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Readiness Assessment Industry 4.0 Manufacturing Companies Recipients of Indonesia Government-Borne Import Duty Facility

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Abstract:

The advancement of technology created massive shifts in the way manufacturers operate to create competitive advantage. Since its first rollout in Germany back in 2013, Industry 4.0 concept has been adopted by manufacturing industries around the world, including in Indonesia. Before these industries can develop and implement strategies for Industry 4.0, it is necessary to assess the condition and readines. Therefore, it is of major importance to formulate and define a set of guidance to assess conditions and readiness in manufacturing industry sectors in Indonesia on their road towards Industry 4.0 implementation. This research aims to assess the readiness for manufacturing industries that received impost duty exemption from Indonesian government for the implementation of Industry 4.0, based on Industry 4.0 assessment model developed by Almamalik. Results showed that 37% of the companies are on the early stages, with another 45% on intermediate stage in terms of Industry 4.0 readiness. Index value for each readiness parameters for all assessed companies are between 1.92 to 2.7 (with majorities of the companies went higher than 2). This means the majority of companies in this industry are newcomers and learners.

Keywords **—Industry 4.0, ManufacturingIndustries, Government-Borne Import Duties Facility, Industry 4.0 Assessment model**

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I. INTRODUCTION

The advancement of technology over the last decade created a fundamental and massive shift in industrialisation process. The term 'industrial revolution' in its basis are the advancement of technology that created significant changes in manufacturing or industrialisation process[1]. The development of steam power in industrialisation bumpstarts the first industrial revolution, with electricity powering up the second revolution, the development of electronic control and information technology system started the third revolution, and the integration of the new digital technology in the form of IT and communication technology launched the fourth revolution. The fourth revolution recalibrates the classical hierarchy of automation systems to autonomously control the cyber-physical production system, enabling a flexible customisation of mass production as well as extra flexibilities in the production number[1]. The integration of ICT in the manufacturing process is expected to accelerate the controlling process of all the value chain to be more agile and more responsive[2], which in turn increases productivity while shaving off production costs and offering better overall service quality, speed, and cost/benefit for customers[3].

The fourth industrial revolution, first initiated by the government of Germany back in 2013, created a highly interconnected industrial landscape. With the Industry 4.0 concept, physical tools and assets are integrated with company systems, enabling a constant and dynamic data exchange and analysis.

Similar concepts was also introduced by several country like USA with industrial internet concept from General Electrics in 2012, France with Industrie du Future, and People's Republic of China with Made In China 2025[1]. In Indonesia, Industry 4.0 concept is adopted into Making Indonesia 4.0[4]. In the beginning, the implementation of Making Indonesia 4.0 initiatives are focused on 5 main sectors, which are food & beverages, textile and clothings, automotives, chemicals, and electronics. Later development includes healthcare equipment and pharmaceutical industries. The basis on choosing aforementioned industries are the result of economical impact evaluation and worthiness criteria for implementation, including GDP size, trades, potential impact for other industries, investment valuation, and the speed of market penetration. As a country with a wealth of natural resources, a transformation towards Industry 4.0 will further improve the development of Indonesia's manufacturing industry. In accordance with the development of Making Indonesia 4.0 concept, to help with implementation of strategy and roadmaps for Industry 4.0 in all 5 chosen sectors, government developed a measuring instrument to measure the readiness level of Industry 4,0 with Industry 4.0 Readiness Index (INDI 4.0)[5].

A wealth of policies to develop manufacturing industries are currently being implemented, one of them is the implementation of Government-Borne Import Duties (GIBD) Facility, where import taxes are paid by government for imported items and materials bought by companies, in accordance with budget caps set in state budgets (AnggaranPendapatandanBelanja Negara/APBN). GIBD is given to companies that qualifies the criteria in order to fulfill the provision of items/services for public purpose, to be consumed by public and/or to protect consumers, improving the competitiveness of certain industries, increasing workforce intake, and increasing state income[6] {6}. Since its implementation from 2008 to 2019, GIBD has been handed over to 241 companies in 41 industrial sectors with total absorbed GIBD at Rp. 1.1 trillion [7]{7}. The majority of GIBD receivers are within 5 main industrial sectors chosen earlier for Industry 4.0 transformation.

There are plenty of benefits if a company transforms to Industry 4.0. The implementation can improve productivities, maintaining competitive edges, increased knowledge sharing and collaborative working, cost effectiveness flexibility and agility, and better customer experience[8]. Applications of IoT and cloud-based technology enables an effective chain supply monitoring to help with the company in designing strategy for chain supply and production management [9], therefore avoiding production surplus [10]. Industry 4.0 automates production process, improving repeating tasks and reducing mistakes and lapses, as well as reducing costly defects and improving productivities as well as consumer's satisfaction [9]. The implementation of Industry 4.0 also enables company to increase or reduce production numbers as well as introducing new product line [11] to increase market absorption from more market segmentations.

In accordance with governments's effort for the implementation of Industry 4.0 strategy and roadmap, as well as to assess the readiness level of Industry 4.0 from companies receiving GIBD, it is imperative for a readiness assessment of Industry 4.0 for manufacturers eligible for GIBD. This paper is a result of a research which aims to assess the readiness of Industry 4.0 for GIBD-eligible manufacturers based on Industry 4.0 readiness model developed by Almamalik[12].This model is used to complete the activity report of industrial verifications for GIBD by PT Surveyor Indonesia. The summary of the developed model is going to be explained on the next section. On Section 3, a summary of research methodology is going to be described. Section 4 is a discussion and analysis of the data gathered during the research. A conclusion will be served on the section 5.

II. INDUSTRY 4.0 READINESS MODEL

The model designed to assess the readiness is based on [12], and consists of 5 analytical dimensions: Technology, Product and Services,

Company Operation Processes, Strategy and Organisation, and Human Resource. All 5 dimensions are assumed of the same importance for assessment. Table 1 shows the dimension for readiness assessment model for Industry 4.0 as well as all the sub-dimensions, totaling 30 sub-dimensions in all. The measurement and grading of each sub-dimensions are done using one indicator set with ordinal scale, related to qualitative characteristics used as a reference for evaluation. Assessment criteria for each sub-dimensions are divided in 6 levels of readiness from 0 to 5, with 0 as the lowest attribute that supports the Industry 4.0 concepts, and 5 representing the highest state of the art from said attributes.

TABEL 1
DIMENSION AND SUB-DIMENSION FOR READINESS FOR INDUSTRY 4.0

Dimension	Sub Dimension
Technology	Automation, preparedness of tools, integration and interoperability of machines, operational data acquisition, IT and data security, IT support, Technological capabilities in data processing and analysis
Product/Service	Product customisation, data-based service, digital feature of a product, data usage level
Company operations	Vertical & horizontal integration, data exchange level, chain supply, chain supply visibility & flexibility, integrated procuct cycle, digital modeling, operational data usage, autonomous process
Strategy/Organization	Preparedness in strategy implementation, strategy and management, collaboration, innovation management capability, investment strategy, financing, organisational formulation/structure, leadership team, work team
Human resource	Human resource capability, management leadership competence, learning process, adaptation process

In general, here are the levels of assessment for each sub-dimensions:

Level 0, Not ready, where a company shows unpreparedness and/or not qualified for Industry 4.0 transformation.

Level 1, Beginners, where a company is starting to get involved in transformation process through exemplary initiatives in several departments as well as investing in one subject.

Level 2 Intermediate, where a company alreadi included Industry 4.0 transformation in its strategic orientation.

Level 3 Experienced, where a company already formulated Industry 4.0 strategies, as well as implementing it in several areas.

Level 4 Expert, where a company has implemented the Industry 4.0 transformation in most of its area as well as monitoring transformation with appropriate indicators.

Level 5 Top Performer, where a company has implemented the strategy and regulary monitors the implementation status.

Afterwards, all six levels are categorised into 3 groups: Newcomers, Learners, and Leaders, which can represent the assessment result better. This grouping also helps with generating conclusions about the advancement and condition in regards with Industry 4.0 transformation, as well as identifying specific action items according to the implementation level. Newcomers include all level 0 and 1, companies which did nothing or very little in regards to the transformation. Learners are a group of level 2, companies which already taken early steps in implementing transformation. Leaders are a group of level 3 and above, companies which are on their way of implementing the Industry 4.0 transformation.

III. RESEARCH METHODOLOGY

The first step of this research is literature study, evaluating and analysing the currently available models for Industry 4.0 readiness models, as well as executing a semi-structured interview with experts and practitioners to devise an assessment model for readiness level for smart manufacturing industries [12].

Second step is data acquisition by doing a survey to GIBD-eligible companies using Industry 4.0 assessment questionnaires. Before field survey is done, questionnaires are delivered to each company by e-mail so that every company can study as well as identifying internal situation withing the company in accordance to the questionnaires. Appointed representatives will then execute an independent assessment to fill the questionnaire. Next step is an interview to confirm several points regarding the questionnaire answers. The data

acquisition is helped by Surveyors from PT Surveyor Indonesia.

The final step is to analyse and process the data acquired to assess the readiness level of GIBD-eligible companies. Each companies with be assessed by each dimensions, with dimension readiness index of Industry 4.0 being the average value of readiness from all sub-dimensions in each dimension, and the readiness index of Industry 4.0 being the average value of readiness in all indicated dimensions.

IV. RESULTS AND ANALYSIS

According to survey, from 113 GIBD-eligible companies surveyed, there are 100 companies returning the questionnaires, with 41 companies under Directorate General of Metal, Machinery, Transportation Equipment, and Electronics Industries (MMTEI) and 59 companies under Directorate General of Chemicals, Textile and Miscellaneous Industries (CTMI).

Here are the assessment result of Industry 40 readiness, obtained from 100 responding companies using Industry 4.0 readiness model designed.

Profile of Respondents

Figure 1 shows the numbers of respondent companies which filled all the questionnaires, grouped based on the workforce number, starting from 20 – 99 personnel, 100 – 249 personnel, 250 – 499 personnel danlebihdari 500 personnel for MMTEI, CTMI, and overall. It can be deducted that companies with more than 500 workforces has themost respondent with 55 companies. 22 of those comes from MMTEI and 33 from CTMI. Companies with 20-99 workforces are the least numerous with 7 companies, 3 from MMTEI and 4 from CTMI.

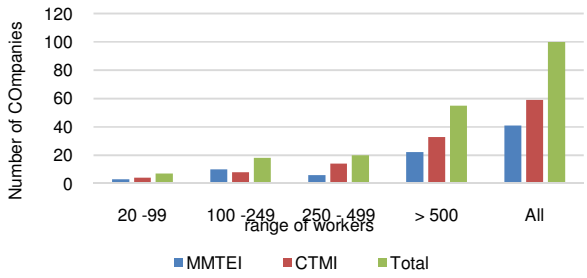

Fig. 1. Numbers of respondents/workforce numbers grouping

Figure 2 and 3 shows the distribution graphics of company respondents for MMTEI and CTMI sectors, respectively.

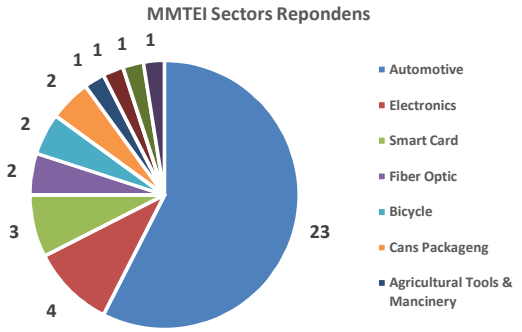

Fig. 2. Numbers of respondents from MMTEI sectors

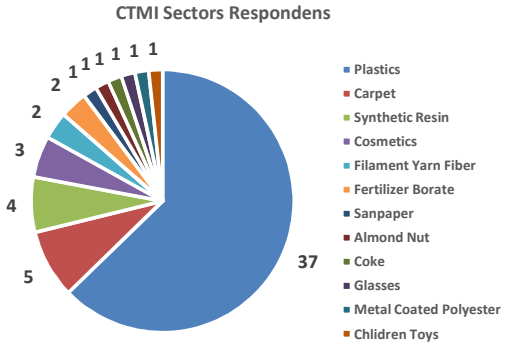

Fig. 3. Numbers of respondents from CTMI sectors

Figure 2 shows a pie graph of distribution for company respondents in MMTEI sector, with 23 from auto industry, 4 from electronics, 3 from smartcard, 2 for fiber optic cables, bicycles and cannery industries, and one for farming machinery, telecommunications, steel piping, metals and

electro-powers Meanwhile, Figure 2 shows a distribution in CTMI sectors, with 37 coming from plastic industries, 5 carpet companies, 4 synthetic resin companies, 3 cosmetic companies, 2 borax fertilizer and filamentous thread companies, and one sandpaper, almond, kokas, eyewears, metal-layered polyesters, and children's toys industries each.

Assessment result for Industry 4.0 readiness

Figure 4 shows a radar graph to visualise readiness level for all GIBD-eligible companies assessed, as well as from each sectors. Table 2 shows average calculation from each dimension from every sectors. It can be deducted that average readiness level of Industry 4.0 for GIBD-eligible companies are 2.2, with 2.17 in MMTEI sectors and 2.25 in CTMI

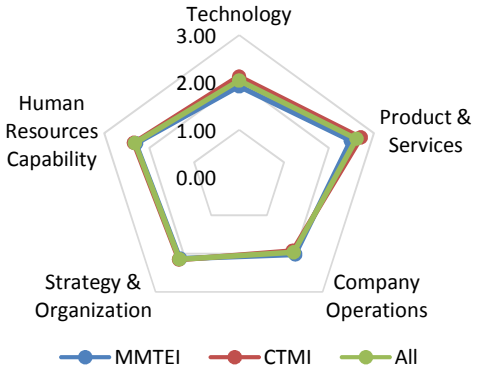

Fig. 4. Radar graph of assessment result on Industry 4.0 readiness for all companies

Figure 5 shows the overall percentage of GIBD-eligible companies based on the readiness level, as well as percentage from each dimensions. It can be seen that, overall, 7% of companies are still not prepared, with 34% on beginners level, 45% in intermediate level, 12% are experienced, and 2% are experts. None of these companies are at the best level. The average result of Industry 4.0 readiness in technology, operational, strategy/organisation and HR are on beginners level, while products and services are mostly on intermediate and experienced level.

TABLE 2
READINESS LEVEL OF INDUSTRY 4.0 FOR GIBD-ELIGIBLE COMPANIES

Dimension	Sector		
	Overall	MMTEI	CTMI
Technology	2,04	1,92	2,12
Product&service	2,61	2,48	2,70
Operation	1,97	2,02	1,93
Strategy&Organisation	2,15	2,13	2,16
Human resource Capability	2,32	2,29	2,33
AVERAGE	2,22	2,17	2,25

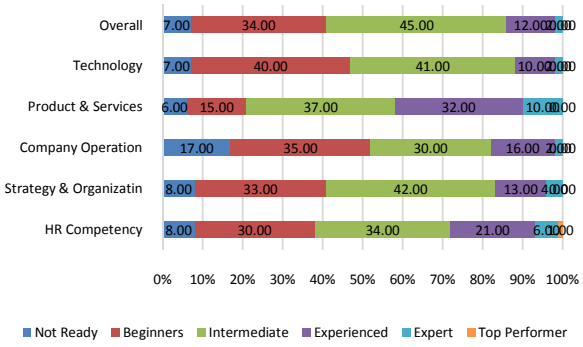

Fig. 5 Percentage of Number of GIBD Companies Based on Industry Readiness Level 4.0 for Overall and Each Assessment Dimension

Figure 6 shows percentage of GIBD-eligible companies for MMTEI sectors, based on readiness level for each dimension. It can be seen that MMTEI sectors are mostly on beginners level in technology, with operations, strategy/organisation, and HR on intermediate, and products/service on experienced level.

Figure 7 shows percentage of companies from CTMI sectors, using the same basis as previous figure. It can be deducted that CTMI sectors are mostly in intermediate level for technology, products/service, and strategy/organisation, while operationals and HR are still on beginners.

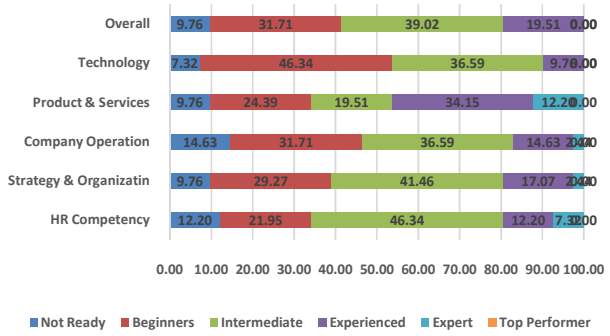

Fig. 6. Percentage of MMTEI companies based on readiness level for overall and each dimension

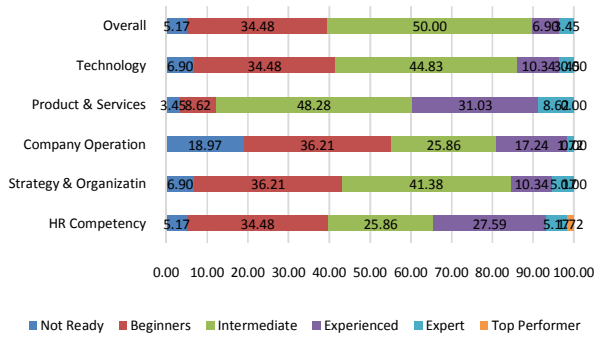

Fig. 7. Percentage of CTMI companies based on readiness level for overall and each dimension

Figure 8 shows percentage of companies in each levels (newcomers, learners, and leaders) for each dimension. It can be seen that 41% of these are newcomers, with 45% learners and 14% leaders. In technology, operations and HR, most of these companies are still newcomers, while for strategies/organisations, there is an equal division between newcomers and learners.

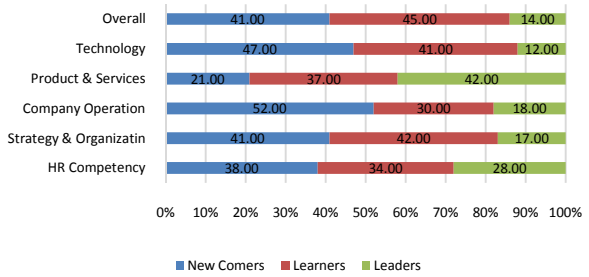

Fig. 8. Percentage of all companies based on level grouping of the readiness level for each dimension

Figure 9 shows overall percentage of the companies as newcomers, learners, and leaders through all the dimensions, as well as percentage for each sectors. It can be seen that CTMI sectors has more learners than MMTEI, with more leaders in MMTEI in comparison with CTMI.

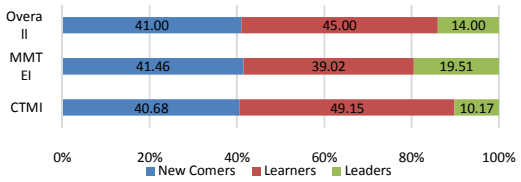

Fig.9. Percentage of all companies based on level grouping of the readiness level for all dimensions

V. DISCUSSION

In general, based on the assessment of the Industry 4.0 readiness, average index levels both for overall as well as in each sectors are within intermediate levels. MMTEI sectors has lower index than CTMI, and through 5 assessed dimensions, MMTEI has higher levels than CTMI in terms of operations.

From technology, based on the survey, CTMI sectors are dominated by plastic industries, which in their production processes already implements automation and control system devices are mandatory. In contrast, MMTEI sector, dominated by auto industries and electronics, still uses human workers in their production process as well as operationals. In this case, the technology used in both sectors properly represents the average index of the readiness in Industry 4.0. From products and

services, CTMI sectors have the advantage of data customisation levels in comparison with MMTEI. In operations, CPS integration, data exchange rate, supply chain, its visibility and flexibility, as well as company operational data usage, MMTEI sectors have higher index than that of CTMI. In terms of strategy/organisation, both sectors have good working team. Companies usually have good working team with works and tasks facilitating teams during work, even though the conditions are pretty average. Meanwhile, in terms of management, company only started to identify the business strategy in the company, and in investment, most companies have just planned on investing in Industry 4.0.

In human resources, most GIBD-eligible companies are still lacking in experience and expertise, as well as in adaptation process for digital technology in regards with IoT, CPS, cloud, and so forth. In terms of learning process, each company has their own curriculum for formal learning and development, with the scope limited in skill acquisition.

Lastly, if GIBD-eligible companies are assessed based on the category, it can be inferred that the readiness level for most companies are on newcomers and learners level. From both sectors, CTMI has more learners than MMTEI, while more MMTEI sectors are in leaders level compared with CTMI.

VI. CONCLUSION

The result of the assessment on the readiness level of Industry 4.0 for all assessed companies shows that 37% of the companies has started their transformation into Industry 4.0 through exemplary initiatives in many departments, as well as investing in one subject (beginners), and 45% of the company now includes the transformation into their strategic orientation (intermediate). No company has implemented the transformation strategy and regulary monitors the implementation (best), but 2% already uses the transformation strategy in most area, monitoring it with appropriate indicators (expert).

Readiness index for technology, products/services, strategy/organisation, and human resources for CTMI companies are higher than that of MMTEI companies. Meanwhile, MMTEI companies has the edge over CTMI companies in terms of company operations. Index value for Industry 4.0 readines for each dimension ranges from 1.92 and 2.7, with majority over 2. The type of industries, in particular products that are made, has an effect on the readiness level, especially in terms of technology.CTMI sectors mostly dominated by plastic industries, where automation and control system devices are mandatory. One important note is the weak human resource dimension, where in general most of these companies are lacking in experience, experties, and adaptation process in regards of digital technology. The success of Insudtry 4.0 transformation strongly depends on the culture and preparedness of the human resources in the companies.

Within most companies in assessment, most of them did nothing or very little in regards of mplementing Industry 4.0 transformation (newcomers) or had just taken first steps in implementing the transformation (learners). CTMI sectors has more learners than MMTEI, with more leaders in MMTEI than CTMI.

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