

CHAPTER

4

SUSTAINABLE PRODUCTION EQUIPMENT IN INDUSTRY 4.0

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4.1 INTRODUCTION

Production equipment (PE) refers to both standard and customized design tools, jigs, fixtures, and machinery used in the manufacturing industry to reduce labor cost and minimize process variation at the same time to improve the overall productivity. The PE manufacturers play a very important role in the development and growth of the manufacturing industry in Malaysia by providing essential support to manufacturing industries in terms of the design of production equipment, fabrication, testing, and maintenance. Hence, the design, fabrication, maintenance, or, in short, the manufacturing process of production equipment has now become one of the core management focuses within the highly competitive and innovative manufacturing environment (Kowang et al., 2019).

Traditionally, production equipment manufacturing (PEM) is not the core of management focus. Conventionally, the subject of PEM was focused on the following areas (Chatha & Butt, 2015; MacDougall, 2014; The Manufacturing Institute, 2009):

- (1) Knowledge Management: Knowledge development for different areas where production equipment can be applied, including the design, structure, and functions of PE, as well as the related

knowledge on computer programming software and technologies that could be applied on PE.

- (2) Project management, which includes the capability to plan, organize, and install manual or automated PE in accordance with customers' requirements and safety regulations.
- (3) The maintenance and calibration of PE.

The Fourth Industrial Revolution, commonly known as Industry 4.0 refers to the revolution of the entire value chain process in the manufacturing industry on the basis of a cyber-physical production system (CPPS). (Qin et al., 2016). In manufacturing, Industry 4.0 adopts information and communication technology (ICT) and links information technology (IT) with mechanical and electronic components that can communicate with each other via a network system to form a CPPS.

Industry 4.0 emphasizes a CPPS. The CPPS's principle works via linking information technology with mechanical and electronic components that communicate with each other via a network. In addition, the central importance of Industry 4.0 is that it interconnects with various smart infrastructures across the value chain, such as smart logistics and smart mobility (Glas & Kleemann, 2016). Hence, the manufacturing of the PE within the arena of Industry 4.0 is no longer confined to a single or unique project. A PE design needs to share a certain degree of community or use of a common IT module in order to interface with other smart production equipment as well as smart facilities.

In par with the development of Industry 4.0, PE manufacturers have no choice but to expand the scope of connectivity with the manufacturing industry beyond the traditional boundary that is limited to business transaction activities alone (Kowang et al., 2019). Production equipment manufacturers need to embed more intelligence connectivity to leverage their knowledge of production equipment designs, maintenance, and fabrication in order to provide additional value-added services to the customers, particularly services that enhance the

Industry 4.0 development (Stock & Seliger, 2016), such as PE with the flexibility to adapt to changes in the other value creation factors, e.g., highly automated machine tools and robots in production equipment that work collaboratively with the workers on joint tasks. Hence, in the Industry 4.0 era, the concept of production equipment design is complicated and needs special attention throughout the fabrication to the setup and operation in the manufacturing industry environment.

With the expansion of the roles played by PE in the modern and innovative Industry 4.0 manufacturing environment, the manufacturing process of PE should go beyond the traditional knowledge and project management-based strategy. However, the question of what the best process strategy for PEM is still remains ambiguous because the adaptation of Industry 4.0's impact into the production equipment manufacturing strategy is not a simple process. Hence, this chapter aimed to bridge the gap by exploring the best production equipment manufacturing process strategy for the machinery and equipment (M&E) companies in response to Industry 4.0.

4.2 MANUFACTURING PROCESS STRATEGIES

A strategy is an organizational activity that is realized through a stream of actions of coherence in a pattern. The realization of the strategy work is a part of the strategic plans, where the strategic plan is a process of delivering a strategy into actions and decisions across an organization (Säfsten et al., 2014). Hence, strategy is how an organization expects to achieve its missions and goals, and the scope of organizational strategy covers all levels of the organization, from the top management team to the frontline staff, and all levels of business and operation processes, including the manufacturing process (Chatha & Butt, 2015).

A manufacturing process is a method or way to perform the transformation of manufacturing resources (such as raw materials, labor) into semi-finished or finished goods (Adamides, 2015). Manufacturing process strategy outlines the best “resource to goods” transformation approach adopted by the manufacturer to achieve its