ASEAN's 10 member states[1]

FY 2020 Ex-Post Evaluation Report for Technical Cooperation Project

"ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net) project Phase 3"

External Evaluator: Kaneyasu Ida, Tekizaitekisho LLC

0. Summary

This project aims to form higher education networks specializing in engineering in the 10 countries making up the Association of South East Asian Nations (ASEAN) and reinforce the educational and research capacities of engineering universities in the region. Phase 3 was implemented following a preparatory phase and phases 1 and 2. Strengthening the networks in higher education is a shared need for ASEAN and the member institutions (MIs), making this project highly relevant. In Phase 3, universities and companies carried out collaborative research, and researchers at MIs engaged in collaborative research on a broad range of themes, such as natural disaster and the environment. As such, researchers at MIs gained a wealth of experience with industry-university linkage and collaborative research on common regional issues. In the scholarship program, the percentage of students earning PhD, which gives them a high likelihood of becoming teaching staff and researchers, was high compared to Phases 1 and 2, demonstrating the program's effectiveness in raising university teaching staff and researchers. In addition, the ASEAN Engineering Journal (AEJ), a publication started by AUN/SEED-Net, was indexed by the Thai Citation Index and ASEAN Citation Index, which increased contributions from researchers other than alumni members of the project's scholarship program and raised its status as an academic journal. In addition, regional conferences in ten engineering fields supported by the project were effective forums not only for the presentation of research results, but also for considering collaborative research and joint education programs. As a result, this program's returning students and researchers at the MIs engaged in collaborative research took the central role in starting courses for international graduate school programs during Phase 3, and the number of joint education programs between MIs, such as double degree programs, exchange student programs, exchange programs for instructors, short-term study abroad and research programs, increased and were highly effective.

In this ex-post evaluation, 114 collaborative research programs supported by the project were examined to what extent they had social impacts, and it was confirmed 29 concrete social impacts to the private sector and government such as joint patents and technology transfer and other. In regards to industrial human resource development, in 2018 at least 1,275 students earned PhDs from MIs, and 174 PhD recipients found employment with companies, showing that the project

[1] The 10 member states making up ASEAN are Thailand, Malaysia, Indonesia, the Philippines, Laos, Cambodia, Myanmar, Vietnam, Singapore and Brunei.

also had an impact in turning out advanced human capital for industry. These points indicate that the project had satisfactory effectiveness and impact.

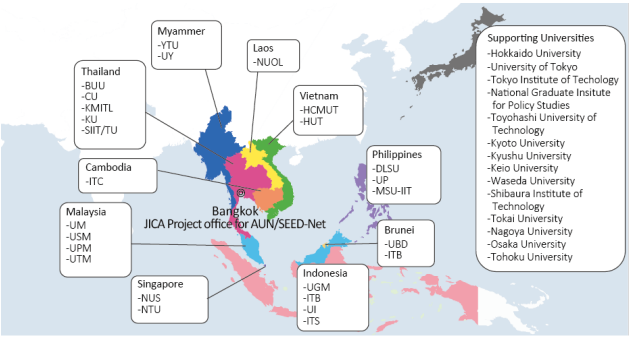
The dispatch of experts, project duration and cooperation amount were in line with the plan. Thailand, where the project's secretariat office is located, took on responsibility for appointing a deputy executive director and secretaries and the running costs for the office. MIs also took steps such as giving exemptions or reducing tuition for the scholarship recipients, as initially planned. Given these points, efficiency was high.

The member countries' government institutions and MIs have strong expectations that collaborative research and scholarship programs within the region will raise the quality of education and research and strengthen networks with Japanese companies and universities. Continuity in the policy aspect is high. In the institutional aspect, almost all MIs have established cooperation agreements with other member universities. Of the six universities in CLMV[2], alumni organizations have been formally established at four universities. As such, the foundation for networks between MIs has been built. In the technical aspect, the publication of AEJ and regional conferences are particularly important. AEJ has extremely high sustainability since its inclusion in the Scopus index[3] in 2019 means that stable contributions can be expected. MIs have built up experience in holding field-specific regional conferences and are already able to run them on their own. They have also gained good experience in conducting Collaborative Research with Industry (CRI). In the institutional aspect, collaborative research continues as a consortium, including the private sector. Alumni associations has been well instituted, and regional conferences and AEJ also continue. On the budget side, the scholarship program, which account for a high percentage of the budget, are almost over, and activities with a narrower input scale are now possible. In addition, MIs are very motivated to continue regional conferences and AEJ, including the budget input, so it will be possible to continue these programs – on a smaller scale for the conferences. There is also a possibility that MIs would continuously support some functions of the secretariat office after the end of Phase 4. Given these points, it is judged that sustainability is high.

In light of the above, the project is evaluated to be highly satisfactory.

[2] The four countries are Cambodia, Laos, Myanmar and Vietnam.
[3] SCOPUS is the world's largest abstract and citation database for post-print documents.

1. Project Description



List of participating universities in ASEAN and Japan

Regional conference hosted in 2017 by the Institute of Technology of Cambodia (geological and geo-resource engineering field)
* Reposted from AUN/SEED-Net's Facebook page

1.1 Background

At the Japan-ASEAN Summit Meeting held in 1997, then-Prime Minister of Japan Ryutaro Hashimoto announced the Japanese government's plans to provide cooperation to strengthen higher education in ASEAN in order to overcome their economic crisis. In response to this announcement, it was recognized that transferring Japan's experience and know-how in higher education and research in the engineering field to engineering universities in ASEAN would be effective in developing human resources able to adapt to globalization within ASEAN. Accordingly, AUN/SEED-Net was established as a sub-network specializing in engineering of the ASEAN University Network (AUN)[4], a framework for cooperation among universities in the ASEAN region. After a two-year preparatory period from 2001, the project was formally started in March 2003 for a five-year period through March 2008. Phase 1 was intended to build the foundation for networks among MIs and improve the qualifications of academic staff. Phase 2 was started in March 2008 for a five-year period lasting through March 2013. This phase was intended to further strengthen the foundation, expand the scope of the project and continue helping academic staff acquire degrees, using as its base the improvements made to academic staff qualifications and the networks among MIs that were established in Phase 1. During both phases, there were 19 universities in ASEAN and 11 Japanese Supporting Universities (JSU). During Phases 1 and 2 of AUN/SEED-Net, the project's focus was on improving the education and research capacity of academic staff at MIs through study abroad in the region and Japan, but there were still issues in terms of reinforcing networks among MIs. As a result, Phase 3 was implemented, and efforts were made to strengthen networks by further promoting the establishment of collaboration with industry and international programs and joint programs at MIs. In Phase 3, the network expanded with the number of MIs in ASEAN increasing from 19 to 26 and the number of JSUs increasing from 11 to 14, and it was necessary to provide support to new members. In addition, based on the realization that the networks need to be strengthened

[4] AUN has its headquarters in Bangkok. AUN/SEED-Net is one of the 17 networks making up AUN.

further through international and joint programs and collaborative initiatives between industry and universities, Phase 4 is currently being implemented.

1.2 Project Outline

Overall Goal		The advancement and globalization of industry and initiatives to address common regional issues are promoted in South East Asia.
Project Purpose		A system for advanced research and education is established by MIs and JSUs.
Output(s)	Output 1	Links among MIs, industry and communities are strengthened.
	Output 2	A system to implement research activities that contribute to the resolution of common regional issues is established.
	Output 3	The research and educational capacity of academic staff at MIs is improved.
	Output 4	The academic networks between organizations and between academic staff among MIs and JSUs are strengthened.
Total cost (Japanese side)		3,860 million yen
Period of Cooperation		March 2013 – March 2018
Target Area		Sites of Member Institutions in 10 countries: Thailand (Bangkok, Chonburi) Malaysia (Kuala Lumpur, Penang, Seri Kembangan), Philippines (Manila, Iligan), Indonesia (Jakarta, Bandung, Yogyakarta, Surabaya), Vietnam (Hanoi, Ho Chi Minh), Cambodia (Phnom Penh), Myanmar (Yangon), Singapore, Brunei
Implementing Agency		26 Member Institutions in 10 ASEAN countries: Burapha University, Chulalongkom University, King Mongkut's Institute of Technology Ladkrabang, Kasetsart University, Sirindhorn International Institute of Technology, Thammasat University (Thailand); Ho Chi Minh City University of Technology, Hanoi University of Science and Technology (Vietnam); Universitas Gadjah Mada, Institut Teknologi Bandung, Universitas Indonesia, Institut Teknologi Sepuluh Nopember (Indonesia); Institute of Technology of Cambodia (Cambodia); National University of Laos (Laos); De La Salle University, University of the Philippines-Diliman, Mindanao State University-Iligan Institute of Technology (Philippines), University of Malaya, Universiti Sains Malaysia, Universiti Putra Malaysia, Universiti Teknologi Malaysia (Malaysia); University of Yangon, Yangon Technological University (Myanmar); National University of Singapore, Nanyang Technological University (Singapore); Universiti Teknologi Brunei, Universiti Brunei Darussalam (Brunei)
Other Relevant Agencies/Organizations		10 ministries in charge of higher education in 10 ASEAN countries
Organization in Japan		14 Supporting Japanese Universities (Hokkaido University, Keio University, Kyoto University, Kyushu University, Nagoya University, National Graduate Institute for Policy Studies, Osaka University, Shibaura Institute of Technology, Tohoku University, Tokai University, Tokyo Institute of Technology, Toyohashi University of Technology, The University of Tokyo and Waseda University)

Related Projects	ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net) Project Phase 1 (March 2003 – March 2008), Phase 2 (March 2008 – March 2013) and Phase 4 (March 2018 – March 2023), The Project for Educational Capacity Development of Institute of Technology of Cambodia (October 2011 – October 2015), The Project for Enhancement of Engineering Higher Education in Myanmar (October 2013 – October 2018), The Project for Enhancing Technological Universities in Myanmar (2014)

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The project purpose, "to establish a system for advanced research and education by MIs and JSUs," has shown results to some extent, but there are issues with the implementation of joint graduate school programs. For this reason, it was determined that the effectiveness was medium.

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation (Including other impacts)

If this project strengthens support for the social implementation of these research results, the prospects for the achievement of the project purpose are relatively high, and various other positive impacts are also appearing. As a result, the project's impact was also deemed to be high.

1.3.3 Recommendations from the Terminal Evaluation

Since Phase 4 was expected to be implemented, it was recommended that in Phase 4, the project should address the following:

- To reconsider a strategy for promoting joint education to further encourage mobility programs between MIs
- To reinforce alumni associations to ensure continuity
- To support collaboration between industry and universities so that advice from a more expert perspective can be obtained on patent approval and other issues
- To encourage the aggressive uptake of external money
- To strengthen internal monitoring based on PDM
- To reinforce the management of data on input and output
- To augment the AUN/SEED-Net website to facilitate applications for research projects and matching between researchers for joint research

2. Outline of the Evaluation Study

2.1 External Evaluator

Kaneyasu Ida, Tekizaitekisho LLC

2.2 Duration of Evaluation Study

When carrying out this ex-post evaluation, the study was implemented as described below.

Duration of the Study: October 2020 – November 2021

2.3 Constraints during the Evaluation Study

- Due to the spread of COVID-19, the Japanese consultant was unable to carry out field research and depended heavily on field work conducted by field research assistants who were on site in the member countries. However, many MIs were closed for prolonged periods due to lockdowns and other, and it was difficult for assistants to collect information face-to-face from those at the university, and they often had to resort to online research.
- In Myanmar, after the military takeover of the country that occurred in February 2021, the internet was shut down and contact with local field research assistants and academic staff of the MIs was impossible. As a result, the interviews and other studies that had been planned were not possible. Therefore, information provided in this report regarding Myanmar is limited to the period before February 2021.

3. Results of the Evaluation (Overall Rating: A[5])

3.1Relevance (Rating: ③[6])

3.1.1 Consistency with the Development Plans of ASEAN

During the project period, several policy papers and documents related to ASEAN were adopted and released, including ASEAN+3's *Cooperation Work Plan* (2007-2017), the ASEAN Secretariat's *ASEAN Socio-Cultural Community Blueprint 2025* and the Ninth Conference of ASEAN Education Ministers' *The ASEAN Work Plan on Education 2016-2020*. These papers identified such issues as strengthening inter-university networks among the member countries, promoting credit transfer on the premise that ASEAN is a collective body, and assurance of universities' quality. The increasing role of higher education institutions was also emphasized for the socio-economic development of the region in these papers. This shows that this project is a cooperation project with a purpose aligned with the direction taken by ASEAN. Moreover, AUN has set contributing to higher education in the ASEAN collective as its mission, and is working on creating system framework, such as establishing the ASEAN+3 Guidelines for Foreign Exchange and Mobility and introducing a university certification system. This project was seen as an effort to give substance to this framework.

In CLMV, producing engineering human resources who can contribute to the society and economy and expanding access for students to higher education have been important issues from the beginning of the project. Building an education and research system through networks, which is this project's purpose, addresses this policy issue. In addition, in the ASEAN countries that

[5] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[6] ③: High, ②: Fair, ①: Low

joined ahead of CLMV[7] (Thailand, Malaysia, Philippines and Indonesia), generating human resources for industry that can meet the needs of more sophisticated industry, by using IT, for example, is seen as important, which is consistent with this project's overall goal of producing human resources for advanced industry. Given these factors, this project is consistent with the policies of ASEAN, AUN and higher education institutions in the individual countries (refer to Appendix 1).

3.1.2 Consistency with the Development Needs of ASEAN

The important needs of MIs in CLMV, excluding Vietnam, were to establish new departments for new engineering fields and set up master's and PhD courses, as well as ensure that academic staff in new engineering fields acquire advanced academic degrees. The founding ASEAN countries and Vietnam had needs such as raising their competitiveness to improve university rankings, globalize, and strengthen industry-university linkage, which is consistent with this project's approach on promoting international programs and strengthening collaboration between industry and universities through collaborative research. Industry-university linkage was also seen as an important activity to link up with Japanese companies operating in these countries.

In interviews with industrial organizations and companies with interest and a track record in cooperating with universities in ASEAN, it was learned that there was a shared need for the development of high-quality human resources in industry who have received a practical education in engineering. This project supported the establishment of systems and environments that serve as institutions developing this kind of workforce, and is thus very consistent. Since the need for innovation, such as collaborative research, differs in the individual countries, we cannot generalize, but in the founding ASEAN countries, collaborative research is gradually gaining recognition as a means of raising technical competitiveness in the private sector. For example, in Indonesia, the mining and manufacturing industries trust the research and investigation capacity of universities, and there is a strong need for cooperation, but the needs are not clear for companies and industrial organizations, which are not aware of the universities' research subjects. According to a study in Vietnam (Ho Chi Minh National Academy of Politics' Survey on Innovation 2016-2019), only 5-10% of university research has been put to practical use, and the National Chamber of Commerce is seeking collaborative research with universities through proposals of technology that could have practical applications. In this sense, companies have a strong need for universities to produce high-quality engineers, and there is a growing need for collaborative research in the founding ASEAN countries and Vietnam, which is very consistent with this project's purpose and approach (refer to Appendix 2).

[7] The five original ASEAN member countries (Thailand, Malaysia, the Philippines, Indonesia and Singapore) are known as the founding ASEAN countries, but in this project, the two universities in Singapore played the same role as JSUs by accepting exchange students, etc., so in this report, founding ASEAN countries refers to the four countries excluding Singapore.

3.1.3 Consistency with Japan's ODA Policy

In regards to cooperation between Japan and ASEAN in education, policies promoting human resource development in the science & technology and engineering fields through AUN/SEED-Net were laid out in the *Japan-ASEAN Summit Action Plan* in November 2011. In the new growth strategies, pursuing scientific and technical diplomacy, such as promoting international collaborative research and scientific and technical cooperation for developing countries, is advocated in the section on Strategies for building a nation based on science, technology and IT. In addition, in the Economic strategies for Asia, utilizing Japan's technology for Asia's growth and expanding Japanese companies' business chances were listed as objectives. In this sense, this project is very consistent with Japan's ODA policy.

The project was sufficiently consistent with the development policies of ASEAN, AUN and ASEAN countries, the needs of this project's MIs, and Japan's ODA policies. Therefore, its relevance was high.

3.2 Effectiveness and Impacts[8] (Rating: ③)

3.2.1 Effectiveness

3.2.1.1 Achievement of Project Purpose

The main objective of Phase 3 was the development of advanced human resources for industry for the sustainable development of ASEAN. The salient features of Phase 3 include the following:

- It continuously supported quality improvement of research and education of MIs in CLMV through provision of scholarships to their academic staff to obtain higher academic degrees - the core initiative in Phases 1 and 2.
- It continued to support joint research programs to build and expand the academic network between ASEAN and Japan.
- It continued to support the publication of AEJ and convening regional conferences to strengthen academic networks
- Its focus was on reinforcing and expanding industry-university linkage and efforts to resolve common regional issues.

The key indicators and results for the project purpose for Phase 3—an advanced system for research and education is established by MIs in collaboration with JSUs—are shown below. Although these indicators do not show numerical targets, the achievements in Phase 3 surpassed those of Phase 1 and 2. Therefore, it is judged that the project purpose was achieved.

[8] The impact is also considered when assessing effectiveness and giving a rating.

Table 1 Achievement of Project Purpose

Project Purpose	Indicators	Actual
Project Purpose	Number of programs at international graduate schools implemented	During Phase 3, 23 courses at 12 universities were started as international graduate school programs. During the Phases 1 and 2, four universities started such programs in English. Many courses were attended by foreign students sent by this project, and in particular, at new MIs in Thailand and MIs in Indonesia, the acceptance of this project's scholarship recipients became the direct catalyst for starting English programs or the acceptance of foreign students. Some programs became popular in neighboring countries since there were no similar courses in their countries.
	Number of joint international graduate school programs implemented	In Phase 3, five universities introduced double degree programs with JSUs, and there was progress with the indicator measuring increases in international graduate school programs, which did not make much progress in Phases 1 and 2. For example, at Shibaura Institute of Technology, twinning programs (intercollegiate transfer system at universities and graduate schools) were actively promoted, and Gadjah Mada University (UGM) has used the project's network to implement an intercollegiate transfer program at the graduate school level. Similarly, Kyushu University and Waseda University introduced double-degree programs and/or other mobility programs with Chulalongkom University (CU), Institut Teknologi Bandung (ITB) and UGM in the field of geological and geo-resource engineering, utilizing the networks built by the project. In addition, there are cases in which close relationships with JSUs, formed through the project's scholarship program and collaborative research, have been utilized. Other mobility programs include 12 student exchange programs, 12 teacher exchange program, and four short-term study abroad and research programs. Phase 1 and 2 were limited to only three foreign exchange programs and teacher dispatch, there were significant improvements in the indicator.

Source: Results of questionnaires given to MIs and interviews.

This project endeavored to 1) promote collaborative research aimed at reinforcing collaboration between industry and universities, 2) encourage collaborative research intended to resolve common regional issues, 3) improve the quality of university research and education by supporting the acquisition of higher degrees, primarily at MIs in CLMV, and 4) strengthen academic networks by publishing an academic journal and holding regional conferences. Below is the description of the extent of these achievements.

(1) Promotion of collaborative research aimed at reinforcing collaboration between industry and universities

AUN/SEED-Net has offered funds for Collaborative Research Program with Industry (CRI) since 2011 during Phase 2 on the condition that financial contribution must be made by the

corporate partner. Joint research with industry was implemented for various objectives, to name a few, productivity improvement, commercialization of new technology and application of new material. CRI has had 47 joint research projects (12 in Phase 2 and 35 in Phase 3). The application competition ratio was 35/80 (2.3x) in Phase 3 and 12/24 (2.0x) in Phases 1 and 2. The budget allocated by the project was 317,298 US dollars, and companies contributed 63,460 US dollars. In Phases 1 and 2, there were views that looking for companies able to contribute would be very difficult, but judging from the number of the implemented projects, which rose from 12 to 35, this program has significantly helped to strengthen collaboration with companies.

Of the 35 CRI-supported research projects, two universities in Vietnam accounted for 14, followed by Indonesia (6) and Malaysia (5). One reason for this was that Hanoi University of Science and Technology (HUST) and Ho Chi Minh City University of Technology (HCMUT), which actively used CRI to boost collaboration with industry, encouraged academic staff to apply for CRI, which increased the number that were accepted. These two universities and some universities in Indonesia utilized their existing networks with companies, which also explains their active pace of applications. At the same time, in Cambodia, Laos and Myanmar (CLM), there are many small- and medium-sized companies and it is difficult to find companies that will actively provide funding, which explains why applications from these countries were low. Of the MIs, 10 universities had experienced joint research with industry using CRI where companies contributed funding, and CRI fulfilled a role in strengthening networks.

Initiatives other than CRI included training in Japan for academic staff to promote industry-university linkage, technology management courses, seminars on industry-university linkage, the establishment of an advisory team to promote industry-university linkage at the secretariat office, and the publication of directories for industry-university linkage for each MI (eight countries), among others. Since internships with companies were widely implemented at MIs, they were not actively facilitated as part of this project's activities, but according to responses to questionnaires[9] (21 universities), all MIs offered internships utilizing AUN/SEED-Net networks and their activities in partnership with 60 Japanese companies and 68 local and foreign companies. In addition, a total of 107 company visits were made to 32 companies (of which 16 were Japanese companies) and technology consultations provided by MIs' academic staff.

According to questionnaires given to 21 universities, project activities related to industry-university linkage were all rated extremely highly, and almost all the universities who responded answered that they were very beneficial or beneficial to some extent. Industry-university linkage is an important issue for universities and interest was high. For example, HUST responded that it became autonomous in 2016 and industry-university linkage was an important policy, but there was not enough expertise, so the series of technology transfers made through this project to MIs

[9] Questionnaire was distributed to 26 universities to collect data and their opinions about the project.

were extremely beneficial. At the University of the Philippines-Diliman (UP), researchers who participated in the technology management course learned about fund procurement, and were then able to secure funding for several research projects. At the Institut Teknologi Sepuluh Nopember (ITS), researchers learned project management methods and then utilized this expertise in a major research project related to electric vehicles, while Institut Teknologi Bandung (ITB) and Chulalongkorn University (CU) used Japan's approach to industry-university linkage as a reference.

(2) Encouragement of collaborative research intended to resolve common regional issues

Collaborative Research Program with Common Issues (CRC) was started from 2011 during Phase 2. Under CRC, various joint research projects in such fields as environmental studies and natural disaster (e.g., typhoon, tsunami and high-tide simulation modeling for different coastal areas in ASEAN countries). In the two years from 2011 to 2012 during which applications were accepted, four of 16 applications were accepted. Initially, the number of applications was not very high since it was difficult to identify common regional issues, but in the Phase 3 period, 138 applications were submitted from MIs in eight countries and 41 were accepted. As a result, 60 papers were produced and 37 presentations made (on average, this amounted to three papers and two research presentations for each joint research).

CRC was particularly active in Vietnam, which had 14 projects, and Malaysia, which had 13. Many of the projects were in the fields of civil engineering (7) and environmental engineering (6), but there were two to five projects in other fields, and there does not seem to have been significant skewing toward a particular field. Since there were not many other joint research projects on common regional issues like CRC, and there were networks of researchers with other MIs, 11 out of 18 universities responded that they actively applied to CRC. Moreover, the 11 universities that carried out joint research in CRC responded that CRC was helpful in spurring extremely high or quite high interest in collaborative research to resolve common regional issues. Given these points, experiences to carry out collaborative research to solve common regional issues was built up. Universities that did not have high CRC application numbers said that this was because they had few students received from MIs and few points of interaction with potential partners in collaborative research, and that they had applied but their proposals were not accepted (due to insufficient skills in writing proposals, for example).

(3) Improvements to the quality of university research and education by supporting the acquisition of higher degrees

From the time it was established, AUN/SEED-Net implemented scholarship program for CLMV members to send their staff to MIs and JSUs to strengthen the CLMV members' education and research capacities; these were continued in Phase 3. There was a total of 540 scholarship

recipients during Phase 3, including 144 PhD recipients, 243 master's recipients and 42 who were not able to earn a degree. The remaining 111 are still in the process of earning degrees. The degree recipient rate was 80.89% for PhD candidates and 96.8% for master's degree candidates. Just under 20% of candidates are unable to earn PhDs, which is more difficult than Master's. The percentage of students earning their master's degree is very high, and overall, the degree recipient rate is also high. Judging from the number of papers and presentations required for graduation at the individual universities, at least 243 papers for master's degrees and 288 for PhDs were completed, for a total of 531 research papers. In addition, in the Collaborative Research Program for Alumni Members (CRA), which is a joint research program that this project's graduates can apply to, 18 presented papers and 21 presentations given. The average length of time needed to earn a degree is 24.42 months for a master's degree and 37.76 months for a PhD, and the percentage of the students who completed within the designated time period was 79% for master's degree students and 68.8% for PhD students. Compared to the scholarship program of Japanese Ministry of Education, Culture, Sports and Science and Technology (MEXT) for foreign students as of 2019,[10] the degree recipient rate during the standard number of years for a master's degree in the engineering field in this program was 92.5% and 59.4% for PhD candidates. The project's degree recipient rate is higher for PhD students although that is lower for master's program students. This shows that AUN/SEED-Net's scholarship program is effective as a scholarship program.

The objective of the scholarship program was not only to encourage students to acquire higher degrees, but to raise the research and education level of MIs, particularly in CLMV, through the acquisition of higher degrees. As a result, they are expected to return to their home universities and contribute to strengthening research and educational capacity of home universities after earning the degree and become an academic staff member. Of the 334 degree recipients from CLMV in Phase 3, 127 (38.0%) returned to their home universities and worked as lecturers and/or researchers. The rate of students returning to their home universities was particularly high in Vietnam and Laos. This was primarily because lecturers were needed in the new engineering fields in Laos and there were many PhD recipients in Vietnam. In Cambodia, Master's degree recipients sometimes could not find a post at their home university, so the rate of return was low and instead they found employment in the government and the private sector.[11] Yet, in Phase 3, measures were taken to select students with higher prospects of finding posts in the university on their return. Therefore, the rate of return would likely be improved. Myanmar has a transfer system for university lecturers and researchers so that they are transferred every few years, so the

[10] https://www.studyinjapan.go.jp/ja/statistics/shinro-and-gakui/data/2019.html (accessed on July 26, 2021)
[11] An increasing number of the returned degree recipients who got employment in the public and private sectors have also contributed to the development of science and technology in their respective countries. For example, the director general of National Institute of Science, Technology and Innovation under the Ministry of Science, Technology and Innovation of Cambodia is one such case in point.

rate of return to home universities was low, but 28 became teachers at other universities, and when including this number, the percentage who became teachers at their home universities was 62.9%.[12] Of those who took paths other than becoming teachers at their home universities, 47 (14.0%) worked in other universities or research institutions, 57 (17.1%) worked in private companies, 20 (6.0%) worked in government institutions, and the jobs of 83 (24.9%) were not known. Some MIs do not necessarily carry out surveys on the career paths of graduates, but since information on the careers of graduates is an indicator for the results of university education in some sense, it is important that universities carry out surveys on career paths.

Table 2 Number of degree recipients from scholarship program by country and rate of return to home universities during Phase 3

Name of country	Number receiving degrees *	Number returning to home universities	Rate of return (%)
Laos	55	39	70.1
Cambodia	132	34	25.8
Myanmar	54	6	11.1
Vietnam	93	48	51.6
Total for CLMV	334	127	38.0
Other	53	21	39.7
Overall total	387	148	38.2

Source: results of questionnaire given to MIs. *Total for PhDs and master's degrees

In the 12 years covering Phases 1 and 2 (including the two-year preparatory period), 218 received PhDs, and in the five years covering Phase 3, 144 candidates received PhDs, with 37.2% of the scholarship recipients in a PhD course. This demonstrates that its role as a program that helps students earn higher degrees grew. Since PhD recipients are likely to become lecturers and researchers, Phase 3 was more effective than Phases 1 and 2 in terms of the program objective of training lecturers and researchers with high degrees.

Moreover, a survey of the universities from which lecturers and researchers graduated (graduate schools) and the percentage of AUN/SEED-Net graduates for six universities in CLMV found that 412 had studied abroad in this project and returned to their home universities to become a lecturer or researcher, and AUN/SEED-Net graduates accounted for 15.1% (412/2,714) of university lecturers and researchers. The percentages were not very high in Vietnam, where the number of lecturers and researchers (PhD holders) was already very high in the universities, and in Myanmar, where lecturers and researchers are transferred. However, the percentage was as high as 56.7% at the National University of Laos (NUOL) and 29.2% at Cambodia's ITC, showing that graduates of this program account for a very high percentage in these two universities.

[12] The whereabouts of half of the returnees in Myanmar are seeking higher education or unknown to the evaluation study team.

The contributions made by returned graduates to their home universities include playing a central role by teaching in newly established programs (for example, the establishment of an environmental engineering program, engineering geology program, and a PhD program for logistics and transportation engineering, and a bachelor's program for materials engineering and industrial engineering in NUOL's Faculty of Engineering; the establishment of an international master's program for construction management at HCMUT and the establishment of a natural disaster course in the civil engineering program; and 18 new courses created at Thammasat University (TU). Many of the returned graduates also contributed to curriculum development and guiding students, as well as playing a key role in conducting collaborative research programs supported by this project. In addition, there were cases in which accepting students from the project became the catalyst for setting up new master's courses, as with seven new courses established at the University of the Philippines Diliman (UP).

(4) Strengthening academic networks by publishing an academic journal and holding regional conferences

In Phase 3, 451 papers were submitted to the ASEAN Engineering Journal (AEJ) and 132 were accepted. Of these, at least 40 papers were international joint papers (according to AUN/SEED-Net's annual report). Until 2016, papers from 10 fields were divided into three books for publication, but beginning in 2017, the fields were consolidated, and it is now issued twice a year in both digital form and as a hard copy. The number of applications was highest for the manufacturing engineering field (65 submissions), followed by chemical engineering (61) and civil engineering (54), but 20 or more have been submitted in other fields as well. There were only 11 submissions in the natural disaster field, which is low, but this is likely because there are still few universities with this field. By university, there were 52 submissions from HCMUT, 33 from HUST, 31 from CU, 32 from ITB, 31 from USM, and 30 from UGM, but there were also 10 universities with few accepted papers, showing that there are significant discrepancies. Universities with low numbers gave as their reasons a low number of the project's scholarship recipients (there were few submissions of papers by students in AUN/SEED-Net's master's degree and PhD programs) and the fact that there are other academic journals.

In Phase 3, AEJ was indexed in Thailand and ASEAN's science index (Thai-Journal Citation Index Centre [TCI] and ASEAN Citation Index [ACI]), which increased submissions from MIs and also increased submissions from universities other than MIs to 67 as AEJ's name recognition and reputation as an academic journal improved. In this project, in 2017, the AEJ editing team was reinforced and a new management system that brought all procedures online was introduced. AEJ also worked to gain inclusion in the Scopus index (the world's largest abstract and citation database for post print documents).

In Phases 1 and 2, the regional conferences were effective in providing AUN/SEED-Net's students a forum to present and submit the papers needed for graduation and providing the results of collaborative research utilizing the network of researchers. During Phase 3 period, a total of 49 regional conferences in 10 fields were held as international academic conferences.

In this project, AEJ and regional conferences were reinforced as a means of strengthening networks, and achievements were made in terms of the number of papers contributed and the number of regional conferences held.

Sufficient results were achieved in promoting collaborative research, which is intended to strengthen industry-university linkage and resolve common regional issues, raising the quality of university research and education by supporting the attainment of higher degrees, particularly at MIs in CLMV, and strengthening academic networks by publishing an academic journal and holding international conferences. As a result, the project purpose of establishing international graduate programs and joint international graduate programs was mostly achieved in view of the achievements on the indicators.

3.2.2 Impacts

3.2.2.1 Achievement of Overall Goal

The overall goal is the advancement and globalization of industry and initiatives to address common regional issues are promoted in Southeast Asia, and the indicators are listed below. The indicators did not show numerical targets to measure to what extent the project achieved the overall goals; however, the impacts generated by joint research is quite significant in comparison with Phases 1 and 2. Thus, it is judged the project generated good impacts.

Table 3 Achievement of Overall Goal

Purpose	Indicator	Actual
Overall Goals	Number of joint patents filed by companies and MIs	There were eight joint patents, based on the results of collaborative research during the project period in 2013-2020 by the 12 universities that responded (six were joint patents with Japanese companies), and there were eight joint patents with companies in Phase 3. Given this, the indicator can be deemed to have been met.
	Number of research outputs utilized to solve common regional issues	As a result of the survey given to researchers on whether social application had been realized in the case of 41 CRC, it was confirmed that there had been specific social application in 15 cases. 36.6% of CRC were utilized, so this was relatively high output relative to the indicator for "utilization in solving common regional issues."
	Number of graduates employed in companies as engineers and researchers	In 2018, 7,599 out of 16,543 students who had earned their bachelor's degrees, 1,275 out of 3,035 who had earned their master's degrees and 174 out of 509 who had earned their PhDs took jobs at private companies. The project targeted

		graduate students. About 40% of master's degree recipients and over 30% of PhD recipients were employed in private companies, showing that the project indirectly contributed to the generation of highly skilled human resources for the industrial sector. As a result, the indicator for the generation of engineers for private companies also showed results (refer to Table 4).

Source: Results of questionnaires given to MIs and interviews with researchers

The research results produced because of the project's collaborative research programs utilized by the public and the private sectors can be recognized as the project's impact. As shown above, the project set the indicator to measure such social impact only for CRC. In this study, we studied all 114 collaborative research projects (CRC, CRA and CRI), and confirmed 29 cases of specific social application. In addition to the aforementioned patents received, other social impacts include cases in which the start of several spinoff companies, commercialization of new, local materials, the spread of new technology and equipment to small- and medium-sized companies and improvements of manufacturing processes. Examples of social application for government organizations include providing geographical distribution data of hazardous substances to government agencies, the development and adoption of new construction methods for public works, the accepted proposal on the use of unutilized resources, the recommendations accepted by the Government on rare minerals and the development of a smart reader and its use in remote education on isolated islands.

In regards to the indicator, the number of graduates employed in companies as engineers and researchers, the table below shows the results of data on the career path of students at the 12 out of 21 universities that were able to provide data. This relates to the indicator on the generation of highly skilled human resources for the industrial sector.

Table 4. Status of employment for graduates from MIs (2018)

Degree	Employment				Continued studying	Looking for a job	Other	Total
	Private sector	Government organization	Research institute, university	Other				
Bachelor's degree	46%	6%	4%	2%	5%	5%	32%	100%
Master's degree	42%	12%	7%	6%	11%	2%	21%	100%
PhD	34%	23%	17%	6%	0%	5%	15%	100%

Source: Results of questionnaires given to MIs

In relationships with companies, the intern program spread considerably, and ties strengthened, but companies were not interviewed about their evaluation of students and graduates. It has

gradually become possible to ascertain the career path of graduates, but it is still difficult to determine the career path of students at universities with many students who look for jobs after graduation. Study methods are issues to address going forward.

Given these points, we have observed favorable results for the overall goals in terms of the advancement and globalization of industry and the promotion of initiatives on common regional issues.

3.2.2.2 Other impacts

(1) Contributions to MIs

In regards to this project's impact on MIs, responses indicated that sending out and receiving the project's scholarship recipients contributed to globalization (16 out of 21 universities) and also had a major impact in reinforcing Japanese and overseas networks other than AUN/SEED-Net (17 out of 21). However, even though this project created many international programs, only five host universities responded that this increased the percentage of foreign students from programs other than this project. Moreover, impacts from joining AUN/SEED-Net were also confirmed. For example, hosted regional conferences raised the recognition of the university (NUOL), it became easier to obtain cooperation from foreign universities including Japanese universities (17 universities) and collaborative research with overseas universities increased (10 universities). In terms of the Memorandum of Understanding (MOU) and the Memorandum of Agreement (MOA) between MIs, a range of cooperation agreements were signed at the university level and engineering department level, including JSUs, with 158 MOUs between MIs and 70 between MIs and JSUs. Not all of these MOUs were directly related to this project, but there is a high probability that the fact that they are MIs was one factor behind agreements between universities.

Other contributions to MIs included the doubling of research projects (ITC), greater reliability of research capacity making easier to acquire research funds from public institutions (HUST), and contributions to university achievements (such as the number of times papers were cited) (five universities). Students participated in almost all collaborative research and such research provided themes to master's degree and PhD students for their papers and academic presentations, thus supporting degree attainment. As such, there was a clear impact on the development of human resources.

In industry-university linkage, there was a case in which joint research and networks between MIs and JSUs led to acquaintance with Japanese companies as well as employee training and acceptance of internships, as well as a case at a university in Malaysia (UM) in which CRI led to the launch of a company and the establishment of a spin-off company. Furthermore, UTM utilized its networks with JSUs, started a technical cooperation project titled "Capacity Development for Technical Vocational Education and Training" and further strengthened its research capacity.

(2) Contributions to shaping and strengthening academic networks

The contributions to academic networks in the region that were identified in this study are outlined below. AUN/SEED-Net researchers were involved in forming many networks.

Table 5 Contributions to shaping and strengthening academic networks in respective countries

Name of country	Description
Indonesia	ITS researchers took a central role in establishing the Indonesia Chapter of the Industrial Electronics Society, and AUN/SEED-Net MIs played a core role in setting up the Sustainable Energy and Environment Forum.
Vietnam	Academic staff at the Ho Chi Minh City University of Technology, who were also graduates of AUN/SEED-Net, set up an engineering department for four nearby universities and provided support for improvements to the curriculum.
Myanmar	Since researchers are transferred every three years in Myanmar's system, researchers from the University of Yangon (YU) and Yangon Technological University (YTU) played a central role in organizing the Myanmar Young Researchers Network (MYReN) under the National Association of Principals in 2019 and formed a network of young researchers.
Malaysia	A network in the renewable energy field was formed in 2018 (Malaysian Thermoelectric Society).
Thailand	Members of Kasetsart University (KU) played a key role in establishing the Solid Waste Association of Thailand in 2013, which held dialogues on policy and held seminars. TU also drove efforts to form a collaborative (government-private sector-research institutions) platform for technology development in 2016 by establishing the Thailand Structural Steel Society (TSSS). The Artificial Intelligence Association of Thailand (AIAT) established in 2015 by TU researchers together with other universities is the largest platform in this field.

Source: Results of questionnaires given to MIs and interviews with researchers

Given these factors, the project purpose of establishing a system for the implementation of advanced research and education in a collaboration between MIs and JSUs was achieved at the end of the Phase 3 period in accordance with the indicators of development of international graduate programs and joint international graduate programs. In terms of the overall goal, collaborative research for industry-university linkage and for solving common regional issues, and MIs producing recipients of high degrees (graduate school level) for the private sector achieved favorable results. Furthermore, other impacts such as contributions to MIs and fostering academic networks by MIs were well recognized. As such, the effectiveness and impact of the project were high.

3.3 Efficiency (Rating: ③)

3.3.1 Input

Table 6 Input Chart

	Plan	Actual
Cooperation period	March 2013 – March 2018	March 2013 – March 2018
Input on the Japan side		
Cooperation amount	3,950 million yen	3,860 million yen
Dispatch of experts	4 long-term experts 1 short-term expert For research guidance, etc.	4 long-term experts 1 short-term expert 439
Recipients of short-term training in Japan	Not specified	156
Inputs from Thailand	Allocation of a budget for the costs of Secretariat staff	Allocation of a budget for the costs of Assistant Executive Director and two secretaries
Inputs from MI	Tuition waivers, dormitory fee waivers, compensation for living costs and transportation costs, etc.	Tuition waivers, dormitory fee waivers, compensation for living costs and transportation costs, etc. equivalent to 304.4 million yen (2014-16)
External funding	Not specified	63,459 US dollars (contributions from private companies for collaborative research)

Source: Data from preliminary evaluation, Phase 3 Terminal Evaluation Report, and AUN/SEED-Net Secretariat

3.3.1.1 Elements of Inputs

In terms of project costs, accurate planned costs and actual costs for each project component cannot be fully contrasted, but the cost items such as funding for the dispatch of experts and scholarships were provided principally in line with the initial plan, and the costs for training in Japan and in third countries were kept below the initial plan.

In terms of the costs incurred by MIs for the program to acquire higher degrees, the project covered living costs, medical insurance, book costs and travel costs, and AUN-SEED-Net Secretariat office and host universities reached an agreement whereby the host university would waive or reduce university entrance fees and tuition. Some host universities took steps such as supporting local language learning and reducing or waiving dormitory fees.

In terms of the validity of input amount, a comparison with the scholarship program for foreign students funded by the Japanese government, which is a similar study abroad program, shows that the Japanese government paid the living costs of a foreign student in a Master's program amounting to 144,000-147,000 yen per month (fiscal 2021).[13] AUN/SEED-Net's scholarship program, although there are differences in living costs between Japan and Southeast Asia, paid only 500 US dollars per month partly because of the support from host universities such as tuition waivers and reductions, which means that cost effectiveness of the scholarship program was high.

[13] https://www.jasso.go.jp/sp/ryugaku/tantosha/study_j/scholarship/kokuhi/kyuyo.html (Accessed on July 26, 2021)

3.3.1.2 Project Cost

Project costs were expected to be 3.95 billion yen, but came out to 3.86 billion yen, which is 97.7% of the estimated project cost.

3.3.1.3 Project Period

The project period was five years (March 2013 – March 2018) as planned.

Given this, the project's costs and project period were in line with plan; therefore, efficiency of the project is high.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and Political Commitment for the Sustainability of Project Effects

In Phase 3, the pillars of the project were the scholarship program, joint research programs for industry-university linkage and tackling common regional issues, the publication of AEJ and the organizing regional conferences. In Phase 4, the scholarship program and joint research programs have been integrated into the Collaborative Education Program (CEP) in partnership with companies. As the project was formed as a regional cooperation project, policy and political commitment of the ASEAN, the respective Governments and MIs are critically important to ensure the project sustainability.

As noted in 3.1.1, AUN's policy is to strengthen regional networks. Higher education institutions in the respective countries also highly evaluate the project's role in strengthening networks with ASEAN and Japanese higher education institutions and promoting globalization. Strengthening education and research through inter-university networks is a crucial policy for ASEAN and AUN, so expectations for this project are high. In 2020, ASEAN adopted *Declaration on human resources development for the changing world of works and its roadmap*, which promotes measures to foster human resource development including graduates of higher education. Therefore, the project's objective of fostering advance industrial human resources is clearly in line with ASEAN's policy. In terms of MI needs, MIs in CLM point out the importance of contributions to improving the quality of education and research through collaborative research and the scholarship program within the region. The founding ASEAN countries and Vietnam have high expectations for the reinforcement of networks with Japanese companies and Japanese universities, and reflecting these expectations, the need for support for the publication of AEJ and the holding of regional conferences is high. As shown in Appendix 2, the industrial organizations and the private sector in the member countries express the strong need for technology development useful for their businesses through cooperation with universities. As a result, sustainability is high in terms of the policy or needs of related institutions.

3.4.2 Institutional/Organizational Aspects for the Sustainability of Project Effects

In sustaining the networks formed in this project, it is important that (1) cooperation agreements such as MOU and MOA, which are the premise for universities to systematically carry out activities with other universities, are signed between members, including JSUs, and that (2) alumni organizations for the project's scholarship recipients and researchers are formed in this project.

As regards (1), various cooperation agreements have been signed at the university level and engineering department level, including JSUs, with 158 agreements between MIs and 70 between MIs and JSUs. All the MIs have developed such relationships with other MIs in some form or other. This indicates that the foundation for networks among this project's members has been sufficiently built up. Moreover, in Phase 4, multiple universities and companies formed six consortiums and provided support. The formation of a platform for cooperation with higher sustainability also indicates that sustainability is high.

As regards (2), concerning alumni organizations, the Alumni Support Program (ASP) was started in 2018 on the recommendations made in the ex-post evaluations for Phases 1 and 2 and the Phase 3 Terminal Evaluation Report, and support for alumni organizations' activities was provided on a full scale. Up until this point, of the six CLMV universities sending out large numbers of students to other member universities, alumni organizations were officially established at four universities, with 28 members at HUST, 116 at ITC and 37 at HCMUT[14] when the organizations were established. In addition, these alumni organizations held seminars, hosted meetings specific to the fields, encouraged the sending of their students to Japanese universities, gave advice to Japanese companies and formed cooperative relationships. Since a wide range of members participated in these alumni associations, such as researchers from universities, companies and government organizations who had participated in collaborative research and regional conferences, as well as the lecturers and researchers who had received scholarships. They are expected to become networks for academic collaboration and joint research going forward. There are also moves to set up alumni associations at host universities, not only the universities sending out students. In 2019, an alumni organization was formed at Universiti Teknologi Malaysia (UTM) as well. Plans to form an alumni association were also made at UGM and ITS. As such, efforts to strengthen networks by systematically forming alumni associations began from the end of Phase 3. However, such initiatives were implemented as activities for phase 4, so establishing a financial foundation for the association through donations or the collection of membership fees will be an issue going forward.

[14] There are 51 members as of October 2021.

In addition, more of those students who earned degrees in this program and who earned degrees in phases 1 and 2 and then became lecturers and researchers at their home universities have taken on leadership roles, such as heads of departments. They will be an important human resource in sustaining the systems and organizations for networks formed in this project.

The secretariat office, the management unit for the operation of AUN/SEED-Net, can be sustained, judged by the facts that the scholarship program that was the largest project component would be significantly scaled down after the end of Phase 4, CU express willingness to help maintain the secretariat office and MIs also show their willingness to support the operation of the secretariat office in such forms as the dispatch of their staff and the transfer of a part of its functions to their universities.

3.4.3 Technical Aspects for the Sustainability of Project Effects

This project's key programs are support for the scholarship program, collaborative research, regional conferences, and the publication of the academic journal. Of these, a system for the scholarship program (such as guidelines) has already been established, and the Secretariat office staff have built up expertise in its administration (e.g., recruitment, selection, acceptance). When financial support is available, management is possible after Phase 4. Host universities also have built up experience in providing support for students, which is particularly important in administering the scholarship program, and there are no particular technical issues.

In regards to collaborative research, the founding ASEAN countries and Vietnam can secure research funds with competitive research funds from the government aimed at promoting science and technology, and although the number differs by university, there have been many collaborative research opportunities with local companies. In regards to CLM members, collaborative research is still limited. They need to pursue opportunities for collaborative research utilizing the networks developed with other MIs in founding ASEAN countries.

In regards to collaborative research with Japanese companies, they often have their research functions in Japan, so there is a risk that without ties to JSUs, collaborative research with Japanese companies may be very difficult to be continued. The key issue here is how to provide opportunities for matchmaking and how to continue functions such as intermediation with Japanese companies.

MIs can already gain experiences in holding regional conferences in the ten fields and running them independently. In regards to the publication of AEJ, an online system for applying, screening and peer reviews for the publication of AEJ was set up, and inclusion in the Scopus index meant that a stable number of submissions can be expected, making the sustainability extremely high.

3.4.4 Financial Aspect for the Sustainability of Project Effects

At present, Phase 4 is being implemented, of the program components—collaborative research, the scholarship program, regional conferences, and AEJ publication—the collaborative research and the scholarship program have been consolidated for implementation as the Collaborative Education Program (CEP). In addition, the Alumni Support Program (ASP) is being implemented to strengthen the network of alumni associations, and regional conferences and AEJ are continuing.

In Phase 4, ongoing support is being given to students supported in Phase 3, but the scholarship program was largely scaled down and at present, the project is shifting to CEP, which promotes collaborative degree programs, collaborative research, and industry-university linkage (training and research at companies) through a consortium in which several universities (not limited to MIs) and companies participate. At present, six consortiums have been formed. There are about 10 students in each consortium, so the inputs are on a small scale and there are few scholarship recipients. For this reason, compared to Phase 3, the number of targets is also less than 1/10, and given that tuition waivers and company support is available at each of the universities, this can be continued after the end of Phase 4 if small-scale financial support is available. As mentioned earlier, it would be difficult for the MIs in CLM to maintain the current level of joint research as public research fund is limited in these countries. Therefore, it is desirable to involve these universities at a time when a new consortium is formed by other MIs so that the researchers from these universities can participate in joint research.

The motivation of MIs for AEJ and regional conferences is extremely high, and in response to a question about intentions to continue with this project's programs, 12 universities responded that they definitely wanted to continue AEJ and nine that they wanted to continue regional conferences after the end of Phase 4. Of these, five and three universities, respectively stated that they wanted to continue these programs even if the university provided funding for them. AEJ has already been included in the Scopus index, which makes it relatively easy to secure financial resources by subscription and paper submission fees. The scale of regional conferences needs to be addressed and costs reduced, yet it is possible to continue the program.

There are strong calls from MIs in CLM for the scholarship program to continue, but many respondents to a questionnaire stated that it was difficult for MIs in founding ASEAN countries to provide a budget for scholarships (since a request has to be formally submitted to university authorities for approval, and the fiscal burden will be substantial). Given this, if the scholarship program is to continue within the region, collaboration with other scholarship programs of MIs' higher education institutions would be most feasible. The schemes that we were able to identify in this study are as follows.

Table 7 Scholarship programs provided by governments of founding ASEAN countries

Country name	Overview
Thailand	The Thai International Cooperation Association (TICA) provides scholarships on a small scale to foreign students from Laos and Cambodia. There are at least nine schemes to support Thai students pursuing higher academic degrees both in Thailand and overseas. There have been 1,143 PhD candidates and 412 master's degree candidates, with the US and UK accounting for 70% of students and Japan for 4.7%. The Thai Government also offers scholarships under the Project for the Promotion of Science and Mathematics (PSMT), a program for university lecturers and researchers and others wanting to work in the science and technology field in the public sector in the future. The scheme only covers the science field, so it can be used to strengthen ties between universities in Thailand and Japan.
Malaysia	Through the Malaysia International Scholarship (MIS) program, students from CLMV are accepted at 20 public universities, and acceptance to the PhD course makes it possible to collaborate with four universities that are members of AUN/SEED-Net.
Indonesia	Indonesian Government provides a scholarship program for CLMV, and scholarship recipients can attend UGM (GNB scholarship). The Ministry of Finance has a LPDP Scholarship, and the Ministry of Education has the BUDI Scholarship for Indonesian students, and these programs can be used for students seeking higher degrees in Indonesia, other ASEAN countries and Japan.
Vietnam	In the cooperation program between the Vietnamese government and the Laotian and Cambodian governments, there are scholarship programs that send students from both countries to graduate school in Vietnam. HUST and HCMUT are already receiving students.

Source: Results of questionnaire and interview surveys conducted to higher education institutions

MIs are already waiving entrance fees and tuition related to the acceptance of the scholarship recipients under the project, providing accommodations such as dormitories, and covering part of transportation costs, among other measures, and they responded that similar measures could be taken after the end of Phase 4 as well if the scholarship program continues. Twelve universities also answered that they would proactively consider taking responsibility for some of the cost of the dispatch of their faculty staff to the AUN/SEED-Net secretariat office. Official request must be submitted to MIs for their consideration if such financial support is necessary.

Given these points, the results of Phase 3, can be adequately sustained in Phase 4 while shifting to a new program that meets the needs of MIs.

The ex-post evaluation for the project's Phases 1 and 2 recommended strengthening the alumni associations, reinforcing support for the academic journal, supporting cooperative research, and considering strategies for the period following the project's completion. These recommendations are included as project components and activities in Phase 4, and these project initiatives are making significant contributions to improved sustainability.

No major problems have been observed in the policy background and the institutional/organizational, technical, financial aspects. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aims to form higher education networks specializing in engineering in the 10 countries making up ASEAN and reinforce the educational and research capacities of engineering universities in the region. Phase 3 was implemented following a preparatory phase and phases 1 and 2. Strengthening the networks in higher education is a shared need for ASEAN and MIs, making this project highly relevant. In Phase 3, universities and companies carried out collaborative research, and researchers at MIs engaged in collaborative research on a broad range of themes, such as natural disaster and the environment. As such, researchers at MIs gained a wealth of experience with industry-university linkage and collaborative research on common regional issues. In the scholarship program, the percentage of students earning PhD, which gives them a high likelihood of becoming lecturers and researchers, was high compared to Phases 1 and 2, demonstrating the program's effectiveness in raising university academic staff. In addition, AEJ, a publication started by AUN/SEED-Net, was indexed by the Thai Citation Index and ASEAN Citation Index, which increased contributions from researchers other than alumni members of AUN/SEED-Net's scholarship program and raised its status as an academic journal. In addition, regional conferences in ten engineering fields supported by the project were effective forums not only for the presentation of research results, but also for considering collaborative research and joint education programs. As a result, this program's returned students and researchers at the MIs engaged in collaborative research took the central role in starting courses for international graduate school programs during Phase 3, and the number of joint education programs between MIs, such as double degree programs, exchange student programs, exchange programs for instructors, short-term study abroad and research programs, increased and were highly effective.

In this ex-post evaluation, we examined whether the 114 collaborative research programs carried out had had an impact and it was confirmed that at least 29 social impacts such as joint patents and concrete contributions to the private sector and government due to technology transfer and other. In regards to industrial human resource development, in 2018 at least 1,275 Master's degree recipients and 174 PhD recipients from MIs found employment with companies, showing that the project also had an impact in producing advanced human capital for industry. These points indicate that the project had satisfactory effectiveness and impact.

The dispatch of experts, project duration and cooperation amount were in line with the plan. Thailand, where the project's secretariat office is located, took on responsibility for appointing an assistant executive director and secretaries and the running costs for the office. MIs also took

steps such as giving exemptions or reducing tuition for the study abroad programs, as initially planned. Given these points, efficiency was high.

The member countries' government institutions and MIs have strong expectations that collaborative research and scholarship programs within the region will raise the quality of education and research and strengthen networks with Japanese companies and Japanese universities. Continuity in the policy aspect is high.

In the institutional aspect, almost all MIs have established MOU/MOA with other member universities. Of the six universities in CLMV, alumni organizations have been formally established at four universities. As such, the foundation for networks among MIs has been built.

In the technical aspect, the publication of AEJ and regional conferences are important, AEJ has extremely high sustainability since its inclusion in the Scopus index in 2019 means that stable contributions can be expected. MIs have built up experience in holding field-specific regional conferences and are already able to run them on their own. They have also gained good experience in conducting joint research with industry through CRI.

In the financial aspect, collaborative research continues as a consortium, including the private sector, a system for running the alumni associations has been set up, and regional conferences and AEJ also continue. On the budget side, the scholarship programs, which account for a high percentage of the budget, are over, and activities with a narrower input scale are now possible. In addition, MIs are very motivated to continue regional conferences and AEJ, including the budget input, so it will be possible to continue these programs on a smaller scale for the conferences. There is also a possibility that MIs would continuously support the functions of the secretariat office. Given these points, it is judged that sustainability is high.

In light of the above, the project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the AUN/SEED-Net Secretariat office and MIs

Securing financial resources to expand and continue alumni organizations

Alumni organization activities were strengthened significantly in Phase 4, but since they were only recently formed. In order to ensure the organization's sustainability, we recommend that the merits for members are maintained by offering appealing services, while also strengthening the organizations of the respective associations so that financial resources can be stably secured by collecting membership fees and donations.

To support such actions, it is recommendable that the secretariat office would collect and distribute useful information from JSUs and other alumni organizations' activities. Also, there are increasing number of graduates of the project's scholarship program at home universities who have taken on leadership roles such as heads of departments. Therefore, it is effective for the secretariat office to encourage these people to play an active role in alumni activities.

Implementation of survey on graduates' career path and evaluation of graduates by companies

In this evaluation study, information on the career path of graduates from MIs was collected. Compared to Phases 1 and 2, more universities carried out career path surveys and the number of graduates whose path could be ascertained increased. The survey's accuracy also improved. However, only about half of the universities are actively surveying career paths. Since career path surveys are important information for career education for students and universities' PR, we recommend that universities systematically carry out surveys (if it is difficult for universities to do this, the engineering department could fill this role). For example, Japanese universities compile and publish career-related information with great accuracy, so this could be a resource for learning their experiences. Moreover, some MIs such as ITB have instituted carry out career path surveys in the university, so it would be effective for the secretariat office to share such experiences to the MIs eager to improve their survey method.

In terms of generating human resources with a high level of education in the advanced engineering field, it is also important to learn how companies evaluate MI graduates, but according to responses to questionnaires, no MIs are currently doing so. Given this, we recommend that MIs collect information from the companies that employ large number of graduates and introduce mechanisms to reflect findings in the education programs. Also, it is important to proactively create opportunities for communication with companies, such as holding events for the exchange of views between MIs and industry organizations, industrial estates, and Japanese business organizations in respective countries. University job fairs can be also a good opportunity to hear opinions. It is recommended that the secretariat office actively help create such opportunities for communication between MIs and companies.

CLM support through active use of founding ASEAN countries' scholarship programs for foreign students

As noted in 3.4.1, MIs in CLM still need more teaching staff to acquired high degrees. As a means of meeting this need, we recommend that scholarship programs for CLM provided by government institutions in founding ASEAN countries be actively used, as described in Table 7 in 3.4.4. During the Phase 4 period, CLM and founding ASEAN MIs and the secretariat office should promote the collaboration with the organizations running the scholarship programs. In addition, JICA began the Innovative Asia program in 2017 and the Innovative Human Resources Development Program in Science and Technology in 2020, provides opportunities for students to enter master's degree and PhD programs in fields in which innovation can be expected, such as the engineering field. Since all MIs in CLM are eligible, we recommend that the active use of these programs be considered. Furthermore, ASEAN is preparing a proposal to develop an intra-ASEAN scholarship program that would be participated in by higher education institutions and

universities in the region. Therefore, there is a possibility that AUN/SEED-Net's scholarship program could align with this program, and it is recommended that AUN/SEED-Net secretariat office and MIs discuss possible cooperation with ASEAN.

4.2.2 Recommendations to JICA

Follow-up support from Phase 4

If the project is ended in Phase 4, MIs have very clear expectations from JICA for cooperation to sustain the project's effects. They want to receive information on matching with Japanese companies and networking with Japanese universities, and also advice and suggestions concerning best practices and models of collaborative research. In regards to support from Phase 4, we recommend considering effective cooperation in light of these strong needs.

4.3 Lessons Learned

Measures to increase effectiveness of a scholarship program

One reason that this project successfully had a major effect is that the project components functioned well together in a mutually complementary way. Specifically, collaborative research programs that lecturers and researchers who had acquired higher degrees in the scholarship program could apply for with their supervisors and fellow students from the university from which they had graduated were offered. Then, regional conferences at which the results of this research could be presented were held periodically, in addition to the publication of an academic journal. This increased the sustainability of researchers' networks, and the utilization of the networks to set up joint education programs between universities succeeded in forming systematic networks. Forming platforms that can maintain relationships between researchers is effective in achieving multi-faceted effects. This kind of framework can be a reference when considering designs for other projects with scholarship component and mechanisms for ensuring the project's sustainability.

This project's scholarship program also helped strengthen industry-university linkage by providing research funding for former students who have returned and implemented joint research with Japanese and/or local companies. In addition, the convening of technical management courses, the holding of seminars on industry-university linkage, and the dispatch of advisory teams to encourage industry-university linkage were all effective in supporting a wide range of industry-academia ties in this project. These initiatives are also useful references.

Appendix 1: Main policies on higher education institutions in key member countries and views on AUN/SEED-Net

Country	Relevant policies	Views on AUN/SEED-Net (respondents)
Laos	Raising engineering staff who can support industrial development is an important policy in the National Plan 2020-2030 for higher education in engineering. In Laos, the Law on Higher Education has gone into effect and teachers and researchers have been given clear roles in providing services to companies and society, so industry-university linkage and responses to regional issues are called for.	This project has made very significant contributions to the development of higher education in the engineering field. When Phase 1 began, the National University of Laos' engineering department had only six PhD holders and five courses in its bachelor's degree program, but at present, its bachelor's degree program has 16 courses, the master's degree program was expanded to nine courses, and there are 56 PhD holders, almost all of whom are AUN/SEED-Net graduates. AUN/SEED-Net is highly praised by those involved in Laos' higher education (Director General, Department of Higher Education, Ministry of Education and Sport).
Cambodia	The Policy on Higher Education Vision 2030 lays out goals to provide high quality higher education, develop curriculum for the training of personnel needed for national development and markets, and strengthen governance. Providing scholarships and expanding STEM are designated as strategies to achieve these goals. Cambodian Higher Education Roadmap 2030 and Beyond lays out a strategy to achieve this vision, and discusses raising the quality of STEM teachers, augmenting education and research facilities at priority universities, and increasing investment in research and innovation. The Education Strategic Plan (2019-2023) and its Reform Strategies lays out the goal of increasing the percentage of students in STEM fields from 27.1% in 2018 to 32% in 2023 by setting up three centers of excellence in science fields and developing curriculum that meets industry's needs.	ITC is Cambodia's most important higher education institution in the engineering field, and it is extremely important that ITC's level be raised through networks with top universities in the region and cooperative relationships with Japanese universities (Deputy Director General of Higher Education, Ministry of Education, Youth and Sport).
Myanmar	The National Education Strategic Plan (2016-2021) consists of nine pillars, and in higher education, the plan aims for access to higher education that meets international standards and contributions to employment and national development. (The current military Government has changed the administrative structure of ministries. The strategic plan is likely revised accordingly.)	The project made major contributions to the development of higher education in Myanmar and the strengthening of research capacity (Director General, Department of Higher Education, Ministry of Education – the responsible agency of higher education at the time of the evaluation study)

Vietnam	The Socio-Economic Development Strategy 2021-2025 discusses strengthening international competitiveness and prioritizes enhancing the level of education and training, including at ICT, and improving science and technology to achieve this. Vietnam has carried out initiatives to reform the quality of higher education since 2019 with ministerial decrees to reform the curriculum at higher education institutions and a ministerial decree on the university certification system.	The project is helping to raise the quality of the two universities (Deputy Head of International Education Division, International Cooperation Department, Ministry of Education and Training).
Indonesia	In Indonesia, cooperation between industry and academia as well as the development of personnel for advanced industry are highly valued, and to achieve this, the Higher Education for Technology and Education (HETI Project 2021-2025), Science and Technology Research Funding Program SBSN 2020 – (multiple years), APBN funding and Kampus Merdeka (emancipated learning program) are implemented.	Through this project, the number of students at Indonesia's MIs who earned PhDs by studying abroad in Japan increased, and there was also progress in accepting foreign students from other ASEAN countries. In particular, by participating in education and research at international standards, the start of graduate programs in English was beneficial for Indonesia (Director of Resources, Directorate General of Higher Education, Ministry of Education and Culture).
Thailand	The 20-Year National Strategy (2018-2037) is a strategy to propel the country from developing to developed status. One of the seven pillars of this strategy is human resource development. The Higher Education, Science, Research and Innovation Policy and Strategy (2020-2070) has four pillars, and research and innovation to solve social issues and raising the international competitiveness of research are related to this project.	This project contributed to the development of personnel in the engineering field in Thailand and other ASEAN countries, and even in Phase 4, the project is contributing to the Thai government's policies (listed to the left), particularly in strengthening ties between industry and academia (Director, Bureau of International Cooperation Strategy, Ministry of Higher Education, Science, Research and Innovation).
Philippines	Centers of Excellence and Centers of Development are strategies aligned with the goal of international research and national construction in the Higher Education Act 1994 and are intended to raise the quality of international research activities and education and increase universities with networks with overseas entities.	There have been reports from UP, DLSU and MSU-IIT, which are MIs, that this project has been effective as a platform for expanding and strengthening collaborative research. The project is expected to strengthen open networks through which AUN/SEED-Net supports engineering networks in individual countries going forward (International Affairs Division, Commission on Higher Education).

Malaysia	Of the 10 pillars in the *Malaysia Education Blueprint 2015-2025* (Higher Education MEB [HE]), international competitiveness and talent development are listed.	The project contributes to the ASEAN Engineering Journal, industry support with research, and revitalizing research and education in the region (Director, Education Malaysia Division, Department of Higher Education, Ministry of Higher Education).

Appendix 2: Needs for industry-academia collaboration in industry

Country	Name of responding organization, company	Needs
Laos	Two electric power companies, a sugar refining company, and four major telecommunications companies	These companies want practical training of engineers (joint degree programs with the Chamber of Commerce and Industry and others, revisions to joint curriculum, etc.), research that helps small- and medium-sized companies, which account for the vast majority of the private sector, and the establishment of a contact point for industry-university linkage at universities.
Cambodia	Waste disposal company, elevator manufacturing company, machine control company, startup support company (four companies)	All four companies are managed by graduates of ITC and AUN/SEED-Net. Their main concern is the generation of talented employees, and up until this point, their cooperation has consisted of taking on interns and providing backup support for student projects, among other. They are also interested in companies providing scholarships since this could be adopted if there was a guarantee that the students would take a job with the company. However, only large companies need staff at the graduate school level. Students are very interested in startups, so this is an area that support can be expected from in the future.
Vietnam	Association of Young Vietnamese Managers	Universities have the technology, so the Association would like them to take a more strategic approach to the ways in which they spread technology to private sector companies. The Association would like personnel for industry who have soft skills and a strong interest in addressing the changing business environment (statement at a British Council seminar, March 21, 2021).
	Vietnam's Chamber of Commerce and Industry	Universities need to create technology that is more practical and that can potentially lead to business. At the same time, the government should work to create a platform for technology transfer linking companies and universities, and at this point, universities contribute only a small amount to companies' innovation. According to a 2016-2019 survey by the Ho Chi Minh National Academy of Politics, only 5-10% of research was utilized in business. Research needs to be more proactive about commercialization (statement on August 18, 2019).
	Japanese company	The main purpose of affiliations with universities is to train young personnel and strengthen relationships with related organizations in Vietnam.

Indonesia	Mineral resources company	University technology is extremely important in the mineral resource field, and we have signed MOU and requested joint research and advisor roles. We did not know about the AUN/SEED-Net scholarship program, but we are interested and want this to be promoted to companies.
	Major public construction corporation	The infrastructure repair and reinforcement materials of Japanese companies are expensive and can't be used, so there is a need for localized products that are competitive in Indonesia. Companies have graduates of Japanese universities, and these graduates have Japanese friends from university working on this kind of product development, so the networks are in place. MIs can make use of these ties with Japanese universities.
	Semiconductor manufacturing company	There are many research needs, and we are cooperating with ITB. As a company, we have study abroad programs to overseas universities and ITB. Although they are currently suspended due to COVID-19, we have full scholarships. When conditions improve, we could collaborate with AUN/SEED-Net on scholarships and other aspects.
	Publicly-managed mining company	We are very familiar with AUN. They are an important partner in our research. We have not considered scholarships until now, but it is a good idea, and we would like someone to come to headquarters to explain it officially.
Thailand	Federation of Thai Industries (FTI)	According to a survey of member companies, collaborative research is seen as one option for technology development. The difficulty is that large companies want to conduct research without sharing information openly, but small- and medium-sized companies want technology cooperation with universities but lack the funds and engineers necessary for this. This means that matching is important. One method is to actively use the science parks established by the government (providing one-stop services for industry-university linkage), and another possibility is to apply for the funding for industry-university linkage that FTI provides to small- and medium-sized companies. In addition, 60% of the research funds for the National Research Council of Thailand (NRCT), the government's organization for providing research funds, are provided to applied research, and support for small- and medium-sized companies is not sufficient, but it could be used on a project basis. Applications for these funds could be encouraged for environmental and cyclical-type technology.
Philippines	Philippines' Chamber of Commerce and Industry	Universities are expected to meet needs such as a university curriculum that fits the knowledge and skills that companies require, a good understanding of business, training and interns by universities and companies, and joint research. The Chamber of Commerce and Industry has a sub-committee for each field, such as higher education and vocational training, and provides this kind of cooperation. In addition, we have a cooperative relationship with the Japanese Chamber of Commerce and Industry in the Philippines through the Philippines-Japan Business Council, and cooperation is possible, including with Japanese companies.

Malaysia	White paper on Malaysia's participation in international standards technology in energy sector (March 2019)	The results of interviews with companies showed that the need for industry staff in the energy field is not for specific skills and technology, but to raise the comprehensive capacity of staff. It is also important to improve curriculum content so that it meets international standards.
	Clair Report No.471 Progress of Malaysia's economic industry policy to aim at being a developed country by 2020 (2018, August)	The utilization of employees with practical skills, high-quality employees who meet international standards, and employees who have received an education overseas; labor productivity has grown 2.3% a year (2011-2015), and the educational programs were improved to raise it to 3.7% in 2016-2020 (4.1% in the service industry, 3.0% in the manufacturing industry).