



Accelerating Industry 4.0 for Plant Efficiency Case of PT. Bangun Perkasa

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ABSTRACT: Industry 4.0 buzz has moved from hype to investment and real benefit today. Many companies expect to significantly increase their portfolios of digital products, services, and operations. Hence, the companies have a mission to have highly digitalized horizontal and vertical value chain processes. The cement industry as one of the heavy manufacturing industries has a target to increase plant efficiency. It will include equipment efficiency, energy utilization, productivity, and production maintenance cost by implementing the transformation.

Cement market competition become more challenging and harder in Indonesia with the growth of new cement players. As the result, capacity was getting higher and higher. Even though the demand increase was not significant so the utilization of the cement industry drop to 60% approximately. Therefore, the need for cost efficiency is more urgent for business sustainability and one of the key factors is Industry 4.0 transformation.

This research will focus on the assessment and actual implementation of Industry 4.0 in the cement plant PT. Bangun Perkasa. PT. Bangun Perkasa is on level 3 with the predicate "Company is at MATURE step in Industry 4.0 transformation" by using INDI 4.0 (Indonesia Industry 4.0 Readiness Index) tool from Indonesia Ministry of Industry. As a result, most technologies that are considered as important to be accelerated and deliver more benefit for plant efficiency are big data analytics & advanced algorithms and smart sensors.

KEYWORDS: Big Data Analytics, Cement Industry, INDI 4.0, Industry 4.0, Plant Efficiency, Smart Sensors

INTRODUCTION

Industry 4.0 is creating value in cost and efficiency gains by real-time inline quality control based on big data analytics; modular, flexible, and customer-tailored production concepts; real-time visibility into the process and product variance, augmented reality and optimization by data analytics; predictive maintenance on key assets using predictive algorithms to optimize repair and maintenance schedules and improve asset uptime; vertical integration from sensors to real-time production planning for better machine utilization and faster throughput times; horizontal integration as well as track and trace of products for better inventory performance and reduced logistics; digitization and automation of process for smarter use of human resources and higher operations speed; system-based real-time end to end planning and horizontal collaboration using cloud-based planning platforms for execution optimization; increased scale from an increased market share of core products.

Before 2012, not many cement players in Indonesia. It was only about 8 cement companies that exist. The utilization of production in the plants were high, up to 90%. Almost all production will be absorbed by the market.

With that situation, many investors built the cement industry in Indonesia. As the result, capacity was getting higher and higher whereas the demand increasing was not significant so the utilization of cement industry drop to 60% approximately as shown in Figure 2 about cement market in Indonesia. And the situation is remaining until now that cement market competition is more challenging and harder. During the pandemic of Covid-19, many business sectors became slowing down including the cement industry. Cement demand was lower and impacted company revenue and probably margin if the company can not be efficient.

Industry 4.0 is expected able to improve plant efficiency, energy consumption in the plant can be reduced, and as a result cost of production and maintenance become lower. This situation is needed to face harder cement competition where sales volume might be lower and the margin of product sold, revenue can be maintained or even higher.

LITERATURE REVIEW

Global Industry 4.0 Transformation

In line with the need for innovation in the industrial sector, as well as efforts to accelerate licensing, simplify bureaucracy, and reform regulations, economic transformation is encouraged through Making Indonesia 4.0. Based on Presidential Regulation (Perpres)



Number 18 of 2020 concerning the 2020-2024 RPJMN, the application of industry 4.0 is one of the major projects to increase productivity, efficiency, the contribution of the added value, competitiveness, and sustainability of the national industry.

Ministry of Industry built regulation about the measurement of Indonesia industry 4.0 readiness index (INDI 4.0) to be implemented based on "Peraturan Menteri Perindustrian Republik Indonesia No. 21 Tahun 2020". Cooperate with Ministry of State-Owned Enterprises, all SOEs need to do INDI 4.0 assessment until 2024 to speed up the processes and lead to economic transformation.

There are five pillars used in INDI 4.0 which are

1. Management and organization

On this pillar, the policy of the company leadership to transform its factory to industry 4.0 will be measured. It is for finding out how much support from management to create a system production becomes more efficient with Industry 4.0. This is because the strategy companies, corporate investments, and support from management become very important in the successful transformation of Industry 4.0. Besides the structure organization is also an assessment, for example about the availability of special departments/teams to transform the company into Industry 4.0.

2. People and culture

People are elements very important in the process of company transformation to Industry 4.0. This also includes the culture of the employee's company, such as discipline, will to continue to learn, and local wisdom. Employees who tend to be open with change will be better prepared for transforming to Industry 4.0, vice versa if employees are antipathetic towards there being a change, the company will more difficult to implement Industry 4.0.

3. Products and services

Products that have been integrated with Industry 4.0 is products that have technological features in them, as if you already have an interface that can be connected the to internet, has a data storage feature (RFID, barcode, etc.), and products that have been customized according to the wishes of the user. Meanwhile, data-based smart services also show that the company has started using Industry 4.0 based technology. The use of data from customers for the development of service and product systems is also the element measured to know the company's readiness to enter Industry 4.0 and implementation.

4. Technology

Technology in Industry 4.0 is very diverse, ranging from intelligence artificial, 3D printers, augmented reality, robot collaboration, etc. In Industry 4.0 what must be there is connectivity between machines and between systems (vertical) and horizontal integration). In this pillar, INDI 4.0 the extent to which the use of technology supporting Industry 4.0 will be evaluated to measure readiness the company is transforming to Industry 4.0.

Another important thing in this pillar is the existence of digitization in the entire system production and corporate cyber security.

5. Plant operation

This pillar is also very close concerning the use of technology in a plant operation. This matter includes supply chain systems and logistics enterprise, maintenance system application intelligent machine/system, production process which are already autonomous/automatic and exist data storage and control system which is centered.

The value range of INDI 4.0 is from level 0 to level 4. A value of 0 means the industry is not ready and a value of 4 means the industry is ready to implement Industry 4.0 in most systems production. For INDI 4.0 each pillar is weighing 17.5% except People and Culture pillar with 30% because, in Indonesia, success or failure company transformation towards Industry 4.0 is very dependent on the culture and readiness of the person who will carry out the transformation.

Table 1. INDI 4.0 Score Level

Score Range	Level	Classification
0 – 0.50	0	The company is NOT READY to implement Industry 4.0
0.51 – 1.50	1	The company is at INITIAL step in Industry 4.0 transformation
1.51 – 2.50	2	The company is at MEDIUM step in Industry 4.0 transformation
2.51 – 3.50	3	The company is at MATURE step in Industry 4.0 transformation
3.51 – 4.00	4	The company ALREADY IMPLEMENTED Industry 4.0 transformation

Industry 4.0: Building the Digital Enterprise

Whereas PwC release Global Industry 4.0 Survey which talking the main eleven technologies used in industry 4.0 as shown in Figure 1. Then there are some key points related to global industry progress towards transforming into a digital enterprise which is 1) From talk to action, 2) Digitization drives quantum leaps in performance, 3) Deepen digital relationships with more empowered customers, 4) Focus on people and culture to drive transformation, 5) Data analytics and digital trust are the foundation of Industry 4.0, 6) Robust, enterprise-wide data analytics capabilities require significant change, 7) Industry 4.0 is accelerating globalization, but with a distinctly regional flavor, 8) Big investments with big impacts: it is time to commit.

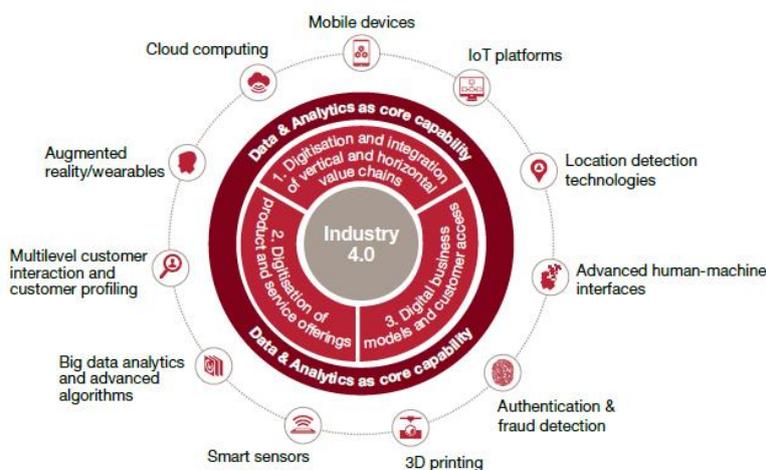


Figure 1. Industrial 4.0 Framework and Contributing Digital Technologies
(Source: PwC, 2016)

METHODS

This research will use a qualitative method approach and data collection by process of an in-depth structured interview with purposive sampling. The respondents are the key persons and middle top management of industry 4.0 in the company. With purposive sampling, the assessment and the answers will be representative for the company to identify current industry 4.0 activities running, program planning, and the ideal target industry 4.0 transformation in the plant. Direct observation from the researcher which is an employee at PT. Bangun Perkasa with more than 13 years of work experience and is involved directly in industry 4.0 transformation process in the plant. And also secondary data is taken from internal and external literature so that the framework and data analysis will be compared with some of the best practices in the literature.

The interviews were done with a person by a person both online and offline. The interview questions were developed by literature study and direct observation from the researcher whereas the content can assess the current situation of industry 4.0 implementation in descriptive, open-ended, and level options as well. The questions also are expected able to find out the ideal situation of industry 4.0 which is applicable to be implemented in the plant of PT. Bangun Perkasa.

The questions are divided into two sets of questions, 1) Questions are based on assessment INDI 4.0 Ministry of Industry and added some questions to know the reason behind the answer, 2) Second are based on PwC journal and modified to explore respondent opinions related to the research objective. The questions ask the importance level of industry 4.0 categories to be implemented in the plant of PT. Bangun Perkasa. Then the question about the impact of industry 4.0 categories to improve plant efficiencies. Another question asks whether each category of industry 4.0 has already been implemented in the business process of plants and the ideal business process to implement those categories.



Table 2. Sequence Data Analysis and Collected Data

No	Data Analysis	Collected Data
1.	Current industry 4.0 implementation in cement plant PT. Bangun Perkasa Tbk.	level readiness INDI 4.0 in each part and reason, the current condition of implementation question each category of industry 4.0 whether already implemented in the business process of plant or not and the location of implementation
2.	The impact of industry 4.0 in each category	The second bundle of questions asking the impact each category of industry 4.0 related to plant efficiencies and the impact level Literature study
3.	The ideal industry 4.0 implementation for cement plant PT. Bangun Perkasa Tbk.	The maximum level of INDI 4.0 in each part Question each category of industry 4.0 for the ideal cement business process to implement those categories Literature study
4.	The gap of industry 4.0 implementation in cement plant PT. Bangun Perkasa Tbk.	The current score of INDI 4.0 in each category compared to the maximum level The difference of current and ideal implementation for cement business process or departments
5.	The categories prioritization of industry 4.0 to be accelerated for plant efficiency	The second bundle of questions asking the prioritization to be accelerated
6.	The recommendation how to accelerate industry 4.0	The first bundle of questions in INDI 4.0 asking about the challenge and the expectation to government The second bundle of questions asking how to accelerate the prioritized categories of industry 4.0

RESULTS

Indonesia Industry 4.0 Readiness Index (INDI 4.0

Management and Organization

From the respondent interview evaluation, management gave very well full support for industry 4.0 transformation. It is indicated from this transformation led by the manufacturing director himself and regularly review for the progress of project running and new initiatives. Not only from the monitoring and direction but top management also allocate the budget for many new projects and CAPEX. The main challenges to be good at this part are management investing more budget to implement another pilot project, training & certification, and strategy of Industry 4.0 in the plant.

People and Culture

PT. Bangun Perkasa has a good culture in time management, willingness to learn, and openness for change. Before being acquired by SOE, the company belonged to a multinational company and it made some industry 4.0 transformation culture already embedded in most of the people. The employees also have a very good working ethic, finish the job with good quality and dedication. And also generally the employees are ready for continuous improvement, critical and open, international-minded, and flexible for the change. To support industry 4.0, the company already did some routine socialization through business briefing events by BOD every quarter. In that event, BOD and the team inserted agenda to present the importance of industry 4.0, the progress of current company did and the planning for the future. Socialization was also held before launching the project.



Product and Services

PT. Bangun Perkasa as a cement industry produces cement in the bulk truck and bag packaging. There is some type of cement for different purposes and customers. PT. Bangun Perkasa produce 7 type of cement. Each type has specific material composition and quality target. Customer number of PT. Bangun Perkasa is more than hundred. So the customer should choose which type of cement will be bought and used for their purposes. Even cement industry competitors only produce 1 or 2 types. So company cannot customize exactly what customer wants an especially retail and small number of sales. There is a case that customers with a big number of sales volume through B2B request certain cement quality then PT. Bangun Perkasa accepted, prepared the formulation, certain storage, and production. PT. Bangun Perkasa becomes cement company with the most type of cement product in Indonesia.

Technology

Some technologies of industry 4.0 that already been implemented in PT. Bangun Perkasa which area computer networking, artificial intelligence, industrial internet of things (IoT), RFID, industrial robotic, ERP, PLC SCADA, augmented reality/wearable, online OEE, M2M connectivity. Related to digitalization, the company surely already implemented this initiative many years ago. The respondents consider digitalization level is about 50% and others consider almost 100% digitalization is into all business processes. For example, the company has a management report using application social media and Microsoft power BI going to mobile devices which integrated to big data gathering TIS by IoT.

Plant Operation

PT. Bangun Perkasa stores the data mostly in the company internal server and is managed by IT department and some data such as ERP / SAP already in the cloud. In the supply chain business process, a barcode exists in the product packaging. So, it will identify the line production, dispatched cement storage, packer code, and time of production. When there is an abnormality of product or customer complaint then it will help to track the production and quality of material to solve the issue. In a trucking system, GPS is utilized to monitor movement, efficiency, and safety. The logistic team and the owners of the transporter can see the truck movement in the system. During the fulfillment of material, equipment, or spare part, the company’s ERP system that already been integrated with some contracted suppliers or vendors.

On the maintenance side, the company tends more to be preventive. There is a master and weekly schedule to plan the maintenance of every main piece of equipment. However, maintenance department has a team to do condition base monitoring means to check the equipment manually to the field and the finding will trigger equipment that needs to be stopped and repaired before breaking down. Besides that, from DCS and TIS systems, the operators and engineers can know some parameters for the equipment in real-time depending on the sensors that have already been installed, such as vibration, temperature, skew, etc. The finding will lead to a request for some persons related to check the real condition on the field.

As the result of INDI 4.0 assessment, PT. Bangun Perkasa with the predicate “Company is at MATURE step in Industry 4.0 transformation” can have a lot of opportunities to catch up the gap and speed up the transformation so the goal to improve plant efficiency, productivity, and cost reduction can be achieved.



Figure 2. Gap Identification INDI 4.0 Score at PT. Bangun Perkasa



Industrial 4.0 Framework and Contributing Digital Technologies

Each technology category industry 4.0 based on PwC will be assessed to understand the importance level and the impact for cement plants. Based on respondent interviews and secondary data, the recommendation is created to accelerate industry 4.0 transformation, prioritize the actions for plant efficiency in PT. Bangun Perkasa.

Table 3. Assessment Result Table PwC Framework PT. Bangun Perkasa

No	Category	Score importance vs impact (Prioritization)						Score avg	
		MU	KH	EN	BU	SA	RE		KU
1	Big data analytics and advanced algorithms	9	9	6	9	9	9	9	8.6
2	Multilevel customer interaction and customer profiling	2	6	6	1	1	1	1	2.6
3	Augmented reality / wearables	6	6	2	4	6	9	6	5.6
4	Cloud computing	3	6	9	9	9	2	2	5.7
5	Mobile devices	9	6	6	9	9	9	6	7.7
6	IoT platforms	9	3	6	9	9	6	2	6.3
7	Location detection technologies	2	2	3	9	2	1	4	3.3
8	Advanced human machine interfaces	4	2	9	9	9	9	2	6.3
9	Authentication & fraud detection	1	1	1	4	6	6	3	3.1
10	3D printing	6	2	1	2	1	6	1	2.7
11	Smart sensors	9	9	9	9	9	9	6	8.6

Big data analytics & advanced algorithms and smart sensors are considered as the most important technology to be implemented and able to deliver maximum benefit for cement plant efficiency in the case of PT. Bangun Perkasa. Whereas multilevel customer interaction & customer profiling and 3D printing are less needed in the scope of the cement manufacturing plant. However, those will give more benefits for product application and sales and marketing units.

PT. Bangun Perkasa had implemented big data analytics in some business processes like production and waste management as a pilot project. The output of this category still needs to be utilized better. Some big data is only for collection and not yet used. Then for the storage of this big data currently in local server. The storage is supposed to be integrated with the other category such as cloud computing to be more beneficial. Data analytics, artificial intelligence (AI), machine learning (ML), and advanced algorithms will be classified in this category.

Become integration tools of big data analytics, AI and ML will support the output of big data. From the failure, follow-up action, or target data, this system will learn how to handle some kind of frequent problem, how to react and act, and parameter adjustment. The output of the new process parameter will trigger advanced algorithms to instruct the program to adjust accordingly to solve the problem or create better process conditions or achieve the targets. All the processes might run automatically without the interruption of humans. Some work from engineers for analysis can be supported or even replaced by this system

PT. Bangun Perkasa as a cement manufacturing company will be highly impacted if smart sensor technology can be implemented well. Another pilot project for smart sensors can be tried in the different equipment in the plant. The cement plant has more than hundreds of pieces of equipment in the field and the equipment is typical. So when equipment type A is succeed with smart sensors, most probably other equipment with the same type A will also succeed. Smart sensor technology needs an internet connection to transfer the data in the field to users or a web-based dashboard. Hence, the internet infrastructure in the plant must be able to support smart sensors (located in the field) and other industry 4.0 categories. For maximum benefit, smart sensors might be integrated with other industry 4.0 categories such as IoT platforms.

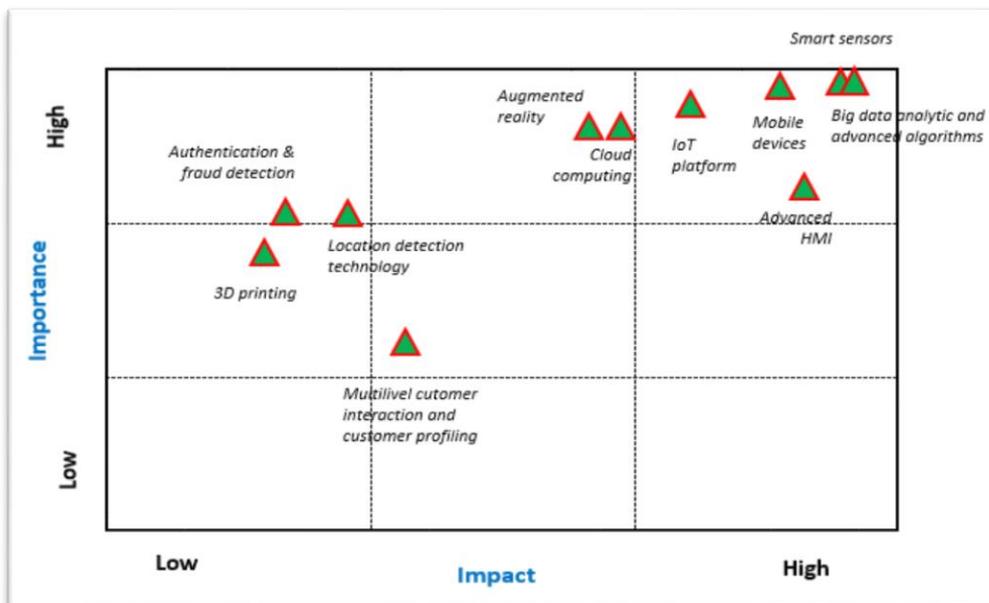


Figure 3. Prioritized Industry 4.0 Technology Implementation for Plant Refer to Importance and Impact

DISCUSSION

Knowing the current Industry 4.0 implementation and the ideal transformation needed, gap analysis of industry 4.0 implementation can be identified and followed up by timeline both CAPEX and OPEX project and expected able to increase plant efficiency in the equipment, energy consumption, productivity, production, and maintenance cost. In addition, Industry 4.0 can support the sustainable development goals of the company in many aspects and is relevant to climate change issues as well as zero carbon emission.

With efficient operation in cement plant so the margin and revenue can be maintained even though the cement sales volume is decreasing. Energy costs both thermal and electrical are the main production cost that still has room for improvement for innovation and efficiency through industry 4.0 technologies.

People and the competencies also become the management task to understand and master new technology so the utilization can be maximized. The organizational transformation will be part of it and also develop internal resources and consider external resources to support Industry 4.0 transformation.

PT. Bangun Perkasa as part of SOE also needs and expects support from the government to accelerate Industry 4.0 implementation. This could be from the regulation, resources, system, infrastructure, and all components that can collaborate internal and external initiatives to move forward.

CONCLUSION

Currently PT. Bangun Perkasa is at “Company is at MATURE step in Industry 4.0 transformation” with a score of 2.92 using INDI 4.0 assessment. All sections on average are on level 3 between the ranges of 2.5 – 3.5. The lowest score is on a section of “Product and Services” and the highest score for a section of “Plant Operation”.

Looking at industry 4.0 technology categories as PwC framework, PT. Bangun Perkasa needs to accelerate 5 prioritized technologies implemented in the cement plant which are big data analytics and advanced algorithms, smart sensors, mobile devices, IoT platforms, and advanced human machine interfaces. Those categories are considered important and able to deliver a big impact on plant efficiency.

To close the gap, accelerate industry 4.0 transformation, and deliver more benefit to the company, some actions need to be followed up. In the pillar of Management and Organization: speed up a pilot project and multiplied to other business processes with firm technology, budget allocation for industry 4.0 strategy implementation both CAPEX and OPEX scheme, maximize industry 4.0 team, hire Machine Learning, Big Data Analytics for a plant, routine socialization, and empowerment from management to all departments,



and work together with technology third party the customized by the plant. For the pillar of People and Culture: conduct more training, certification for all employees following their needs and job and create industry 4.0 competition for all employees, mix millennial and senior employees. For pillar of Product and Services: focus benefit industry 4.0 for plant efficiency, productivity, and cost optimization, and utilize and analyze big data more effectively. Then a pillar of Technology: Certification of ISO 27001 can be planned for improvement, online monitoring using Technical Information System can be optimized and generated for more equipment, and improve internet network and infrastructure in the plant and need government support also. Whereas pillar of Plant Operation: select the right technology, sensors, compatibility with cement plant and continue automation for non-critical equipment and use IoT for remote or far location.

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Cite this Article: Ronny Pujiwiyono, Dedy Sushandoyo (2022). Accelerating Industry 4.0 for Plant Efficiency Case of PT. Bangun Perkasa. International Journal of Current Science Research and Review, 5(1), 189-197