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Developing Technology Center of Excellence (CoE), Center of Heavy Equipment to Prepare Competent Heavy Equipment Mechanics and Operators

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Abstract

The low demand for vocational education graduates has led to high unemployment. The low demand for vocational education graduates has led to high unemployment. Vocational college graduates still need to be commensurate with industrial needs. Many Senior High School, Vocational High School, and Vocational College graduates have not been able to find a job for more than six months. Conditions on Madura island worsened this, and the lack of accelerated industrialization even after the Suramadu Bridge was built. Madura has the lowest Human Development Index (HDI) score in East Java. Data from the Central Bureau of Statistics (BPS) Sampang in Figures 2021) shows that the HDI value in 2020 only increased by 0.76 from 2019 of 62.70. Politeknik Negeri Madura (Poltera) together with PT. United Tractors and LSP ABI want to take an active role in improving Madura's HDI by preparing human resources on heavy equipment mechanics through the development of a centre of excellence for technology (PUT) of Heavy Equipment (CHE). Using the causal-comparative method, the researcher observed the impact of each stage on PUT-CHE development activities and reviewed the data to find causal factors and correlations. Poltera took a strategic step by equipping lecturers with virtual training on heavy equipment mechanics (SOBAT Program), organized by PT United Tractors. The SOBAT program has positively impacted heavy equipment engineering graduates in 2022, which has increased significantly. Academic data showed that 13 out of 34 heavy equipment mechanical engineering graduates were employed in leading heavy equipment industries before three months. Other data stated that three lecturers participating in Virtual Training on heavy equipment mechanics were selected as 50 interns at PT United Tractors.

***Keywords**: Uptake of Vocational graduates, IPM Madura, PUT-CHE, Competent Human Resources*

Abstrak

Rendahnya serapan lulusan pendidikan vokasi menyebabkan tingginya angka pengangguran. Lulusan Perguruan Tinggi Vokasi (PTV) belum sepadan dengan kebutuhan industri. Banyak lulusan SMA, SMK, dan PTV belum memperoleh pekerjaan hingga lebih dari 6 bulan. Kondisi di pulau Madura, percepatan industrialisasi pasca suramadu belum terwujud dan Indeks Pembangunan Manusia (IPM) terendah di Jawa Timur. Data BPS (Sampang dalam Angka 2021), IPM tahun 2020 hanya naik sebesar 0,76 dari tahun 2019 sebesar 62,70. Politeknik Negeri Madura (Poltera) bersama PT. United Tractors dan LSP Alat Berat Indonesia ingin berperan aktif meningkatkan IPM Madura dengan penyiapan SDM bidang mekanik alat berat melalui pengembangan pusat keunggulan teknologi (PUT) *Center of Heavy Equipment* (CHE). Dengan metode kausal-komparatif, peneliti mengamati konsekuensi tahapan kegiatan pengembangan PUT-CHE dan melihat ulang data untuk menemukan faktor penyebab dan hubungannya. Langkah strategis Poltera membekali dosen dalam *virtual training* bidang mekanik alat berat yang diselenggarakan PT. United Tractors dalam program SOBAT berdampak positif bagi lulusan teknik mesin alat berat tahun 2022 yang meningkat signifikan. Data akademik, 13 dari 34 lulusan prodi teknik mesin alat berat bekerja di industri alat berat terkemuka sebelum 3 bulan. Data lain menyebutkan 3 dosen peserta *Virtual Training* bidang mekanik alat berat lolos 50 peserta magang di PT. United Tractors.
Kata kunci: Serapan lulusan Vokasi, IPM Madura, PUT-CHE, SDM Kompeten

1. Introduction

Indonesia's geographical condition (as a country with many natural resources) impacts the number of industries in the mining sector, be it oil, gas and other minerals [1],[2]. Infrastructure preparation cannot be separated from construction services, especially for land clearing and construction of roads connecting economic routes in various regions. The realization of construction services will encourage the use of heavy equipment, which in turn has the consequence of preparing human resources under their expertise. Data from Indoanalisis shows that the market share of heavy equipment by industrial sector 2000-2016 shows: the mining sector 20%, construction 50%, plantation 15% and forestry 15% [3].

Indoanalisis data 2019 shows a decline in heavy equipment production until the end of 2015 and the resulting weakening of the mining sector and declining demand. This occurred because the mining sector, as the main market for the heavy equipment industry, was sluggish due to weak coal prices in the global market. However, starting in 2017, heavy equipment production increased by 38% compared to 2016. The increase in production was due to improved business growth in the coal sector and increased demand for heavy equipment. Figure 1 shows the production and growth of heavy equipment production in Indonesia from 2006-2019 [3].

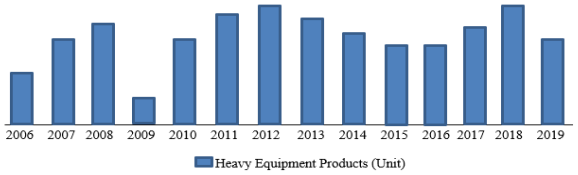

Figure 1. Production and Growth of Heavy Equipment Production in Indonesia, 2006-2019

Contradictory conditions occur on the island of Madura. As part of the East Java province, Madura's industrialization sector's development and acceleration have not occurred significantly. One of the causes is that Madura island's Human Development Index (HDI) ranks the lowest in East Java. Based on Centre Bureau of Statistics (BPS) data (Sampang in Figures 2021), the HDI of Sampang district in 2020 only increased by 0.76 from 2019 of 62.70. Interestingly, the construction services business's GDP increased by 264,371.4 in 2019 compared to 2018 (BPS, 2021), as shown in Figure 2 [4] - [6].

INDUSTRY	2016	2017	2018	2019	2020
(1)	(2)	(3)	(4)	(5)	(6)
CONSTRUCTION	1.462.999,0	1.603.143,6	1.909.204,6	2.173.576,0	

Figure 2. Sampang in numbers, GDP from the construction business sector

Unfortunately, these conditions and situations have yet to be accompanied by the readiness of Human Resources (HR) from vocational higher education. Vocational Education graduates need to be commensurate with industry needs. Vocational Schools and Vocational Colleges (PTV), as a sub-system of national education, should equip students with practical experience and expertise according to their majors to be ready to enter the workforce [7]. However, the National Labor Force Survey (Sakernas) recorded that the "highest unemployment rate" based on education level during 2005-2008 was for high school graduates. The curriculum in SMK and PTV is also different from the needs of the industry, so the industrial sector does not absorb many graduates. In addition, SMK graduates cannot continue their education to a higher level due to financial constraints (economic factors).

Based on the explanation above, Politeknik Negeri Madura, in collaboration with PT. United Tractors, Tbk. and LSP ABI (Heavy Equipment Indonesia) take a role in efforts to increase the Human Development Index (HDI) on the island of Madura. Poltera, PT. United Tractors, Tbk and LSP ABI try to overcome the obstacles of PTV and SMA / SMK graduates in obtaining the skills needed by the industry through education and training for the younger generation to produce mechanics and heavy equipment operators who are reliable, professional and skilled with international standards [3].

To implement PUT-CoHE in the curriculum aspect, UT (as a cooperation partner) implements a curriculum that covers two main aspects: knowledge and skills and attitudes/behaviour. In the aspect of knowledge and skills, the program is implemented to provide students with basic knowledge about periodic service on heavy equipment, basic skills in removing and installing components on heavy equipment, simple troubleshooting skills, and the ability to analyze problems that occur in heavy equipment through the monitor panel located in the operator's cabin. While in the aspect of attitude/behaviour, students are directed to have disciplined behaviour, integrity, motivation, and positive initiatives so that they will find it easier to adjust to the work environment they will face in the future.

To overcome the highest unemployment rate from the vocational education level, which reached 13.55%, strategic steps in the form of active contributions from industrial partners (PT. United Tractors) to the world of vocational education, especially PTV, aim to realize Sustainability Development Goals (SDGs) point 4.4. This strategic step taken by PT United Tractors Tbk is motivated by Government Regulation 45 of 2019, which reads, "companies that organize certain-based HR development can be given a maximum gross income reduction of 200%" (Government Regulation Number 45, 2019). In addition, the heavy equipment field is the Government's focus in the vocational program of the

Ministry of Education, Culture and Research (UT Future, 2021). The Competency Gap between Teachers / Lecturers and the Heavy Equipment Engineering curriculum that has not been linked and matched with the business world and industry (UT Future, 2021) is also one of the reasons why the development of the Center of Technology Excellence (PUT) Center of Heavy Equipment (CoHE) is needed.

2. Research Methods

The development of PUT-CoHE has several activities, such as competency improvement training and competitions in heavy equipment engineering, emphasizing improving human resources quality. Figure 3 is a road map of the PUT-CoHE pilot implementation in collaboration with PT United Tractors, Tbk. and LSP Heavy Equipment Indonesia (ABI).

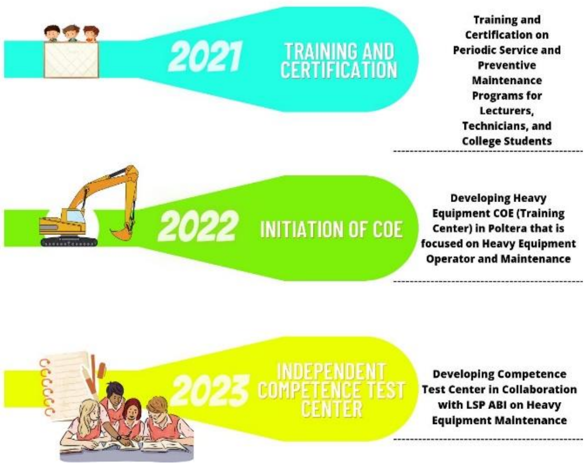

Figure 3. Roadmap for the Development of the PUT Center of Heavy Equipment

For the first eight years, Politeknik Negeri Madura was established, and most core lecturers in TMAB Department experienced limitations in conducting industrial internships. This causes lecturers to need help in providing real case examples of problems in the industry, especially for Case Method and Project Base Learning (PBL) learning methods. This is evidenced by the number of graduating students (heavy equipment mechanical engineering study program of Madura State Polytechnic) who work in the heavy equipment industry is still below 55% in each year of graduation. This condition worsened during the covid 19 pandemic in March 2020. In 2021, the absorption of graduates working in the industry will decrease because students have to carry out lectures online so that learning outcomes are not met.

PUT-CoHE development research began in 2019 by involving five lecturers in Assessor Training. 5 assessors (from the TMAB department) passed and were competent and stipulated in the SK (Assessor appointment) by the Indonesian Heavy Equipment LSP. Furthermore, Poltera was also appointed as a competency test site (CTS), as shown in Figure 4.

ABI

SURAT KEPUTUSAN KETUA
LEMBAGA SERTIFIKASI PROFESI ALAT BERAT INDONESIA
NOMOR : 001/SK/ASKOM/LSP ABI/III/2020
TENTANG
PENGANGKATAN ASESOR KOMPETENSI

Menimbang : Perlu adanya surat pengangkatan Asesor Kompetensi.
Mengingat : a. Peraturan Pemerintah Nomor: 10 Tahun 2018, tentang Badan Nasional Sertifikasi Profesi (Lembaran Negara Republik Indonesia Tahun 2018 Nomor: 32);
b. Pedoman BNSP Nomor: 10/BNSP.303/XI/2013 pasal 4.1.1 dan pasal 4.2.1 tentang Tugas dan Fungsi Asesor Kompetensi;
c. Penambahan ruang lingkup skema sertifikasi LSP ABI.
Menetapkan : Surat Keputusan Ketua Lembaga Sertifikasi Profesi Alat Berat

NO	Nama	No Reg. Asesor	No Blanko	Nama Perusahaan	No Sertifikat	Tgl Terbit	Tgl Exp
148	Ridho Haristyo Mukti	MET.000.001839 2020	5352075	PT Bina Pertiwi	93000 2419 0107417 2020	12-Apr-20	12-Apr-23
149	Ali Abrar	MET.000.006564 2017	3440787	Politeknik Negeri Balikpapan	93000 2419 0059292 2017	21-May-21	21-May-24
150	Nurul Huda	MET.000.006607 2020	5833684	Politeknik Negeri Balikpapan	93000 2419 0114954 2020	21-Jan-21	21-Jan-24
151	Slamet Subagiyo	MET.000.006770 2017	3441039	PT United Tractors Semen Gresik	93000 2419 0059542 2017	21-May-21	21-May-24
152	Edi Sugiharto	MET.000.006765 2017	3441034	PT United Tractors Semen Gresik	93000 2419 0059537 2017	21-May-21	21-May-24
153	Akto Andy Kurniawan	MET.000.005659 2021	6399799	PT United Tractors Tbk	93000 2419 0125395 2021	05-Oct-21	05-Oct-24
154	Adwi Mahendra Setiawan	MET.000.005660 2021	6399800	PT United Tractors Tbk	93000 2419 0125396 2021	05-Oct-21	05-Oct-24
155	Zikri Hamdi	MET.000.005661 2021	6399801	PT United Tractors Tbk	93000 2419 0125397 2021	05-Oct-21	05-Oct-24
156	Elvis Indra	MET.000.005662 2021	6399802	PT United Tractors Tbk	93000 2419 0125398 2021	05-Oct-21	05-Oct-24
157	Triana Dwi Setiaji	MET.000.005663 2021	6399803	PT United Tractors Tbk	93000 2419 0125399 2021	05-Oct-21	05-Oct-24
158	Yulianto Dwi Raharjo	MET.000.005664 2021	6399804	PT United Tractors Tbk	93000 2419 0125400 2021	05-Oct-21	05-Oct-24
159	Akhmad Rozai	MET.000.005665 2021	6399805	PT United Tractors Tbk	93000 2419 0125401 2021	05-Oct-21	05-Oct-24
160	Agung Setyo Nugroho	MET.000.005666 2021	6399806	PT United Tractors Tbk	93000 2419 0125402 2021	05-Oct-21	05-Oct-24
161	Wajianto	MET.000.005667 2021	6399807	PT United Tractors Tbk	93000 2419 0125403 2021	05-Oct-21	05-Oct-24
162	Muhammad Daud Muklisina	MET.000.005668 2021	6399808	PT United Tractors Tbk	93000 2419 0125404 2021	05-Oct-21	05-Oct-24
163	Muhammad Zaenuri	MET.000.005670 2021	6399811	PT Cipta Kridatama	93000 2419 0125407 2021	05-Oct-21	05-Oct-24
164	Satriyo Widy Prasetyo	MET.000.005671 2021	6399812	PT United Tractors Tbk	93000 2419 0125408 2021	05-Oct-21	05-Oct-24
165	Rika Nurhayati	MET.000.005672 2021	6399813	PT United Tractors Tbk	93000 2419 0125409 2021	05-Oct-21	05-Oct-24
166	Muhammad Napsir	MET.000.005673 2021	6399814	PT Cipta Kridatama	93000 2419 0125410 2021	05-Oct-21	05-Oct-24
167	Heru Novef Rupianto Panjaya	MET.000.005674 2021	6399815	PT United Tractors Tbk	93000 2419 0125411 2021	05-Oct-21	05-Oct-24
168	Muhammad Firda Fata Albana	MET.000.003376 2013	6399816	PT United Tractors Tbk	93000 2419 0125412 2021	05-Oct-21	05-Oct-24
169	Duwi Prasetyawan	MET.000.005675 2021	6399817	PT United Tractors Tbk	93000 2419 0125413 2021	05-Oct-21	05-Oct-24
170	Heri Suprijanto	MET.000.005676 2021	6399818	PT Traktor Nusantara	93000 2419 0125414 2021	05-Oct-21	05-Oct-24
171	Gazali	MET.000.005677 2021	6399819	SMK Harapan Timika	93000 2419 0125415 2021	05-Oct-21	05-Oct-24
172	Wisnu Candra Setiawan	MET.000.005678 2021	6399820	PT Traktor Nusantara	93000 2419 0125416 2021	05-Oct-21	05-Oct-24
174	Amin Jakfar	MET.000.013836 2019	5267741	Politeknik Negeri Madura	93000 2419 0099571 2019	27-Dec-19	27-Dec-22
175	Laily Ulfiyah	MET.000.013837 2019	5267742	Politeknik Negeri Madura	93000 2419 0099572 2019	27-Dec-19	27-Dec-22
176	Misbakhul Fatah	MET.000.013833 2019	5267738	Politeknik Negeri Madura	93000 2419 0099568 2019	27-Dec-19	27-Dec-22
177	Mohammad Anas Fikri	MET.000.013834 2019	5267739	Politeknik Negeri Madura	93000 2419 0099569 2019	27-Dec-19	27-Dec-22
178	Lukman Hadi Wijaya	MET.000.013835 2019	5267740	Politeknik Negeri Madura	93000 2419 0099570 2019	27-Dec-19	27-Dec-22

Figure 4. Decree of Poltera as Assessors by LSP Alat Berat Indonesia

Other development research has been carried out by students in collaboration with TMAB department lecturers since 2021 to support the improvement of learning quality, as shown in Figure 5

Figure 5. Engine Trainer Kit, Fuel Consumption Tester, Rotary Hardfacing Welding

Entering the beginning of 2022 (April-June), midway through the covid 19 pandemic, the TMAB department sent lecturers and technicians to the Virtual Training of heavy equipment mechanics initiated by PT United Tractors, Tbk through the "SOBAT program". "SOBAT Program" is part of UT's CSR program that has been running since 2009. In 2019, UT transformed this program to have a wider impact in increasing the capacity of vocational education in Indonesia to be competitive, resilient, and have more impact on the

surrounding area. As is known, the Heavy Equipment Engineering Department is one of the competencies that the Government focuses on in the machinery sector. "SOBAT Program" has a broader scope and reach, limited to fostered schools and non-fostered vocational education in various regions. The "SOBAT Program" includes, among other things, the standardization of the Heavy Equipment Engineering curriculum that can be used by both fostered and non-fostered schools. The complete stages of the SOBAT program in 2022 are shown in Figure 6 below:

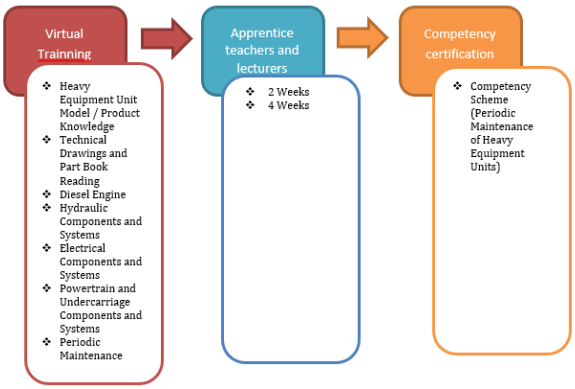

Figure 6. The Stages of Virtual Training Program, Collaboration between SOBAT Teachers and Lecturers 2022 (Source: SRCOM Database PT. United Tractors, Tbk.)

In the first stage, eight members of the research team (lecturers) participated in virtual training in session 1 with material on electrical/electrical components and systems and system controls. Of the total 182 participants, 3 participants passed, and the remaining 179 participants did not pass. This means that there is a 2% pass ratio. The Summary of Virtual Training Results, SOBAT Teacher and Lecturer Collaboration Program, is shown in Figure 7.

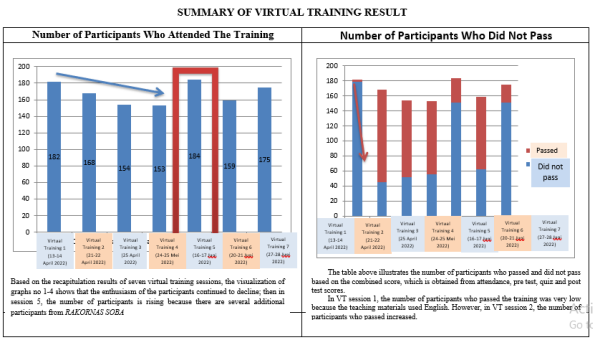

Figure 7. The Summary of Virtual Training Results, The Collaboration Program of SOBAT Teacher and Lecturer (Source: SRCOM Database PT. United Tractors, Tbk.

Virtual Training session 2 discusses the material of Hydraulic Components and Systems. One hundred sixty-eight participants participated in the activity. Of these participants, only 123 passed with a score >70, and 45 participants did not pass, so the pass ratio was 73%. In Virtual Training session three, which discussed Product Knowledge material, there were 154 participants. Furthermore, only 102 participants passed with a score >70, resulting in a pass ratio of 66%. In VT session 4 with Powertrain and undercarriage material, out of 153 participants, 97 passed with a score >70, and 56 did not pass, so the pass ratio was 56%. In VT session 5 with Diesel Engine material, out of 184 participants, 33 passed, and 151 did not pass, so the pass ratio was 18%. In VT session 6 with Technical Drawing and Part Book material, out of 159 participants, 97 participants passed, and 62 did not pass, so the pass ratio was 61%. In VT session 7 with Periodic Maintenance material, out of 175 participants, 24 participants passed, and 151 did not pass, so the pass ratio was only 14%. Several reasons made participants no longer participate in the VT, some of which were concurrent time with teaching schedules, long training duration, and changes in teacher and lecturer assignments during the training, as shown in Figures 8 and 9.

Figure 8. SOBAT Virtual Training Results in terms of Participant Attendance
(Source: SRCOM Database PT. United Tractors, Tbk.)

Figure 9. SOBAT Virtual Training Results, 50 best participants from teachers and lecturers (Source: SRCOM Database of PT. United Tractors, Tbk.)

This development research (PUT-CoHE) is also conducted using the Project Base Learning (PBL) method with the output of the Mini Excavator assembly, shown in Figures 10 to 12

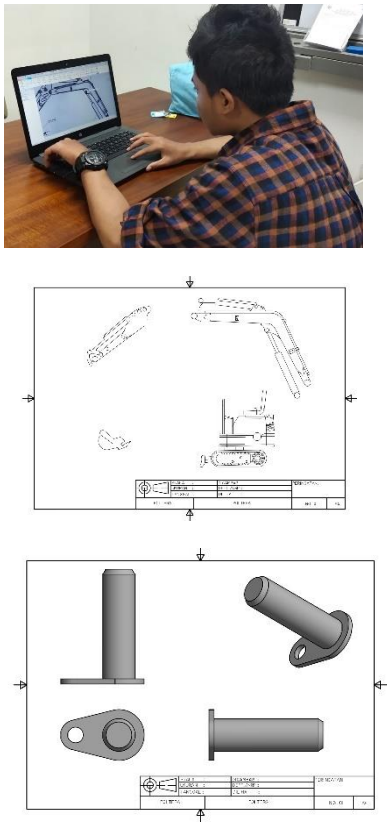

Figure 10. Boomstick and pin design
(Source: PBL Poltera documentation)

Figure 11. Project Base Learning Assembly Mini Excavator

Figure 12. Competency Certification for Mechanics and Heavy Equipment Operators

3. Results and Discussion

One indicator of the results of the Development Research (PUT-CoHE) is shown with a pie chart illustrating the implementation of the causal-comparative method. This questionnaire was submitted to alums who graduated in 2020, 2021, and 2022. The pie chart shows the percentage of linearity in the field of work with the scientific field in alums who have worked and become entrepreneurs.

The results of the questionnaire from the 2020 alums on the linearity of the work field with the previous background study before the PUT-CoHE program was implemented in Poltera can be seen in Figure 6.

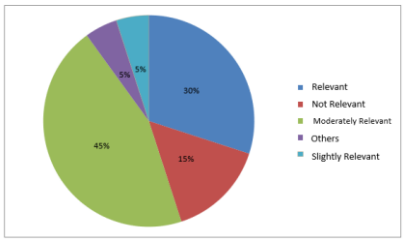

Figure 6. Relevance of the work field with the previous background study
(source:https://docs.google.com/forms/d/e/1FAIpQLSfwVYBYBjADDU2RRUluiDlRgOqAr6zuB1ArSrbPNQZkykTxdQ/viewform?usp=pp_url)

The graph above shows that there is only 30% linearity in the field of alum work with the scientific field, while 45% of respondents think that only part of the scientific field is linear with the current work of alums. The results above show a weakness in the mastery of competencies experienced by students, so they cannot compete for linear jobs in heavy equipment engineering. One of the causes is limited access to improving the quality of human resources (lecturers) through industrial training/internships. The results of the student response questionnaire (2021 graduates) about the linearity of the field of work with the scientific field when PUT CoHE is implemented at Poltera can be seen in Figure 7 below

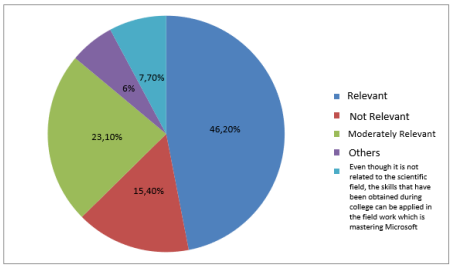

Figure 7. Relevance of the field of work to the scientific field
(source:
https://docs.google.com/forms/d/e/1FAIpQLSfQswTUjfmyuJEiiOu25M9lLE3gUoW4IDBy5JH_LlFSLvEJ_w/viewform?usp=pp_url)

The graph above shows that 13 alumni (46.2%) answered that there is linearity between their field of work and the scientific field of heavy equipment engineering. These results indicate areas for improvement in the student's competency mastery in some core subjects in the heavy equipment engineering study program. However, there is an improvement in graduates' idealism in competing to get a linear field of work. The results of the questionnaire regarding the response of 2022 graduate students regarding the

linearity of the field of work with the scientific field after the focus of PUT CoHE development is implemented in Poltera can be seen in the Pie Chart in Figure 8.

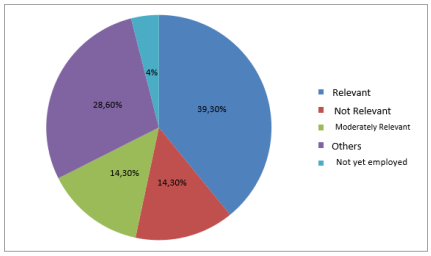

Figure 8. Relationship between the field of work and the scientific field
(Source: https://docs.google.com/forms/d/e/1FAIpQLSem7OEty06CsrOjU5Nym_NXfG69aA6--HAUfPXWExaXtHuxGA/viewform?usp=pp_url)

The graph above shows an increase in the percentage of 39.3% in linearity between the field of work and the scientific field of heavy equipment engineering alums. The above results prove an increase in students' mastery of core competencies in heavy equipment engineering study programs. So, students can gradually win the competition to get a linear job with their background study (heavy equipment engineering). One of the reasons for this improvement is caused by the SOBAT program, a quality improvement program for lecturers and technicians in Poltera initiated by PT United Tractors, Tbk, with one of its featured programs being "Virtual Training during the covid-19 pandemic". The positive impact is felt by lecturers and technicians, especially in supporting the learning quality improvement in the heavy equipment mechanical engineering study program. Tangible outcome results from implementing the "SOBAT program" are shown by the success of four Poltera lecturers as the 50 best participants and selected to participate in the teacher and lecturer internship program at PT. United Tractors, Tbk). This is a proud achievement for the department of heavy equipment mechanical engineering to improve the quality of human resources to achieve Poltera's goal as one of the Centers of Excellence for Heavy Equipment Technology Center in East Java.

4. Conclusion

The research findings above and the previous discussion showed that students who graduated in 2020 and 2021 had a low score on linearity between the field of work and the scientific fields, although they have already worked or become entrepreneurs. What led to this phenomenon was the limited access to improve the quality of human resources of the lecturers through industrial training/internships, which can improve lecturers' scientific competence. Several student innovations have been started through PUT-CoHE Development Research since 2021. Students who graduated in 2022 have a higher score on linearity between the field of work and the scientific fields. The "SOBAT program" has significantly impacted the quality of the human resources (lecturers) and the Heavy Equipment Mechanical Engineering Study Program graduates, Politeknik Negeri Madura. PT. United Tractors, Tbk and Poltera are committed to continuing to build sustainability, especially to improve the HDI of Sampang regency and to prepare competent human resources in the mechanical field and heavy equipment operators. Poltera also collaborates with the construction service business sector to increase the employment rate of Vocational College and Vocational High School graduates through their skills.

Acknowledgments

Gratitude to the director of Politeknik Negeri Madura for the direction and suggestion to develop a centre of excellence technology centre of heavy equipment. Our gratitude also goes to PT United Tractors, Tbk, for providing a lot of knowledge and inspiration through the material presented by keynote speakers that experts in their fields. The gratitude is also for LSP ABI for assisting in heavy equipment mechanics' competency certification activities. The authors also thank you for funding the 2022 matching fund program.

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