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Strategies for Value Creation through Sustainable Manufacturing

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Abstract

Making the business case and establishing strategic directions for sustainable manufacturing requires a collaborative effort. Strategic capabilities that can help create sustainable value for all stakeholders must be identified. Technologies and methodologies to provide these capabilities for implementation must then be developed, through public-private partnerships. This paper presents major business imperatives and strategic capabilities necessary to enable value creation through sustainable manufacturing identified based on extensive engagement with business leaders and industry professionals as well as academic experts and government agency representatives. The paper also presents a future vision for sustainable products, processes and systems that can be derived from such capabilities.

Keywords: Sustainable manufacturing; Roadmapping; Business case

1. Introduction

Many definitions have been presented for sustainable manufacturing in recent times. According to one of the most comprehensive definitions, sustainable manufacturing, ‘at the product, process and systems levels must demonstrate reduced negative environmental impact, offer improved energy and resource efficiency, generate minimum quantity of wastes, provide operational safety and offer improved personnel health, while maintaining and/or improving the product and process quality with overall lifecycle cost benefits’ [1]. Traditional manufacturing practices have focused primarily on the pre-manufacturing, manufacturing and use stages of product lifecycles, leading to excessive waste and landfills. While lean manufacturing practices focus on waste elimination (Reduce), green manufacturing emphasizes the use of 3Rs (Reduce, Reuse and Recycle). However, none of these strategies enable maximizing value recovery from end-of-life products. Implementing sustainable manufacturing practices using a 6R (Reduce, Reuse, Recycle, Recover, Redesign and Remanufacture) methodology enables closed-loop, total lifecycle-based material flow [2, 3], with a holistic consideration at the product, process and system levels [4]. This evolution of
manufacturing strategies, for the entire lifecycle covering four lifecycle stages (Pre-manufacturing, Manufacturing, Use, Post-use), with value recovery through the various ‘R’s, as well as the corresponding gradual reduction in landfill through each strategy, is comprehensively illustrated in Fig. 1.

Progressive companies who understand the strategic importance of sustainable manufacturing practices are already taking steps to implement initiatives for more resource-efficient and socially-responsible business. However, according to some other reports, novices and slow adopters of sustainability initiatives claimed to see less financial benefits [6]. Therefore, if the broader industrial community is to be more engaged to embrace sustainable manufacturing practices, the economic and competitive issues of implementing such efforts must be identified and methods to address those concerns must be developed. This requires a business-focused view of describing sustainable manufacturing as an ‘enabler for the total success of the manufacturing enterprise, and it requires the integration and optimization of products and processes in a systems environment’ [6] in order to exemplify the potential benefits of sustainable manufacturing. Hence, sustainable manufacturing must be addressed from a business perspective while integrating the total performance of the enterprise, and relevant strategies for value creation in manufacturing must be identified.

This paper presents major challenges faced by manufacturing organizations as they attempt implementing sustainable manufacturing practices, as well as strategies/capabilities that must be developed to address those challenges to enable value creation through sustainable manufacturing. The findings are based on extensive interactions with business leaders and industry professionals from all major industry sectors, including automotive, aerospace, consumer products manufacturing, as well as academic experts and government/agency representatives through a few dedicated workshops in the U.S. under a major grant from the National Institute of Standards and Technology (NIST), including a Sustainable Manufacturing Roadmapping Workshop held at the University of Kentucky (Lexington, KY, USA) in November 2014 on establishing the business imperatives and strategic directions [7]. The vision for the future state of sustainable manufacturing that will be feasible through the development and implementation of these strategic capabilities is also presented in this paper.

2. Key strategies to enable value creation through sustainable manufacturing

In manufacturing, value is generated through activities and interactions between suppliers, manufacturers, customers and other stakeholders [8]. However, when it comes to sustainable value creation, the economic, environmental as well as societal (the triple bottom line or TBL) impacts on all stakeholders must also be considered. According to Lazlo [9], in a business context, sustainable value is created when value is generated for shareholders as well as all other stakeholders simultaneously. As such, manufacturing organizations must balance
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