

## **Gap Analysis of Graduates Competencies in Manufacturing Engineering Department with the Industry**

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### **Abstract**

Bandung Polytechnic for Manufacturing (Polman Bandung), as one of The Vocational Colleges (PTV), must synergize closely with The Industry, the world of business, and work also known as IDUKA. The alignment of PTV graduates' competencies with IDUKA's competency needs is a form of Polman Bandung accountability in using Production Based Education (PBE) during the teaching and learning process. The D3 Study Program - Precision Tool Manufacturing Technology (TPPP), which is under the Manufacturing Engineering Department, Polman Bandung, needs to carry out a fundamental transformation in its curriculum. To realize it, this Study Program carries out an Assessment Program for Curriculum Alignment that analyzes industry satisfaction from competencies of graduates. The competency consists of the core competency, hard skill competency, and soft skill competency. This study aims to find out the gap between the competency of students and industrial needs and analyze industry satisfaction with the quality of academic services at Polman Bandung. The analytical method used was the Importance Performance Analysis (IPA) method; this method is an analysis technique that is used to find out which competencies need to be improved through the 4 quadrants classification. Based on IPA analysis, the competency that needs improvement comes from quadrant 1 known as a high priority improvement. The results of this competency gap will be analyzed to improve education programs by transforming its curriculum in preparing graduates who can compete in the world of industry that demands creativity and adequate skills.

**Keywords:** *Curriculum; Assessment; Importance Performance Analysis (IPA); Core competency; Hard skill; Soft skill*



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### **INTRODUCTION**

Vocational Higher Education (VHE), also known as Perguruan Tinggi Vokasi (PTV), is higher education that supports the mastery of applied expertise or technical skills required in certain fields of work with a diploma degree (Sukoco, Kurniawati, Werdani, & Windriya, 2019). In particular, PTV must be able to synergize closely with the Industry, the world of business, and work, also known as IDUKA that will lead to employment needs. Based on this, the pattern of changes caused by the impact of emerging technologies in each company plays an important role in the preparation of the educational program curriculum at Polman Bandung as vocational higher education. The curriculum Alignment Assessment Program with IDUKA is one of the leading programs launched by the Directorate of Partnership and Alignment of Business and Industry (Mitras DUDI), Directorate General of Vocational Education, Ministry of Education and Culture. Polman Bandung implements it with the purpose is to analyze the gap between the curriculum and the graduate competencies required by IDUKA. The used learning method for this developing program is typical with learning more from experience in using technology or work implementation procedures as professionals work. In the education field, it is known as the "deductive" method or, in international

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terms, known as the "Experiential Learning" pattern (DUDI & Vokasi, 2020). Therefore, Polman Bandung needs to prepare graduates who can compete in industries that demand adequate creativity and skills. Competency alignment of PTV graduates with the competency needs of IDUKA is a form of preparation to ensure the best graduates and ready to enter the world of working and industry. The study program of D3 Precision Tool Manufacturing Technology (TPPP) under the Manufacturing Engineering Department is selected to carry out a fundamental transformation in its curriculum through this program. An objective gap analysis between the competency targets of the current curriculum and the competency needs of IDUKA will be used as input in revising the current 2016 curriculum to the 2020 curriculum, which the Director Decree of Polman Bandung will enforce. In addition, the generated data from this development program can be used as material for identifying curriculum and infrastructure deficiencies related to gaps in existing curriculum competencies with IDUKA competency needs.

### **LITERATURE REVIEW**

In the 1970s, the Swiss government assisted the establishment of the first PTV in Indonesia, which was then named Polytechnic Mechanic Swiss-Institute of Technology Bandung (PMS-ITB) and now known as Polman Bandung. The Indonesian government established PTV with the aim of producing many vocational experts that are prepared to become skilled workers in their fields and ready to enter the world of work and Industry (Pradana, 2019) (Ekasari, 2013). Based on this, ideally, PTV would allow its graduates to enter IDUKA with a low level of gap. Therefore, preparing student competencies during education needs to be focused on meeting the competency needs of IDUKA (DUDI & Vokasi, 2020). Curriculum as a body of knowledge from the supply chain of resources is the basis for the formation of graduate competencies who are ready to take part in IDUKA and be formulated on a strong basis through the Curriculum Alignment Assessment Program with IDUKA. The curriculum is defined as a planning document that contains the objectives to be achieved, the content of the material and learning experiences that students have to do, strategies and ways that can be developed, as well as evaluations designed to collect information about achieving goals and implementation of designed documents in real terms (Sanjaya, 2011). Curriculum evaluation is defined as a systematic effort to collect information about a curriculum to be used as a consideration of the value and meaning of the curriculum in a particular context (Said, 2008).

According to Law no. 12 of 2012, Higher Education Curriculum is a set of plans and arrangements regarding the objectives, content, and teaching materials and the methods used as guidelines for implementing learning activities to achieve higher education goals. It is also stated that each university develops the Higher Education Curriculum by referring to the National Higher Education Standards for each Study Program, including the development of intellectual intelligence, noble character, and skills (Undang-Undang Republik Indonesia No.12, 2012). Graduate competency standards are the minimum criteria regarding graduate abilities' qualifications, including attitudes, knowledge, and skills that are stated in the formulation of graduate learning outcomes. The formulation of Learning Outcomes refers to the description of Learning outcomes of KKNI graduates (Indonesian National Qualification Framework) and is equivalent to the qualification levels of the KKNI (Peraturan Menteri Pendidikan dan Kebudayaan No. 3, 2020). Graduates of The Precision Tool Manufacturing Technology (TPPP) study program obtain intermediate degrees in

Diploma 3 (level 5 of KKNI) by having competency in the field of design, manufacture, assembling, and test precision tools specifically for plastic and aluminum-alloy molding tools (plastic injection molds and die-casting molds), forming tools for metal plate products (press-dies / press tool) and tools for positioning and clamping for production processes (jig and fixtures). At the same time, the study program's learning outcomes consist of attitudes, general skills, specific skills, and knowledge (Kurikulum Program Studi Teknologi Pembuatan Perkakas Presisi, 2016).

Challenges Vocational education is related to quality, relevance, and efficiency in the present and future. How vocational education can meet the needs and demands of the world of work, quality, and organization more effectively and efficiently (Triki, Gupta, Rafik, & Wamuziri, 2009). The program launched by Mitras Dudi will overcome this challenge through a map of the gaps obtained between the competencies of graduates and IDUKA competencies, including deficiencies in the facilities and infrastructure used to obtain these competencies. Competency as information data obtained by involving existing stakeholders (industry, graduates, students, and lecturers). The data sources consisted of questionnaires and documentation, which is distributed to all stakeholders as a population. Population and Sample Population is a generalization area consisting of objects/subjects that have certain qualities and characteristics that researchers apply to study and then draw conclusions (Sugiyono, 2017). The collected questionnaire data is analyzed using Importance Performance Analysis (IPA) to obtain a map of the gap between the competencies of graduates and the competencies expected by IDUKA. Martilla and James first put forward the IPA method in 1977 in their article "Importance Performance Analysis" which was published in the Journal of Marketing. In this method, respondents were asked to rate the level of importance and performance of the company, then the average value of the importance and performance level was analyzed on the Importance Performance Matrix, where the x-axis represents perceptions while the y-axis represents expectations (Tjiptono & Chandra, 2011).



Figure 1. Matrix standard of Importance Performance Analysis (IPA)

Based on figure 1, the four quadrants are identified as follows 'concentrate here' (Q1), 'Keep up the good work' (Q2), 'low priority (Q3), and 'possible overkill' (Q4). The other categories on the x and y axes combine with each other, which is interpreted as a quadrant that is fair performance, extremely important, excellent performance, and of slight importance.

In "Concentrate Here", there are factors that are considered important and/or expected by consumers, but the company's performance is considered unsatisfactory, so the company needs to concentrate on allocating its resources to improve the performance that is included in this quadrant. Then, "Keep up the Good Work" represents factors that are considered important and expected as supporting factors for customer satisfaction so that companies are obliged to maintain these performance achievements. "Low Priority" is the factor that is considered to have a low level of perception or actual performance and is not too important and or not expected by consumers so that companies do not need to prioritize or pay more attention to these factors. The last quadrant is "Possibly Overkill", which are factors considered not too important and not really expected by the customer so that the company is better off allocating the resources associated with these factors to other factors that have a higher priority level. As mentioned before, the first IPA method was developed as a market tool to examine and suggest management strategies. However, some fields beyond marketing purposes have been implemented this method, one of which is for education purposes (O'Neill & Palmer, 2004; Sidik, Sunardi, & Supriyanto, 2019; Cladera, 2020). By analyzing all of the methods and various modifications of IPA, it concluded that these tools are very useful assessment instruments for the current state of the organization, and they are greatly assist managers in making valid decisions. During the implementation of IPA, it is necessary to take into account those indicators that will contribute to creating a more comprehensive and clearer picture of an organized state in terms of services/product quality (Kuo et al.). IPA can help quality policy-makers in detecting those elements of the services/products which allocation of resources could contribute to more satisfied users (Ormanović, Talović, Alić, Jelešković, & Čaušević, 2017).

The review of current literature resulted in the following research questions: 1) Which data from IDUKA and Polman Bandung are the most relevant information for the survey, 2) what kind of gap map represents the importance and performance of each stakeholder's related curriculum, i.e., which category courses, hard skill, and soft skill in the best prediction of corrective action priority. The aim of this paper is to make a comprehensive and systematic review of literature referring to different approaches and modifications of IPA and determine the benefits and disadvantages of these different approaches.

## **RESEARCH METHOD**

The Curriculum Alignment Assessment Program with IDUKA is carried out following the model shown in Figure 2.1, through the stages of program implementation, starting from the preparation stage to the reporting stage (DUDI & Vokasi, 2020). The implementation of the program is carried out in accordance with the guidelines provided by the Team of the MITRAS DUDI Directorate, where the stages of the program implementation are as shown in Figure 2.2. There are several stages of the core implementation process discussed in this paper that is carrying out preparations, external surveys, internal surveys, and gap analysis. The preparatory stage starts from designing a questionnaire according to the core courses in the current curriculum. Then, data collection and determination of target respondents were selected according to the whereabouts of

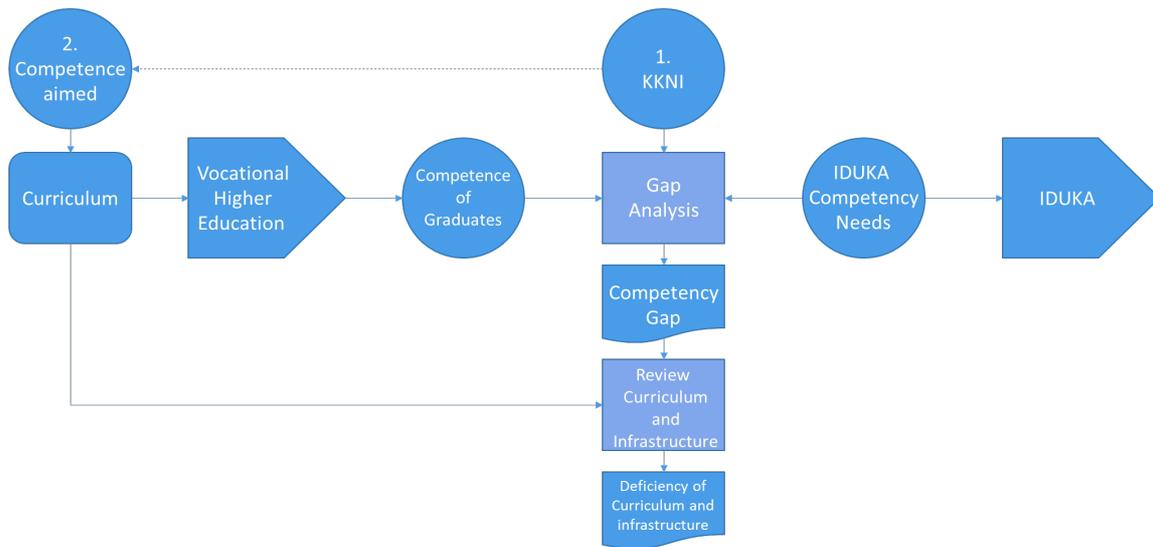


Figure 2.1 Curriculum Alignment Assessment Model (DUDI & Vokasi, 2020)

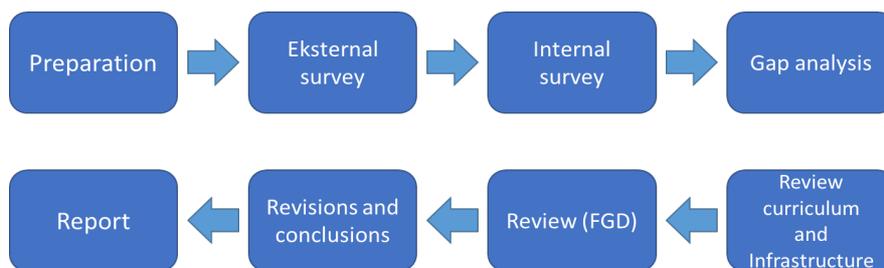


Figure 2.2 Curriculum Alignment Assessment Model (DUDI & Vokasi, 2020)

working graduates and IDUKA partners. The assessment was carried out to stakeholders through a survey as external and internal respondents. External respondents involved graduates and IDUKA, and internal respondents involved lecturers, educational laboratory institutions (PLP), and final year students. External Survey was conducted to analyze competency gaps by processing the results of the questionnaire and mapping the gaps between the curriculum, facilities, and infrastructure, as well as PBM and the competencies needed by graduates / IDUKA. Meanwhile, an internal survey for curriculum and infrastructure review uses the experiential learning method. The target number of respondents for this survey can be seen in table 2.1.

Tabel 2.1 Target Respondents

No.	Study Program	Respondents	Target Amount
1	Precision Tool Manufacturing Technology (TPPP)	Graduates	50
		IDUKA	10
		Lecturer	22
		PLP	9
		Final Year Student	23

The criteria for target each stakeholder respondent data that taken for the implementation of the survey, namely graduates of the last 3 years (2017, 2018, and 2019), IDUKA who employed graduates of the Precision Tooling Technology (TPPP) study program in the last three years, lecturers and PLP who teach core courses, and active students are waiting for the graduation for 2020. All data that will be contacted, it is obtained from the administration section of the Manufacturing Engineering Department and the Academic and Student Administration (BAAK) section of Polman Bandung. Furthermore, the program committee contacts each respondent through e-mail, phone and come to the company to give the questioner form. For respondents in Polman Bandung, they are gathered in one room at different times to fill out the questioner. To test the validity of the data using SPSS software. The testing technique used to test the validity is using Bivariate Pearson correlation (Pearson Moment Product). Meanwhile, the instrument reliability test was used to find the Cronbach Alpha value using SPSS software.

The questionnaire was compiled through a preparatory meeting with the results in the form of a questionnaire design which was then created for filling in offline and online. External Graduates surveys are conducted through online questionnaires, while IDUKA external surveys are conducted through online and offline questionnaires through direct visits to IDUKA. Several IDUKAs were visited directly, both around Bandung and outside the city of Bandung. The instruments used in the questionnaire consisted of the demographics of each stakeholder, 11 core subjects, 12 hard skills, and 29 soft skills. Questions are made with a choice of answers using a Likert scale of 1-5. The Likert scale is a psychometric scale commonly used in questionnaires and is the scale most widely used in research in the form of surveys (Taluke, Lakat, & Sembel, 2019).

## **FINDINGS AND DISCUSSION**

A survey carried out by the Curriculum Alignment Assessment Program with IDUKA will be a bridge-building between the academic world of PTV and the world of working and industry. The analysis is carried out using the IPA (Importance Performance Analysis) method, "Performance" represents the user's perception of the quality of services delivered by the organization, while "importance" refers to the assessment of the importance of those services by users. The curriculum assessment activities carried out by the study program at Polman Bandung involve Graduates, IDUKA, Lecturers, PLP, and final year students of each study program with the number of incoming data: 38 graduates, 16 IDUKA people, 31 lecturers-PLP people, and final year students as many as 23 people. The results of the analysis are quite accurate because they are in accordance with the facts that occur in the field. Data is presented from the perceptions of Graduates, IDUKA, Lecturers-PLP, and Students. Apart from that, the survey results also obtained input/suggestions from respondents.

### **Gaps and Priorities**

#### **❖ Courses**

The grouping of expertise and courses in the diploma 3 program curriculum is in accordance with the competency needs of graduates in the tool industry. The grouping of expertise and courses in the diploma 3 curriculum has a beneficial consequence where graduates can work in two types of industries, namely the tool industry and other manufacturing industries besides tools. In the

competence of tool design theory, the practice of tool construction and the practice of tool analysis need to be improved because it is perceived to be insufficient when compared to its relevance to the tool industry. Meanwhile, the practice of tool design and mechanical theory is sufficient. Supporting scientific groups such as machine element theory and technical material theory need improvement. Regarding graduates' competency, there is a similarity in perception between industry and alumni regarding their assessment of the competence of alumni. Graduates work in various positions or jobs, which can be grouped into Job Tooling, Job Engineering, and Job-Sales and Others. At least up to 3 years of work for the graduates, it can be said that there has been no significant change in the competence of graduates in the core courses of this study program. There is a tendency of a lack of competence in material tool design theory, tool construction practice, and CNC practice among graduates who work on tooling jobs, but it is sufficient to work on engineering jobs. Job sales and others tend to decrease the competence of graduates in tooling and machining skills. There is a tendency of increasing competence in supporting science in all types of jobs. In student competence, there is a similarity in perception between students and graduates regarding their respective competencies in the core courses of the study program, except for the Machine Element theory. The tendency of graduates to perceive a little lower than students. The existence of perceptions between students and graduates becomes a justification or justification that there is no bias between the perceptions of IDUKA (graduates and industry) and perceptions of education (students and lecturers). This perception also shows that there is no evidence of competence between the batch of students in the last 3 years and students in the current final year.

In the perception of the lecturer, students can achieve the competence of all tooling expertise courses, except for the Tooling Design theory. According to the lecturer, only the basic manufacturing process practical competencies can be met by students in machining expertise; the rest are not fulfilled. In the supporting scientific groups, students can achieve competence for Material Engineering theory and Mechanics theory, while for the Mechanical Element theory, it is not yet fulfilled. According to students, student learning experiences have a better effect on mastery of subject competencies than student interest in core courses. Tooling skills and machining skills always received higher perception points than supporting science on the combination of the pair of learning experiences, interests, and mastery of competencies, regarding the facilities owned by the study program and their use in the practice of subjects, which have a higher competency perception than the industry. At the level of diploma 3 it can be said that the facilities owned by the product are sufficient. Its use is also very good because it can be used as a means for the student's learning experience well, this perception is taken from students. According to the lecturers' perceptions, several facilities still need to be improved, as well as their utilization can still be improved. Adding facilities and increasing their utilization can act in the name of higher-level programs such as diploma 4 (because if diploma level 3 becomes over-competent).

#### ❖ Hard skill competence

Based on the IPA analysis, it can be seen that respondents have almost similar perceptions about the importance of hard skills for IDUKA and the level of mastery of hard skills by graduates and students. English language proficiency is the only competency that has a different position. Based on the IPA graph on hard skill analysis, English competency is in quadrant 2 (two) according to the

results of the Natural Science analysis involving external respondent data. While the results of the Natural Science Analysis involving internal respondent data put English language skills in quadrant one. This difference in position indicates a change in the level of mastery of English which can be caused by the work environment of graduates. External respondents have a better assessment of their mastery of English skills after working than those of lecturers and students themselves before entering the world of work. So, improving learning for English language skills is still needed. The distribution of other competencies looks consistent. In quadrant 2 (two), there are 5 competencies, and they have met IDUKA's expectations, so that they must be maintained. Meanwhile, other foreign language skills and the ability to design systems are in quadrant three. These two competencies are also not a priority to be included in the improvement agenda. Meanwhile, there are three competencies whose level of authority is indicated to exceed IDUKA's expectations. The three competencies are knowledge in the field of expertise possessed, the ability to design products and processes, and the ability to carry out work control. Curriculum improvement can be directed to link excess mastery of these three competencies with other competencies that are in quadrant 1 (one) or become a priority for improvement. Research ability is the only competency that is consistently in quadrant 1 (one), so it is a priority for curriculum improvement.

❖ **Soft skill competence**

Based on the conclusion of the science graph for the soft skill competencies of graduates/students of the TPPP study program, wherein quadrant I which is a high priority, there are 3 soft skill competencies that must be of concern, namely: mathematical thinking, verbal communication skills, and factual data identification skills. In the graph of IPA for student soft skill competencies, the competence of understanding high motivation, working independently, and thinking mathematically also appears in quadrant I, so it is also a discussion and point of attention. Improvements in mathematical thinking are more towards the role of Lecturers, which is more enhanced in the PBM Process. There is no need to add soft skills subjects, but more towards giving examples of lecturers' behavior towards their students. Furthermore, students need to improve their verbal communication skills through their activities on campus, both during lecture hours and outside class hours. At KKN level 5, the ability to identify factual data certainly does not reach the in-depth analysis stage. The data and facts obtained are at least understood and can be used as a basis for simple decision-making.

## **CONCLUSION**

This paper has carried out the implementation of the Assessment Program for the Alignment of the Curriculum for the Study Program of Precision Tooling Technology and Manufacturing Engineering Technology with Industry, Business and the World of Work (IDUKA) in 2020 by Polman Bandung. The curriculum assessment program is useful for study programs to see the competency map of graduates it produces with the competencies needed by graduate users (IDUKA) as material for self-evaluation of study programs to make curriculum improvements in an effort to improve the quality of graduates. The core courses of the study program that must be a priority for improved mastery by students are Tool Design theory, Tool Construction practice, and Tool Analysis practice, especially for the tool industry. Mechanical Element Theory and Material Engineering theory in the supporting scientific groups need to increase the competence of

graduates. Hard skills competencies that are a priority for improvement are competency in English language skills and research skills. Soft skill competencies that need attention are the ability to communicate verbally, think mathematically, the ability to identify fact data, understand high motivation, and work independently. This program provides benefits to the development of institutions and study programs.

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