CHAPTER 3

REVIEW OF END-OF-LIFE VEHICLE REMANUFACTURING SYSTEMS

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3.1 INTRODUCTION

Remanufacturing is a value-added process that transforms end-of-life products into products that are as good as new. Even though a product is being remanufactured in good working condition, the standard quality is hard to define. In theory, the researchers suggested that remanufactured products will go into many stages of processes to return the reliability and working conditions close to brand-new original equipment manufacturer (OEM) products to prolong their life span (Butzer et al., 2017; Errington, 2009; Khalifa, 2013). This is different from the normal manufacturing stage, where the quality of a product is identified from the beginning of the design stage until the manufacturing stage, together with the testing procedure.

The design process to the manufacturing process output determines the reliability and durability of a product per life-cycle. However, there is nothing like this in remanufacturing, where the cores (used products) are the input to the whole process. Core supply, core selection and core processing are the most significant subjects covered in academic research

(Errington, 2009; Saavedra et al., 2013; Subramoniam et al., 2009; Xiang & Ming, 2011; Zhou et al., 2014).

Traditionally, after the conception of a new design, there are three aspects for evaluation before entering the manufacturing phase: technical issues, economic concerns and marketability. In the case of remanufacturing, in addition to the three issues, the manufacturer would try to take into account additional issues such as the legislation, environmental issues and managerial aspects of the planned product (Abdulrahman et al., 2014). Even though a few developed countries implement regulations and legislation on product take-back at the end of life, it is still insufficient to bring back the consumer's appreciation for remanufactured products, especially for automotive second-hand goods. They also know the differences between remanufactured or recycled components/parts. A few issues are highlighted on remanufactured automotive components/parts, such as quality assurance, cost and competition with imitation parts which are popular among end-users.

In addition, even though industry experts realise the importance of environmental sustainability through remanufacturing, public awareness of remanufacturing is still low, partially due to concerns about the balance between maintaining good quality and lower operational costs (Yusop et al., 2012). Quality and pricing of remanufactured products are the main concerns in bringing the products back to the consumer market. Prior to this, a certified remanufactured component is essential to ensure safety and marketability. In addition, an established regulation and policy is required to assist the remanufacturing industry's growth in the future.

3.2 REMANUFACTURING CONCEPT IN SUSTAINABLE MANUFACTURING RESEARCH

Three main research areas in remanufacturing can be established—(1) Processes, (2) Supply chain, and (3) Product. Therefore, remanufacturing processes and the remanufacturing supply chain are the most discussed areas.

The expectations for remanufacturing products are expected to be the same as new ones. It is not encompassed within quality assurance (product) only, but also the quality after business (service) is accountable for a sustainable remanufacturing industry. The second significant criterion which has always been left out in previous literature is the social impact on the current industrial practitioners of used product dealers/suppliers. The development of remanufacturing regulations, policies or standards will affect the welfare of recyclers and second-hand product dealers. This issue is significant to a finding where the Malaysia Automotive Recyclers Association (MAARA) requested to secure the Malaysian local workshop businesses and other players by developing the National Automotive Policy in 2009.

In other studies, cannibalisation, economy and material resources found significance in developing a sustainable remanufacturing industry as a whole (Kim et al., 2008; Matsumoto & Umeda, 2011). However, those attributes will not be discussed deeply in this study because they are not significant enough to have a massive impact on the quality of remanufacturing products. Furthermore, this study will discuss the remanufacturing expert/skilled worker, remanufacturing processes, social impact/environment and a few factors to certify the quality of the remanufactured product.

3.3 END-OF-LIFE VEHICLE RECOVERY PRACTISES IN MALAYSIA

The problem is that this business is unregulated, which impacts the business by bringing an unstable ecosystem to the automotive industry and environment to some extent. The presence of imitation, counterfeit and fake components/parts are mixed in the reused market. Thus, the quality and reliability of components/parts regarding safety are questionable.

The Malaysian automotive market is the third largest in ASEAN (605,156 vehicles sold in 2010), just behind Thailand (800,357 units) and Indonesia (764,088 units). However, Malaysia is still the region's biggest