

**CHAPTER**

**2**

**APPLICATION OF SUSTAINABLE-  
VALUE STREAM MAPPING IN THE  
ELECTRONIC INDUSTRY**

*Norhazrina Jamil, Muhamad Zamari Mat Saman, and  
Nur Safirah Bahuriddin*

**2.1 INTRODUCTION**

Industry 4.0 tremendously transformed the nature of manufacturing in the digitalisation era with increasing data availability and accessibility, bringing forward the market competitiveness in product/process design and quality control to fulfil customer satisfaction. On the other hand, sustainable manufacturing (SM) remains a focal point (Titmarsh et al., 2020). SM integrates systems and processes to produce quality products and services using adequate resources that are safe for communities (Machado et al., 2019).

In the past few years, there have been ongoing discussions among academicians and industrialists on sustainable manufacturing. Manufacturing processes and activities are deemed essential factors that contribute to significant planetary damage in terms of environmental, economic and social aspects (Dubey et al., 2015). By integrating sustainability and manufacturing, non-polluting manufacturing

processes that preserve energy and are economically sound and sustainable for society, workers, and customers can be developed.

The sustainable value stream mapping (Sus-VSM) is used to analyse one or two environmental, economic and social elements but has not been defined and structured properly (Dufrou et al., 2012). In general, research on this sustainable-oriented lean tool is still considered limited (Hartini et al., 2018; Powell et al., 2017), thus requiring a systematic review in this field to provide an overview the current situation and limitations of lean six sigma (LSS), clearly define the structure of LSS methodology and showcased it through an industrial case study. This chapter is organised into three sections. Section 1 highlights the background of LSS that focuses explicitly on the integrated sustainable lean manufacturing tool, Sus-VSM, while Six Sigma will focus on the based approach. Section 2 represents the industrial case study that applies the integration of sustainability and LSS, while Section 3 will highlight the limitations of the research and conclusion.

## **2.2 SUS-VSM AND DMAIC METHODOLOGY IN PRACTICE**

Table 2.1 shows the comparative analysis of various research conducted using lean manufacturing tools and six sigma (DMAIC) from 2007 to the present was improved by Vinodh et al. (2015). Powell et al. (2017) carried out integration of LSS research focused on environmental elements. Recently, Jamil et al. (2020) structured the framework of the DMAIC-based approach to Sus-VSM and practically validated it with an industrial case to support this narrow body of knowledge. This case study will be elaborated in detail in Section 3.

Based on the table above, many researchers have researched sustainability elements towards LSS methodology focused on applying traditional or extended value stream mapping (VSM) and Six Sigma. However, researchers tend only to consider one of two elements in their studies, while overall sustainability should consider all TBL, as Barrett and Sexton (2000) highlighted, that sustainability can be successfully improved and maximise the economic benefits by minimising the environmental and social impacts.

**Table 2.1** Comparative analysis for lean six sigma and sustainability elements research study

Authors	Research Focus	Lean Six Sigma		Sustainability Elements		
		Lean Manufacturing Tool	Six Sigma (DMAIC)	Environment	Economic	Social
Jamil et al. (2020)	Integrate the Sus –VSM and DMAIC approach for environmental, economic, and social concerns	Sus-VSM	+	+	+	+
Acero et al. (2019)	Created a VSM & VSD (value stream design) towards military logistics improvement activity	VSM VSD	+	-	+	-
Pereira et al. (2019)	Integrate Lean & Six Sigma in a case study for economic – OEE	VSM	+	-	+	-
Nedra et al. (2019)	Combined PDCA and DMAIC methodology in improving the process for clothing small- and medium-sized enterprise (SME)	PDCA	+	-	+	-
Erdil et al. (2018)	Developed framework by integrating VSM and DMAIC	VSM	+	-	+	-
Powell et al. (2017)	Integrate Lean & Six Sigma in a case study for environmental sustainability - Dairy Producer	VSM	+	+	-	-
Nagi and Altarazi (2017)	Incorporated VSM into the DMAIC approach, but with a focus on assessing the economic impact	VSM	+	-	+	-
Vinodh et al. (2015)	VSM integrated with LCA.	Integrated mapping	-	+	+	+

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