of broadly-defined problems in industrial automation and manufacturing responsibly.	120	4.27	0.84	Important Skill

5	Demonstrate expertise and effectiveness in the use of relevant modern enabling technology and engineering tools necessary for the practice in industrial automation and manufacturing technology.	120	4.22	0.81	Important Skill
6	Convey ideas clearly through understanding of current societal issues in the development of quality human capital, technology solutions and economic enterprise.	120	3.99	0.96	Important Skill
7	Articulate the impact of technology and engineering solutions of broadly-defined problems in industrial automation and manufacturing through electro-mechanical technology.	120	4.13	0.80	Important Skill
8	Demonstrate professional, social and ethical responsibilities in the application of diverse knowledge and multi-disciplinary competencies.	120	4.26	0.75	Important Skill
9	Function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multicultural teams using modern communication tools.	120	4.30	0.75	Important Skill
10	Communicate persuasively and effectively the technical project information and documentation in broadly-defined electro-mechanical technology related activities.	120	4.22	0.72	Important Skill
11	Effectively demonstrate knowledge and understanding of industrial automation and manufacturing management principles.	120	4.33	0.78	Important Skill
12	Recognize the need for, and engage in life-long learning in the electro-mechanical technology discipline.	120	4.23	0.80	Important Skill
13	Participate in the generation of new knowledge and advancement of existing discoveries in research and development projects, and in technopreneurial activities in the areas of automation and manufacturing technology.	120	4.09	0.87	Important Skill

Composite Mean	**4.18**	**0.82**	**Important Skill**

Legend:			
Scale		**Mean Description**	**Interpretation**
4.50-5.00	=	Very Important	High Important Skill
3.50-4.49	=	Important	Important Skill
2.50-3.49	=	Moderately Important	Low Important Skill
1.50-2.49	=	Slightly Important	Partially Important Skill
1.00-1.49	=	Not Important	Not Important Skill

Result on the ratings of importance of skills needed by Electro-Mechanical Technology (EMT) graduates are shown in table 3. The respondents are of the view that all the skills listed were important and is currently in demand by the technology industries.

4. Ratings of Graduates' Demonstration of Generic Skills (Program Outcomes) as Perceived by the Industry

For the graduate's skill demonstration level, table 4 summarized graduates' performance in the workplace rated as 'good' and interpreted as "Good Performance", nine out of the thirteen skills listed. These includes the topmost three skills: recognize the need for, and engage in life-long learning in the electro-mechanical technology discipline (M=3.96; SD=1.04); effectively demonstrate knowledge and understanding of industrial automation and manufacturing management principles (M=3.88; SD=.70); demonstrate professional, social and ethical responsibilities in the application of diverse knowledge and multi-disciplinary competencies (M=3.84; SD=.71), and all other remaining six important skills with a mean approximately 4. On the other hand, the respondents rated graduates' performance as only been 'fair' interpreted as "Low Performance" in the workplace with (mean score approximately 3) one skill listed: function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multi-cultural teams using modern communication tools (M=3.43; SD=.93).This clearly shows that the performance of these graduates' on the listed set of skills are just fair on the Likert scale drawn.

In addition, respondents rated graduates' performance as "poor" and interpreted as "Poor Performance" of the graduates (mean approximately 2), three out of thirteen skills listed found to be the lowest means among others. These are: apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems (M=2.49; SD=1.04); demonstrate expertise and effectiveness in the use of relevant modern enabling technology and engineering tools necessary for the practice in industrial automation and manufacturing technology (M=2.44; SD=1.02); and communicate persuasively and effectively the technical project information and documentation in broadly-defined electro-mechanical technology related activities (M=2.30; SD=.84). This clearly shows that the performance of these graduates on the listed set of skills are poor on the Likert scale drawn which fell short on the expected skill level required by the industry employers on the particular skills sets listed.

Table 4. Ratings of Graduates' Demonstration of Generic Skills (Program Outcomes) as Perceived by the Industry

No.	Program Outcomes (PO)	N	Mean (M)	Standard Deviation (SD)	Interpretation
1	Apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems.	120	2.49	1.04	Poor Performance
2	Identify research literatures and analyzes broadly-defined technology and engineering problems reaching substantiated solutions and conclusions using analytical tools.	120	3.65	0.81	Good Performance
3	Design solutions for broadly-defined industrial automation and manufacturing problems and contribute to the design of systems, components or processes.	120	3.71	0.73	Good Performance
4	Conduct investigation, analysis and interpret data of broadly-defined problems in industrial automation and manufacturing responsibly.	120	3.75	0.72	Good Performance
5	Demonstrate expertise and effectiveness in the use of relevant modern enabling technology and engineering tools necessary for the practice in industrial automation and manufacturing technology.	120	2.44	1.02	Poor Performance
6	Convey ideas clearly through understanding of current societal issues in the development of quality human capital, technology solutions and economic enterprise.	120	3.73	0.77	Good Performance
7	Articulate the impact of technology and engineering solutions of broadly-defined problems in industrial automation and manufacturing through electro-mechanical technology.	120	3.73	0.72	Good Performance
8	Demonstrate professional, social and ethical responsibilities in the application of diverse knowledge and multi-disciplinary competencies.	120	3.84	0.71	Good Performance

9	Function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multi-cultural teams using modern communication tools.	120	3.43	0.93	Fair Performance
10	Communicate persuasively and effectively the technical project information and documentation in broadly-defined electro-mechanical technology related activities.	120	2.30	0.84	Poor Performance
11	Effectively demonstrate knowledge and understanding of industrial automation and manufacturing management principles.	120	3.88	0.70	Good Performance
12	Recognize the need for, and engage in life-long learning in the electro-mechanical technology discipline.	120	3.96	1.04	Good Performance
13	Participate in the generation of new knowledge and advancement of existing discoveries in research and development projects, and in technopreneurial activities in the areas of automation and manufacturing technology.	120	3.78	0.80	Good Performance
	Composite Mean		**3.44**	**0.83**	**Fair Performance**

Legend:			
Scale		**Mean Description**	**Interpretation**
4.50-5.00	=	Very Good	High Performance
3.50-4.49	=	Good	Good Performance
2.50-3.49	=	Fair	Low Performance
1.50-2.49	=	Poor	Poor Performance
1.00-1.49	=	Not At All	No Performance

For the demonstration of skills, the result manifested that graduates of EMT craft practice is within the range of poor to good performance level, though there are some perceived shortfalls but not a large gap at the top level of the hierarchy. The result on ratings of graduate demonstration of Electro-Mechanical Technology skills is shown above. The respondents are of the view that nine out of thirteen skills were rated as good. Meanwhile, all other mean values carrying less than 3.5 in the Likert scale are rated fair and poor performance level. All the skills have been rated as “important”, but four out of the thirteen skills listed fell under fair to poor level interpreted as low and poorly performing respectively which means they are deficient in those skills, therefore creating some minor gaps.

The table above indicates that 13 skills listed have some measures of gap as none yielded a mean score of 5.00. The generic skills were tested on a 5-point Likert scale with a mean score of 3.50 and a test value of 3.5 was applied. After grouping the skills under the demonstration level, 4 skills show deficiencies or skills gap up to 1.3 (-1.3) on the scale. Among the generic skills showing deficiencies are item 1: apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems; item 5: demonstrate expertise and effectiveness in the use of relevant modern enabling technology and engineering tools necessary for the practice in industrial automation and manufacturing technology; item 9: function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and multi-cultural teams using modern communication tools; and item 10: communicate persuasively and effectively the technical project information and documentation in broadly-defined electro-mechanical technology related activities.

The table further shows that the remaining 9 areas yielded mean scores around 3.78 out of the maximum obtainable mean score of 5.00 indicating moderate skills gap of minus 1.2 (-1.2) on the scale. These are on items 2, 3, 4, 6, 7, 8, 11, 12, and 13. Above all, the weighted average of 3.44 out of 5.00 highest score possible indicates an overall skills gap of -1.56. This shows that there is a deficiency of up to 31.23% in the skills measured.

The results reveal four essential skills in which this set of graduates is lacking, which aligns with much of what previous literature has identified that the skills and education provided to these graduates do not meet the demands of today's job market, resulting in employer dissatisfaction regarding the effort levels and work attitudes of young EMT graduates. Additionally, the advent of new technology has significantly impacted the performance of these graduates due to their outdated training, which is insufficient and creates a skills gap (Odusami et al., 2003; Oloyede et al., 2010; Olusegun and Micheal, 2011; Olomolaiye and Ogunlana, 1989; Muya et al., 2006; Jayaram & Engmann, 2017).

The findings demonstrate and confirm that the skills and education obtained are inadequate, which will inevitably impact the industry and employers. In the literature review, it was found that the lack of skilled graduates, their insufficient experience, and the absence of specialization have led to low productivity levels, hindering business growth in terms of productivity, quality of work, overall organizational profit, and project timelines (Durdyev & Mbachu, 2011; Kuroshi & Lawal, 2014).

Conclusion

In accordance with the findings of the study, the following conclusions were made.

1. The findings indicated that the 13 skills from the EMT program were important in the work demands necessary to possess by the graduates. The skills were relevant and consistent with the needs of the industry. It is also vital that educational institutions must align current industry demand skills to keep abreast with the latest high important skills interpreted to be highly in demand in the job market.
2. Except for the areas of cognitive skills category particularly in critical thinking (apply innovative and critical thinking in the integration of knowledge in mathematics and natural science, engineering fundamentals and electro-mechanical technology to solve broadly-defined technology problems.), communication skill (communicate persuasively and effectively the technical project information and documentation in broadly-defined electro-mechanical technology related activities.), and inter-personal skill category (function independently, collaboratively and effectively as individual, member or leader of multidisciplinary, trans-disciplinary and multi-disciplinary, trans-disciplinary and

multi-cultural teams using modern communication tools.), there are significant differences between these skill categories that technology industries stated as important and the skills demonstrated by the EMT graduates at USTP-CDO campus. This lack of alignment can be attributed to the fact that industries require the graduates' to not just academically ready but technically and foundationally know-how on structured problem solving, logical reasoning, understanding biases, and seeking relevant information, as well as synthesizing and conveying information in a right and persuasive way. Further, to interpersonally make them a good team player where inclusiveness, motivating different personalities, resolving conflicts, collaboration, and empowerment foster.

3. Mismatch also exists in the area of digital skills specifically in understanding digital systems (demonstrate expertise and effectiveness in the use of relevant modern enabling technology and engineering tools necessary for the practice in industrial automation and manufacturing technology.) rated as poor performance of the graduates' as perceived by the industry. This gap is evidently attributed to lack of technical expertise and exposure of the graduates to the latest relevant modern enabling technology and engineering tools necessary to data and cybersecurity literacy, smart systems, and tech translation and enablement. To the fact that industries are keep on upgrading with the fast-paced technologies, academes must also keep on trends. It is crucial that EMT teaching departments identify the range of skills required by technology industries and focus their curriculum towards offering these skills to students. Skills must align with the 21st century skills requirement to deal with the graduates' poor performance level at work and dynamically align both academe and industry inputs.

Recommendations

The findings of this study are substantially ideal for curriculum design inputs specifically in skill gap analysis for the entire EMT development program in the whole USTP system. The government, academe, policy-makers, and faculty must ensure adequate training and support is carried out to achieve quality education relevant for the needs of the industry. The focus of this research has been directed at the EMT department of USTP-CDO campus alone. Comparative and qualitative studies could be conducted at other universities on a national or an international basis. This could lead to valuable insights into diversified course design and the implementation of EMT program development and upgrading projects.

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