

CHAPTER 1 INTRODUCTION TO SUSTAINABLE MANUFACTURING

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1.1 INTRODUCTION

Sustainability is a crucial issue related to significant environmental concerns concerning pollution and consumption of natural resources. The concept of sustainability has been defined from various perspectives and has no universal definition. Sustainability has different meanings from different interpretations of people.

Many areas apply the concept of sustainability, especially in the engineering field. Currently, the issue of sustainability has become the primary concern among most manufacturers. For example, the decision-making relationship between the natural environment and manufacturing operations has become one of the essential aspects that will be considered among industrial societies.

Manufacturing companies face a pressing need or obligation to incorporate environmentally friendly practices into their marketing decisions to safeguard the environment and benefit society. Due to increased sustainability concerns, manufacturing companies have begun implementing ecologically sound processes. In modern manufacturing, implementing sustainable systems is necessary to minimise health and environmental risks, especially in conserving energy and natural resources.

Sustainable manufacturing (SM) has become an unstoppable world-wide trend in the manufacturing industry and has received much attention from various stakeholders. Askew and Desai (2018) stated that SM entails design for manufacturing to satisfy our current needs while allowing the next generation to fulfil their future demands. SM will give manufacturing companies a competitive advantage and help build a sustainable value-creation business.

The sustainable manufacturing approach has three primary levels: product, process, and system scales. These three levels will interact and provide the direction of sustainable targets. The most crucial part is understanding and defining the concepts and needs of the sustainability approach. Defining and understanding the implementation and assessment method is necessary to build a sustainable manufacturing system.

The SM is concerned with developing goods with minimal environmental effects and preserving energy and natural resources. As resource scarcity and pollution have become more severe in recent years, organisations have emphasised energy conservation and ecological preservation as their corporate social responsibilities (CSR) strategies and future direction. The manufacturing sector plays a role in the growth of the global economy by producing goods and services. SM has manufactured goods using cost-effective methods that reduce adverse environmental impacts. SM is receiving growing interest and achieving high industry and business recognition. Developing countries must implement effective policies and practices for long-term growth in sustainable development. Rosen and Kishawy (2012) stated that adopting sustainability in the industrial sector would undoubtedly be one of the most beneficial improvements to the companies. Therefore, companies should take on SM responsibilities and commitments, which can help alleviate social and environmental issues while promoting a positive brand image for economic gain.

However, Malek and Desai (2019a) discovered that many industrial sectors have yet to use SM in their products and processes. With the rapid growth of industrialisation in recent global trends, the manufacturing

industry has always neglected sustainable perspectives. In recent days, SM has been lauded for its considerable advantages at the triple bottom line (TBL) dimensions, namely social, environmental, and economic (Jayal et al., 2010). The TBL is divided into “3Ps”—profit, people, and the planet. These are expanding the aspects (also defined as pillars) that must be addressed when considering sustainability elements (social, environmental, and economic). Zarte et al. (2019) claimed that there is a need for a strong emphasis on integrating sustainability in all three dimensions at the strategic planning level rather than the operational level (production planning and controlling). Badurdeen et al. (2017) stated that all stakeholders’ economic, environmental, and societal (the TBL) effects and impacts must be addressed when creating sustainable value. SM concepts strive to improve the integration of these three elements in sustainability. Nevertheless, most manufacturing strategies focus on one or two elements individually or separately (Shankar et al., 2017).

The SM is an essential element that must be considered now and in the future. To enhance people’s understanding of sustainable manufacturing, this book will elaborate more on how SM works regarding concept and practicality. This book will consist of three parts in SM: concept, materials, methods, and tools. This book will introduce the SM by giving an overview of recent trends and current research in the SM area. Next, the concept of SM consists of sustainable-value stream mappings, remanufacturing systems, sustainability performance in Industry 4.0 applications, and sustainability of the supply chains. The materials part will cover sustainable materials for green lubricants and biomaterials. On the methods and tools, this book will cover the implementation of sustainability in machining and additive manufacturing. In contrast, tools will cover multi-criteria decision analysis and design for disassembly products.

1.2 SUSTAINABLE MANUFACTURING OVERVIEW

Moldavska and Welo (2017) stated that many definitions of SM in earlier work imply a lack of agreement on the actual meaning of the