Occupational competence needs analysis of welder on medium-scaled car body industries in Indonesia

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Abstract. The purposes of this research are 1) Identify the duties and 2) tasks of welders in medium-scale welding industries. This research uses a descriptive qualitative method. The research objects are 4 welders and 3 supervisors/chief productions from two medium-scale car body industries in Magelang, Indonesia. The data collection techniques used are documentation, observation, and interview. The data analysis techniques used are descriptive analysis and DACUM research chart which are validated by an expert's judgment. This research manages to identify (1) six kinds of duties (plan the job, machinery and equipment preparation, material welding, inspect welding results, fix welding results, maintain machinery and equipment) and (2) seventeen kind of tasks that are executed by welders in medium-scale car body welding industries, twenty three knowledge and skills, nine working attitudes that should be owned by a welder, and at least nineteen kind of machines and supporting equipment in which the operation should be mastered by a welder in medium-scale welding industries.

1. Introduction

Welding industry is included in industrial services as an industry in which the main activity is to serve others' needs. The industrial service is in a form of processing raw materials supplied by the other party into half-finished or finished goods. This industry receives incomes as compensation for the service of processing the raw materials [1]. As any other industries, welding industry, especially in car body industries, is also divided into four scales, which are micro, small, medium, and large. The micro and small-scale industries tend to run on body repair or small-scale production but varies. Medium-scale car body industries are more likely to run on a larger-scale production but intermittent, it happens because they have to adjust their production according to their costumer’s demands as the direct consumers. Large-scale car body industries cover mass production with variations that tend to be monotonous in a long time. Differences in production activity of each car body industry cause different needs in welding competencies. The micro, small and medium industries actually need welders with more complex skills than large-scaled car body industry. Within the large car body industry, they tend to use automatic welding machines so they only need operators with certain simple and routine tasks. Based on the explanation, a more detailed mapping regarding welders' competencies by identifying the duties and tasks that are executed by the welders is needed.

In Indonesia, the growth of the manufacturing industry shows a positive-growth that has a direct impact on labor needs. Minister of Manpower, Hanif Dhakiri, said that the demand for skilled workers in Indonesia reaches 113 million in 2030 [2]. It means Indonesia needs about 3.7 million skilled labor
per year. Within the welding field itself, Asosiasi Pengelasan Indonesia - the Indonesian Welding Society (API-IWS) noted that the national manufacturing industry development requires 5000 welding personnel, like Welding Coordinator, Welder, Welding Inspector and Non-Destructive-Testing personnel [3]. In order to meet the needs of welders that are ready to work in Indonesia, mandatory competencies that should be owned by welders need to be planned out thoroughly. One of which is by identifying the welder competencies that are really needed by the industry.

The research on the task analysis has been done by many experts. A research by Barliana et al. was conducted to analyze the needs of occupational competence in the furniture making industry. This research was conducted using Occupational Task Analysis-Work Process Analysis technique, that results in 6 professional tasks with each description of Occupational Task [4]. Another study was also conducted by HyunSook, et al. which analyzed Clinical Research Coordinator (CRC) job. This research has explored the task of CRC by using the DACUM Task Analysis method. After the CRC tasks had been defined and validated, 12 jobs and 78 assignments were obtained. Based on this research, there has also been a classification of the tasks which have been difficult to implement and frequently performed tasks [5]. Dixon & Stricklin have been conducted a job analysis to identify the competency profile of the entry-level CADD technician in northern Idaho. The DACUM Research Chart has generated during the study that consists of 8 duties and 54 task [6].

A study has been conducted by Thonguthai and Kaewkuekool analyzed the link and match between the competencies that were taught in the course institutions and the needs of the industrial world. Through the questionnaires and FGD with the industry, has been obtained 10 knowledge, 9 skills and 11 working attitudes which are required in the foundry industry. Delphi technique was used to search for the relevancies between competencies found within the industries with the competencies that were taught in course institutions and is generated varying degrees of relevance [7]. A similar research was also carried out by Johnson in order to analyze the job of Geospatial technicians in the United States. The research was conducted by the National Geospatial Technology Center (Geo-Tech) to support and validate the needs of workers that required special skills by DOLETA. The validation was conducted by implementing a DACUM Job Analysis method. The research involved 8 GIS technicians, has successfully identified, ranked, and documented 55 categories of current tasks, 35 skills and knowledge, and 27 attitude categories [8].

A Similar research has also been conducted by Nickbeen et al. which research was due to the lag of curriculum in universities towards Green Building Technology which was developing very fast. Therefore, Task Analysis has been done by DACUM technique and successfully identified 6 main duties with 7 to 20 tasks which have been validated later by Expert Judgment by professionals in the field of Green Building [9].

Based on the six kinds of research on the job analysis above, it appears that workers have an awareness of their respective duties and tasks. Workers in large industries tend to have routine jobs, whereas workers in micro, small and medium industries actually have more complex jobs with non-routine tendencies depending on consumer orders, this also occurs in the welding industry and the welders’ duties and tasks. Due to the cause, a research that analyzes the duties and tasks especially for welders in medium-scale car body industry is needed. Specifically, the aims of the research are to (1) identify the welder's duties in the medium-scaled welding industry and (2) identify the welder's tasks in the medium-scaled welding industry.

2. Method

This research used the descriptive qualitative method. The object of the research was chosen by Purposive Sampling which is two medium-scaled car body industries in Magelang city they are Putra Agung Setia Ltd. and Karoseri Trisakti CV. The methods of data collection were done through documentation study, observation, and interview. Data analysis technique used descriptive analysis
and DACUM Research Chart. Data validation techniques used Expert Judgment involving three expert worker that is the supervisor or chief of production in each industry.

3. Result and Discussion

The Indonesian Central Bureau of Statistics (BPS) defines the Processing Industry as an economic activity which processes a raw material mechanically, chemicals, or by hand into an intermediate or finished good, turning less valuable goods into higher value goods, and closer to the end user. Included in this activity are industry services and assembly work. Based on the number of labors within an industry, BPS classifies the processing industry into 4 groups, which are (1) Home Industry with the number of labors less than 5 person, (2) Small Industry with the number of labors between 5-19 person, (3) Medium Industry with the number of labors between 20-99 labors, and (4) Large Industry with the number of labors reaches 100 person or more [10].

BPS further classifies the processing industry into 24 categories based on International Standard Industrial Classification of all Economic Activities (ISIC) 4th revision, which has been adjusted with the condition in Indonesia by the name of Indonesia Standard Industrial classification (KLBI). From the 24 categories of manufacturing industries which are listed in the Indonesian Manufacturing Industry Directory year 2017, welders are directly needed in 5 industrial categories, namely (1) Metal goods industry, not machinery and equipment, (2) Machinery and equipment industries ytdl, (3) Motor vehicle industry, Trailer and semi-trailer (4) Other transportation equipment industries, (5) Repair and installation services of machinery and equipment.

The number of labors that work in the 5 industrial categories on a large and medium scale industry according to BPS data shows a various growth but commonly grows positively. The data of increasing labors can be observed in Table 1[11]

Table 1. The Number of Large and Medium Manufacturing Workers by Sub Sector Year 2013-2015

| No. | Industry Sub-Sector                             | The Number of Labors in Year : |
|-----|------------------------------------------------|-------------------------------|
|     |                                                | 2013        | 2014        | 2015        |
| 1   | Metal Goods, not Machinery and Equipment       | 173.210     | 160.849     | 156.134     |
| 2   | Machinery and equipment ytdl                   | 58.679      | 61.720      | 70.584      |
| 3   | Motor vehicle, Trailer and Semi Trailer        | 138.179     | 140.107     | 147.553     |
| 4   | Other transportation equipment industries     | 86.350      | 89.992      | 103.057     |
| 5   | Repair and installation services of machinery and equipment | 17.620 | 18.995 | 13.465 |

The growth of the processing industry is not only visible from the needs of the number of labors. Directly, industrial growth is also seen in the increasing number of large and medium industries for the industry sub-sector as above in the year 2013-2015. That data can be observed in Table 2 [1] Table 2. The Number of Large and Medium Industry Company by Sub-Sector (2 digits KBLI) Year 2013-2015
Based on the data description of the industry growth, it seems that the needs of competent and ready for work welders are so urgent for industries’ operational activity. The increase of needs toward labors and number of industries surely causes an increase in the needs of welders because they are the main worker in welding-based manufacture industries on those 5 categories. In order to generate welders that are ready to work and according to industry’s need, a mapping related to the duties and tasks of each welder is needed.

Based on field observation and interview to 4 welders and 3 supervisors/chief of productions, six main duties of a welder are acquired and grouped, they are: (1) Plan The Job, (2) Machinery and Equipment Preparation, (3) Material Welding, (4) Inspect Welding Results, (5) Fix Welding Results,(6) Maintain Machinery and Equipment.

Based on these six main duties of a welder, they are then further classified into 17 tasks. In executing these 17 tasks, a welder has to master different steps from each existing tasks. In detail, the 17 tasks are divided into six duties as follow: (1) Job A, consists of 4 tasks, (2) Job B, consists of 4 tasks, (3) Job C, consists of 3 tasks, (4) Job D, consist of 2 tasks (Bernardus Sentot Wijanarka, 2018), (5) Job E, consists of 2 tasks, (6) Job F, consists of 2 tasks. The duties and tasks of a welder can be seen in detail in the DACUM Research Chart in Table 3.

Table 3. Dacum Research Chart for Welding

| No. | Industry Sub-Sector                                      | The Number of Industries in Year: |
|-----|---------------------------------------------------------|----------------------------------|
|     |                                                         | 2013    | 2014    | 2015    |
| 1   | Metal Goods, not Machinery and Equipment                | 958     | 951     | 1022    |
| 2   | Machinery and equipment ytdl                            | 364     | 379     | 407     |
| 3   | Motor vehicle, Trailer and Semi Trailer                 | 366     | 380     | 412     |
| 4   | Other transportation equipment industries               | 315     | 331     | 380     |
| 5   | Repair and installation services of machinery and equipment | 85      | 105     | 137     |

| No | Duties                                      | Tasks                                                                 |
|----|---------------------------------------------|----------------------------------------------------------------------|
| A  | Plan The Job                                | A.1 Identifying models                                               |
|    |                                             | A.2 Organizing material that has been cut and formed                  |
|    |                                             | A.3 Identifying the material assembly position                       |
|    |                                             | A.4 Identifying material welding technique                           |
| B  | Machinery and Equipment Preparation         | B.1 Preparing the SMAW welding machine                                |
|    |                                             | B.2 Preparing gas-cutting equipment                                   |
|    |                                             | B.3 Preparing electric hand equipment                                 |
|    |                                             | B.4 Preparing hand equipment                                          |
| C  | Material Welding                            | C.1 Setting the welding machine                                      |
|    |                                             | C.2 Material welding                                                 |
|    |                                             | C.3 Fixtures assembly                                                |
| D  | Inspect Welding Results                     | D.1 Cleaning welding results                                          |
|    |                                             | D.2 Visual assessing the welding results                              |
| E  | Fix Welding Results                         | E.1 Grinding welding results                                         |
|    |                                             | E.2 Re-welding                                                       |
| F  | Maintain Machinery and Equipment.           | F.1 Checking machines and                                             |
|    |                                             | F.2 Repairing                                                        |
Duties and tasks that have to be mastered by a welder in medium-scale industry is a bit different compared to the Indonesian National Competency Standard (SKKNI) that is written in the Ministry of Labors and Transmigration’s Decision No. 342 Year 2017 about the Implementation of National Job Competency Standard in Processing Industry Sector, Metal Industry Sub-Sector in SMAW Welding Service Industry. Within the Indonesian National Competency Standard, there are 31 competencies which are divided into 3 groups of competencies, they are; general, main, and special [13]. The duties and tasks of a welder in the field are more practical than they are written in the Indonesian National Competency Standard, which is theoretical.

Within the general competency of Indonesian National Competency Standard, the implementation of occupational safety and health management systems tends to emphasize only on the use of personal protective equipment, sickness caused by work and environmental damage after an accident (contamination). The implementation of occupational safety and health management systems in the field is more related to the use of personal protective equipment, the prevention of accidents including by creating situation and condition that are safe while working, so as the safety of the equipment and machines while being operated. The competency unit of Implements Quality System, the Indonesian National Competency Standard is more related to the standard quality fulfillment according to consumers. While the implementation in the field, the standard quality implementation was done by a welder is related to how good the welding results are, either visually or non-Visually. So as for how the repairing process should be done if the welding quality is below the predefined standard.

Within the Indonesian National Competency Standard core competencies, there are actually competencies that are less needed by welders in the medium-scale industry in executing their duties and tasks. The competency of using precision mechanic measuring instruments are not really needed because the welding projects often use rough measurements and tolerance by only using basic mechanical measuring instruments. So as the blueprint and welding symbols reading, welders in medium-scale industries more often receive blueprint in 2D or 3D without any specific welding symbols.

Within the Indonesian National Competency Standard special competencies, there are actually also competencies that are less needed by welders in the medium-scale industry in finishing their duties and tasks. Competency unit as Making Report, Translating Literatures Written in English, Operating Computers, and Implementing Welding Metallurgy that are not really needed by welders in medium-scale industry. While competency in Machinery And Equipment Maintenance is really worth to be made as a core competency because the welders prepare their own welding machine and equipment before they use them, making sure the safety of the machines and equipment while being operated, cleaning the welding machine and equipment after they are used, so as repairing the welding machine and equipment if they are damaged.

The duties and tasks of welders that have been created still have a few steps that have to be mastered by a welder. The steps are not explained in this paper because they are too specific and directly related to the kinds of machines and equipment that are operated. In implementing his job and tasks, a welder does not only need the skills that mentioned earlier. As part of the competencies, a welder should have the skills, knowledge and working attitudes relevant to his job and tasks. As mentioned by Baser, et al. the competency consist of three domains; knowledge, skills, and attitude. The attitudes aspect cannot be separated because it is a must for workers at the present time [14].
As an integrated part, this research also studies the knowledge that should be owned by a welder. The mandatory knowledge should be owned by a welder as a theoretical base for the welder to refer to the rules and Standard Operating Procedures that have been standardized while doing his job and tasks. Based on the results of observation and interview, mandatory knowledge that should be owned by welders in medium-scale industries are acquired, they are (1) Reading basic and 3D blueprint, (2) Using basic measuring instruments (Metrology), (3) Doing basic technical calculation, (4) Operating SMAW welding machine, (5) Operating GMAW welding machine, (6) Operating GTAW welding machine, (7) Operating OAW welding machine, (8) Metal fabrication, (9) Material knowledge, (10) Physical and Mechanical Metallurgy, (11) Maintenance, (12) Basic electronic, (13) Gas-cutting, (14) Mechanical cutting, (15) Metallography, (16) Using hand tool and equipment, (17) Sketching, (18) Welding defect and welding imperfect, (19) Using powered-tool and equipment, (20) Welding procedure and position, (21) Ergonomic, (22) Material handling, (23) Occupational safety and health management systems.

Within the Indonesian National Competency Standard, the knowledge aspect is written in more detailed sub-sciences. But the main point is, from 23 knowledge acquired during the research, there was 5 core knowledge that is not included. They are (1) Operating GMAW welding machine, (2) Operating GTAW welding machine, (3) Metal fabrication, (4) Basic electronics, (5) Sketching, (6) Welding defect and welding imperfect.

The last aspect of the welders’ core competencies in finishing their duties and tasks are working attitude. As also an integrated part, this research also studies things that are related to mandatory working attitudes of welders. There are at least 9 kinds of working attitudes that are observed during the research, they are (1) Methodist, (2) Accurate, (3) Creative, (4) Logical Thinking, (5) Good listener and easy to understand, (6) Good and effective speaker, (7) Teamwork, (8) Diplomatic, (9) Alert. Within the Indonesian National Competency Standard, the mandatory working attitudes of welders do not explicitly write. But within the general competence, there are two competencies that are quite relevant to working attitude, there is a competency unit in Doing Reciprocal Communication and Teamwork. It means that there are still seven working attitudes that need to be included in the competency units of the Indonesian National Competency Standard.

Welders that work in small and medium-scale industries tend to be required to have more complex working attitudes due to their kind of complex duties and tasks. So they have to be more adaptive to many conditions. According to Wagner, the main attitudes that need to be owned by welders are critical thinking, good problem-solving skills, wide collaboration network, effective oral and written communication, information analysis and access skills, curiosity and imagination [15]. Based on the results of the research and Wagner's opinion, it can be underlined if adaptive, critical thinking and high creativity skills in problem-solving are vital attitudes and are going to be needed in the future. It is also supported by Baser, et al. that state if these attitudes (adaptive, critical thinking and high creativity skills in problem-solving) will help the students to have complete competencies. It can also be used as a guide for the students to identify the need of the industrial world in the present time [16]. Based on the explanation, it can be concluded if the research's results are relevant to the condition of students' readiness to enter the industrial world.

A welder in medium-scale industry does not only required to be able to operate welding machines, but also many hand tools and machines that are often used by a welder in medium-scale industry as: hand-grinding, hand drill, roll meter, steel ruler, etcher, screwdriver, wrench, hammer, tracker, steel
brush, pliers, oxygen gas tube, acetylene gas tube, gas hose, gas-blender, blender nozzle, lighter, cutter and hole cleaner.

As the development of the industrial world, the machines that are used in the industry especially in manufacturing including the welding industry become more advanced. Automatic machines controlled by a computer (CNC) are more commonly used. These machines are generally used by large industries with mass production and limited variation. For examples the industry of gas tube, automotive, and others. Even though only a few small and medium industries that have already used the automatic machines, but knowledge of these machines are still needed by welders. Besides new knowledge and skills, certification and English skills are also among the absolute requirements that have to be met by welders. Furthermore, in facing globalization and free trade, English skills and competency certificates issued by professional certification center or professional association in the national level, regional and international also among the absolute requirements for a welder to compete with other competitors.

The increase in skills and knowledge that have to be owned by welders also proven by certification and foreign language skills, it should also be balanced with the increase of working attitude. According to Billet, working attitudes are needed by welders to deal with and anticipate the tendency in the future working world are the need of non-routine character, specific and varies, intents, conceptual, wise, complex and able to interact with other people, tools and many other things [17].

Besides the globalization and free trade, the development of industrial worlds have also reached on industrial revolution chapter 4, but Indonesia seems to be so far from being ready to deal with it. It can be seen from many industries in Indonesia which operate with the concept of labor-intensive in which the reason is due to the abundance of citizens and labors that can suppress the level of unemployment. Specifically, Pardede also reasons that Indonesia’s lack of readiness is due to conventional industries in Indonesia that still uses low and medium skills. So many adjustments needed in order to change the process of production in which most of them still analog into the digital industry. Furthermore, the industrial revolution chapter 4 still need full and more specific attention [18].

4. Conclusion

Based on the results of research conducted on the duties and tasks of a welder, it can be concluded that; (1) there are six main duties of welder, they are: plan the job, machinery and equipment preparation, material welding, inspect welding results, fix welding results, maintain machineries and equipment, (2) there are 17 tasks with 23 knowledge and skills with 9 mandatory working attitudes of welders and at least 19 kind of machines and supporting equipment that should be mastered by a welder.

5. References

[1] Wijanarka, B.S., Nuchron, Rahdiyanta, D. and Habanabakize, T., 2018, The Task of Machine Tool Operators in Small and Medium Enterprises in Indonesia, *J. Pendidikan Teknologi dan Kejuruan*, 24, 39-45

[2] Ratya, M.P., 2017, *Menaker: RI Butuh 3,7 Juta Tenaga Kerja Terampil Per Tahun*, [Online], Available: https://news.detik.com/berita/d-3474059/menaker-ri-butuh-37-juta-tenaga-kerja-terampil-per-tahun
[3] Rini, A.S., 2017, *Industri Manufaktur Butuh 5.000 Tenaga Las Per Tahun, Ini Kualifikasinya*, [Online], Available: http://industri.bisnis.com/read/20171112/257/708276/industri-manufaktur-butuh-5.000-tenaga-las-per-tahun-ini-kualifikasinya

[4] Barliana, M.S., Ilhamdaniah and Kurnia, D., 2015, Occupational Competence Needs Analysis in Furniture Making Industry, *The 3rd UPI Int. Conf. on Technical and Vocational Education and Training (TVET)*

[5] Hyun-Sook, K., et al, 2012, Job Analysis of Clinical Research Coordinators Using the DACUM Process, *J. Korean Acad Nurs.*, 42, 1027-1038

[6] Thonguthai, S. and Kaewkuekool, S., 2011, The Development of a Competency-Based Course of Study to Meet Thailand's Mould and Die Industry Needs, *Medwell J.*, 6, 241-249

[7] Hyun-Sook, K., et al, 2012, Job Analysis of Clinical Research Coordinators Using the DACUM Process, *J. Korean Acad Nurs.*, 42, 1027-1038

[8] Nickbeen, P., Valentin, V., Bogus, S.M. and Ballard, A., 2017, The Dacum Process to Develop an Industry-Directed Construction Education Curriculum type, *CSCE/CRC Construction Specialty Conf.*

[9] Badan Pusat Statistik, 2018, *Perusahaan Industri Pengolahan*, [Online], Available: https://www.bps.go.id/subject/9/industri-besar-dan-sedang.html

[10] Badan Pusat Statistik, 2017, *Jumlah Perusahaan Industri Besar Sedang Menurut SubSektor (2 digit KBLI) Tahun 2013-2015*, [Online], Available: https://www.bps.go.id/dynamictable/2015/09/14%2000:00/1086/jumlah-perusahaan-industri-besar-sedang-menurut-subsektor-2-digit-kбли-2000-2015.html

[11] Menteri Tenaga Kerja dan Transmigrasi Indonesia, 2007, *Penetapan Standar Kompetensi Kerja Nasional Indonesia Sektor Industri Pengolahan Sub Sektor Industri Barang Dari Logam Bidang Jasa Industri Pengelasan Sub Bidang Pengelasan SMAW*

[12] Baser, J.A., et al, 2017, Competency of National Dual Training System Industry Advisors,” *J. Pendidikan Teknologi dan Kejuruan*, 23, 328-338

[13] Wagner, T., 2008, *The Global Achievement Gap*, New York: Basic Book

[14] Baser, J.A., Hasan, A.H., Asha’ri, A.H. and Khairudin, M., 2017, A Study on The Transferable Skills of The Engineering Students at Universiti Tun Hussein on Malaysia, *J. Pendidikan Teknologi dan Kejuruan*, 23, 257-264

[15] Maclean, R., Wilson D. and Chinien, C., 2009, *International Handbook of Education for the Changing World of Work, Bridging Academic and Vocational Learning*, Germany: Springer Science Business Media

[16] Parde, R., 2018, *Indonesia Hadapi Revolusi Industri Keempat*, [Online], Available: http://www.kemenperin.go.id/artikel/15554/Indonesia-Hadapi-Revolusi-Industri-Keempat