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A Review of the Literature on Process Innovation in Remanufacturing

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ABSTRACT: The aim of this article is to present a concise review of the relationship between environmental sustainability, environmental innovation and remanufacturing. In the past, corporate environment was accounted as an environment determining the firm performance by economic, social, political and technological factors. However, lately, environmental factors are also included into the corporate environment. Recent research studies focus on the Environmental Management System (EMS) as an extremely effective instrument for organizations; and concentrate on the Environmental Innovation as technological product and process innovation. Product innovation has been widely studied in the areas of new product development, product design for environment**,** and design for remanufacturing. The studies on remanufacturing show that it can be profitable and can create environmental benefits. However, the literature is insufficient on process innovation. Consequently, environmental innovation as technological product and process innovation results in a reduction of environmental impacts, and there is an emerging need for further studies on process innovation in remanufacturing.

Keywords: Environmental Sustainability; Environmental Management System; Environmental Innovation; Product Innovation; Process Innovation; Remanufacturing
JEL Classifications: O31; O33; Q54; Q55; Q56

1. Introduction

There have been significant transformations in the world and organizations do not want to be behind and are willing to keep up with these changes. The important issue is that organizations should not contribute to the depletion of environment while they cope with these changes in their economic activities. Organizations have a social responsibility to preserve and restore our natural environment by integrating social and environmental concerns in their business operations.

Shrivastava (1994) said that the need is to understand "the organization" from the environmental perspective, instead of understanding "the environment" from the organizational perspective. Environmental sustainability can be achieved through building an Environmental Management System, and applying environmental innovation in business operations as a part of their social responsibility. Emerging environmental degredetions push organizations to implement these methods. If organizations do not use these methods now, in the near future they will be obligated to take actions to regain the health of environment before it is too late.

Corporate social responsibility (CSR) and sustainable development are being the key elements of the environment. Two important considerations, namely, business performance and regulation are the drivers of environmental practices (Williamson et al., 2006). According to Shrivastava (1994), organizations viewing their environments in eco-biosphere terms would constitute clear ecological missions, build up complex ecological strategies, and have powerful environmental management programmes. The key finding in voluntary environmental programs which are combining ISO 14001 seems to increas facilities' environmental performance; has important implications (Potoski and Prakash, 2005). Florida and Davison (2001) stated that EMS is an extremely effective instrument to reduce environmental costs and risks. For creating successful environmental strategies, and helping to steer companies and economies towards environmental sustainability; the effective development of new, environmentally improved products will clearly be crucial (Pujari et al., 2003). Avoiding or

reducing hazardous environmental impacts by new and modified processes, equipment, products, techniques and management systems are included in environmental innovation (Arundel et al., 2007).

New field of innovation activities are opened up by eco innovation, there are tremendous opportunities available, not only for saving on material costs but also finding alternative ways for scarce resources (Bleischwitz, 2009). Inderfurth (2005) states that an emerging business area, that is attractive from both an economic and an environmental perspective, is the remanufacturing of used products. Remanufacturing of used items presents the opportunity for an ideal initiative: 1) enabling positive environmental outcomes; 2) meanwhile increasing firm profits by extracting additional value from used items (Galbreth et al., 2006). It seems that remanufacturing is environmentally preferable since the geometrical form of the product is retained and the product's related economic and environmental values are preserved (Kerr and Ryan, 2001; Sundin, 2004).

This study aims to collect and integrate the most relevant researches of the literature on the Environmental Sustainability, Environmental Innovation and Remanufacturing. Firstly, an introductory section is structured. Secondly, Environmental Sustainability is addressed to combine growing concerns over the economic, social and environmental issues for the purpose of guarantying the long term viability of society at large and the planet. Thirdly, Environmental Management System is examined, and next Environmental Innovation is defined, the types of environmental innovation as product and process innovation are explicated. Subsequently, Remanufacturing is clarified. Finally, the last section includes the conclusion, and leads the way for future researches. This article presents the relationship between environmental sustainability, environmental innovation and remanufacturing.

2. Literature Review

2.1. Environmental Sustainability

Environmental problems started with the industrial revolution in 17th century that caused to use the energy in fossil fuels. Environmental problems became global in scale in the late 20th century; industries and communities have become dependent on nonrenewable energy resources. The world's consumption gets more than its regeneration capacity. In the 21st century, global awareness increases due to the threat of decreasing resources, greenhouse effect, global warming, water pollution, toxins, rainforest destruction, nuclear issues, etc.

Although, Environmental sustainability (also called ecological sustainability) is a very important concept and highly concerned by organizations worldwide, is often unclearly defined and the literature is poor in number of definitions. First of all, sustainability and sustainable development are defined for clear understanding of environmental sustainability's definition.

Universal definition of the sustainability includes the factors which influence the ability to help meet today's needs while no sacrifices are made to the ability of future generations to meet their own needs (WCED, 1987). In United States Environmental Protection Agency's (EPA, 2011) definition; Basic principle of sustainability is: Everything needed for our survival and well-being is dependent upon, either directly or indirectly, on our natural environment. The conditions created and maintained by sustainability under which people and nature can coexist in productive harmony allowing the fulfillment of the social, economic and other requirements of present and future generations. Basically, three broad themes; economic, social and environmental which should all be coordinated and addressed to guarantee the long term viability of our community and the planet are referred by sustainability.

In broad perspective and effort to combine growing concerns for a range of environmental issues with socio-economic issues is the concept of sustainable development. Fundamental challenges for humanity now and the future are potentially answered by sustainable development. However, more clarity of meaning, concentrating on sustainable livelihoods and well-being rather than well-having, and long term environmental sustainability, which requires a strong basis in principles that link the social and environmental to human equity; are needed for doing this (Hopwood et al., 2005).

According to Goodland and Daly (1996), Environmental Sustainability is the target to which one of the means to approach can be sustainable development. Sustainable development is a kind of development without increase in throughput of material and energy away from regenerative and absorptive capacities. Environmental sustainability, as one of the four kinds of capital (natural, human, human-made, and social), necessitates maintaining natural capital; and understanding environmental sustainability which consequently contains the definitions of "natural capital" and "maintenance of

resources" (or at least "non-declining levels of resources"). Regardless of being renewable or nonrenewable and marketed or nonmarketed, the natural capital or the natural environment is defined as the stock of environmentally provided assets (such as soil, atmosphere, forests, water, wetlands) which supply a flow of useful goods or services (Goodland, 1995). Within the concept of conservation; Ecological sustainability should be recognized to be the maintenance of two interactive "things", at same time in the same place: culturally selected human economic activities and ecosystem health. Callicott and Mumford (1997) suggest a new angle to preserving humanly inhabited and economically exploited ecosystems under the headline of ecological sustainability.

Dyllick and Hockerts (2002) stated the definition of Corporate Ecological Sustainability as follows: Ecologically sustainable companies consume at a rate below the natural reproduction, or at a rate below the development of substitutes. The emissions produced by these companies do not accumulate in the environment at a rate more than the capacity of the natural system to absorb and isolate these emissions. In conclusion, they do not perform any activities, which degrade eco-system services. Jennings and Zandbergen (1995) worked on the role of companies in concluding the consensus within a firm for the structure of an "ecologically sustainable" organization. Organizations are pushed to implement practices which are structured to keep the environment safety and minimize energy utilization. Decreasing production costs and avoiding environmental problems for keeping green and clean atmosphere are for sustainable organizations (Vinodh, 2011).

Wheeler and Elkington (2001) examined some stories from more traditional sectors in which the stakeholder approach to strategy has a longer history. In reality, references to stakeholder approaches, sustainability and CSR which are found most frequently, corporate transparency and dialogue on environmental and social performance are often best developed; are found in energy production, mining, forestry and oil and gas industries.

Kemp (2002) explained why performing a radical change in technology, like a shift away from hydrocarbon-based energy technologies, is likely to be a gradual and slow process. Radical technologies often require longer lead times and also special skills, infrastructure and all kinds of institutional changes (organizational changes, regulation, new ideas and values etc.). Moreover, since the new technologies have not yet benefited from dynamic scale and learning effects (that result in economies of scale and revolutionary improvements in the technology); the short term costs are most likely to be at the higher end. According to Pujari et al. (2003), the most advanced environmental technologies and products will make contribution to the pursuit of sustainability, if those technologies and products can not provide a viable green product choice and can not push market share away from conventional products. Fuller and Ottman (2004) who are parallel to Pujari et al. (2003) stated that if such products can not show fundamental efficiency in their eco-performance without having any concession on the functional benefits of the products, those products doubtfully to be able to maintain long-term success in the market.

For leading to enhanced environmental performance and/or reduced environmental impact, environmental sustainability issues must include resource efficiency, dematerialization, reduction of waste and emissions (Pujari, 2006). The need for reacting appropriately to sustainable development challenge and, as a result, many have altered their business activities in purchasing (Carter et al., 2000), product development, marketing (Pujari et al., 2003) and corporate strategy (Aragon-Correa and Sharma, 2003). Company benefits can occur, in general from internalizing environmental sustainability issues into business operations; and specifically, in developing greener products. Those benefits contain return on investment, increased sales, improved competitiveness, and enhanced image in addition to the others (Pujari, 2006).

Environmentally and socially responsible supply chain management is put into practice; and these practices are promoted to the consumers by the businesses. Tactics such as choice-editing, the elimination of hazardous substances in products, communication and marketing strategies, or the utilisation of eco-labels and fair trade labels for promoting products can be used by the companies for sustainable environment (Bleischwitz, 2009).

In the past, environmental sustainability was portrayed as involving compliance, expense and trade-offs with other corporate goals; currently and also increasingly, it is viewed as an opportunity and a win-win logic of being "green and competitive" environmental performance (Porter and Van der Linde, 1995; Pujari 2006).

2.2. Environmental Management System

In recent years, there is a significant change in the companies' views of environment due to the concept of sustainable development and increase in environmental conservation consciousness. Corporate managers are under the pressure for changing their point of view to the ecological environment, and taking ecological environment into consideration as a significant factor during their decision making process for corporate activities. Non-Governmental Organizations (NGOs) and consumers are demanding lesser pollution and waste, more recycling, higher utilization of renewable resources and ecologically safer products. Corporate managers who do not want to be behind these changes, consider such demands while they are taking strategic decisions, and are in a position to develop environmentally conscious management systems. Development of environmental conscious and environmental management systems in the companies is based on the top management's sensitivity to the environmental issues.

Management sensitive to the environment has a goal for considering ecologic environment as an important element in their decision-making processes, and for reducing or totally eleminating the environmental damages in their activities. In this framework, management sensitive to the environment has an understanding for changing design and packaging of the products, changing manufacturing processes, for infusing the protection of ecologic environment into the corporate culture, and for being an institution to fulfill its duties to the society within the concept of social responsibility (Nemli, 2000). Onkila (2011) accepts and defines the environmental management as any action taken towards, in a sense of improving corporate environmental performance. Those actions, from identifying the impacts to managing them and utilizing them in improving competitiveness, within an organization for reducing the environmental damage are regarded as environmental management. Hopkins (2005) addressed to the effects on, not only any particular stakeholder group, but on the larger institution of business. As an example, numerous environmental disasters made the public aware of the effect of business decisions on the public at large. Such a new awareness resulted in the pressures for environmental regulations, which eventually affected not only one specific firm, but the whole institution of business.

Nowadays, in addition to the NGOs and customers, governments are pushing the companies for participating in responsible activities to the environment. Since 1996, Environmental Management Systems (EMSs) have earned increasing attention after The International Organization for Standardization (ISO) defined its EMS standard, ISO 14001. By developing an environmental policy, evaluating their internal processes affecting the environment, creating objectives and targets, monitoring progress and obtaining management review; Their impact to the natural environment is under systematical consideration via EMS which is adopted by enterprises (Darnall and Edwards, 2006). A tool to the organizations with a method for systematically managing and improving the environmental aspects of their production processes is called EMS. This tool assists organizations for fulfilling their environmental obligations and performance goals. Despite an EMS can be put into progress in several different ways according to the precise sector or activity and the needs perceived by management, but there should be several common operating principles present (The European Commission, 2011). In Rajendran and Barrett's (2003) article; these operating principles of an EMS, particularly ISO 14001 which is built on Total Quality Management (TQM) concepts, follow a 'Plan-Do-Check-Act Cycle' (PDCA Cycle).

Despite ISO 14000 standards are mutually supportive to each other, but also for achieving environmental goals, each can be implemented independently. As a management tools for organizations the entire ISO 14000 family of standards can be used for managing their environmental features and assessing their environmental performance. Significant material economic benefits, including the following, can be obtained by these tools, collectively: decreased raw material/resource use, decreased energy consumption, enhanced process efficiency, and decreased waste generation and disposal costs, recoverable resources utilization (ISO, 2009). EMS can be dealt with ISO 14001:2004 and ISO 14004:2004 while ISO 14001:2004 includes requirements for an EMS, ISO 14004:2004 is a general EMS guideline. ISO 14001, a management tool, enables an organization of any size of type for: identifying and controlling the environmental impact of its activities, products or services, enhancing its environmental performance on continuous basis, implementing a systematic approach to set environmental objectives and targets, to achieve these and to demonstrate what they have achieved. Guidelines on the elements of an EMS and its implementation are in ISO 14004:2004 which

also discusses principal issues involved. The requirements for such an EMS are specified in ISO 14001:2004. Objective evidence, which can be audited for the purpose of demonstrating that the EMS is operating effectively in conformity to the standard, is demanded for fulfilling these requirements (ISO, 2011).

Commencing an initial complete review of its environmental practices, formulating and implementing an action plan for environmental management with continuing performance targets, clearly identifying internal governance responsibilities for environmental issues, and making necessary corrections to address identified environmental problems; are required for a facility to be awarded for ISO 14001 certification (Potoski and Prakash, 2005). Florida and Davison (2001) concluded that increased recycling activity as well as reductions in air emissions, solid waste, and energy usage; were more likely reported by the high-adopters of EMS. Their studies focusing on the results from implementing EMS have also identified economic benefits as well as environmental performance improvements. Potoski and Prakash (2005) added to Florida and Davison's (2001) studies that facilities surrounded with more educated residents in their neighborhoods are more likely to join ISO 14001. Anton et al. (2004) stated that the lower toxic emissions, particularly for firms that have higher pollution intensity; and also, the lower toxic emissions per unit output particularly for firms with higher pollution intensity in the past; were attained by more comprehensive EMSs. Reductions in both off-site transfers and on-site releases per unit output are the results of EMSs. Lastly, regulatory and market-based pressures have no direct impact on toxic releases but an indirect effect by encouraging institutional changes in the management of environmental concerns. Dasgupta et al. (2000) suggested that environmental management led to a significant improvement in the compliance status of Mexican firms.

Natural resource use, solid waste generation, and wastewater effluent, as three areas of impacts, not explored in the literature before; were examined in Arimura et al. (2008) study. The effectiveness of ISO14001 in relation to environmental regulations was also studied uniquely. Summary of their findings are: first, all three impacts were helped to be reduced by ISO14001 and report publication; all impacts except waste water were found in previous studies; second, environmental regulations have no weakening effect on ISO 14001; third, as a voluntary approach, promoting facilities' adoption of ISO 14001 were supported through assistance programs by local governments. Findings also suggest that command-and-control and voluntary approaches can concurrently be used by governments.

Initiating and controlling environmental improvements in the context of supply chain cooperation are used by EMSs in the study of Nawrocka (2008). ISO 14001 uses an optional supplier selection criterion for supply chain cooperation. As a result, companies, which are not focusing on environmental work within their supply chains, lose the potential of impacting the environmental profile of suppliers by shaping their ISO 14001. According to the outcomes of Rehfeld et al. (2007) analysis, considerable positive effect on environmental product innovations is achieved via EMS by ISO 14001.

Determining the degrees of importance of the factors influencing the ISO 14000 EMS implementation in the Turkish firms and the differences of these factors according to firm characteristics are the primary objectives of Bolat and Gozlu's (2003) study. For this purpose, 66 firms, which implement ISO 14000 EMS, or firms that prepare to implement ISO 14000 EMS in one-year time, were surveyed. Four groups of the factors persuading the implementation of ISO 14000 EMS were; (1) willing to obtain improvements in financial indicators, (2) expectations of improvements and attitudes in processes related to environment, (3) competition, and (4) certain issues related to stakeholders. The most important factors influencing the ISO 14000 EMS implementation were the expactations of improvement, attitudes in processes related to environment, and issues related to the stakeholders. Moreover, sector, firm age, sales revenue, foreign capital, being export oriented, practice of duration for ISO 9000 Quality Management System (QMS), starting date of ISO 14000 EMS, having received environmental award and implementation status of TQM were some differences found in the factors influencing the ISO 14000 EMS implementation.

According to Florida and Davison (2001), has been used by a fairly large group of manufacturing plants; and been associated with plants which are larger in size, more committed to the total quality management, and more innovative in general. The bottom line quest to increase productivity and as well as government regulation are the primary motivation for these companies.

The lack of impartial regulation should be accounted as a key difference among firms in different sizes (Brio and Junquera, 2003). Biondi et al. (2002) said that greater attention to bigger companies than to smaller ones were the practice of the public policy-making bodies responsible for environmental control. SMEs perceived as being the backbone of European industrial system, represent more than 99% of the total number of enterprises in Europe (The European Commission, 2010). SMEs, numerous and heterogenous in nature and their environmental performance are difficult to be controlled by the public policy-making bodies.

Despite their intervention will be primarily focused on their company sector and particular circumstances; the crucial issue for future survivability of SMEs have to be environmental pressures (Sanchez et al., 2003). The immediate target of some Public Administrations is at the same level as large companies facing the environmental challenge and Environmental legislation is general in nature (The European Commission, 2010). The basic question at this point is what will happen to SMEs.

However, their individual sizes as a whole, SMEs are accounted as a giant group. Therefore, their cumulative impact on environment is tremendous; and inevitably SMEs have to implement EMS.

As a key note, Florida and Davison (2001) emphasized that EMS was an instrumental tool for orchestrating the community relationships with dealing with the key stakeholder groups on potentially controversial environmental topics. Finally, EMS is an extremely effective instrument for managing environmental costs and risks inside and outside the factory and is a factor that adds to – rather than detracts from – bottom-line.

2.3. Environmental Innovation

Today, environmental problems have gained a strategic importance parallel to the recent developments. Current level of environmental problems is increasingly becoming essential in the eyes of investors, regulators, customers and the society at large. Organizations, in one hand, are improving their economical strenght via controlling the nature by rapidly progressing science, technology and industry; on the other hand, are destroying the nature. While organizations are the main contributor to the environmental problems, they have significant responsibilities for solving those problems. Whatever their sizes are, organizations should incorporate all their activities with environmental issues; and their approach and responsibilities to those problems should not be limited to "resolve it after it occurs", but be proactive and find solutions to those problems, before they surface. Organizations must tailor more active approach, and should be heading towards a greener direction more clearly. Environmentally friendly organizations are considered as the future organizations. Organizational activities are required for changes and improvements, like innovation as a first step, for preserving the environment.

"The implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" is the definition of innovation by OECD (2009).

The importance of all types of innovation in creating and maintaining competencies and responding to environmental and demographic restrictions, was highlighted by UK's Department for Innovation (2008). In their commend on the wider implications of innovation in the face of globalisation and environmental challenges. There is a consensus that organizations and economies must innovate and promote innovation for both to sustain their competitive position and to strengthen it. Innovation is a strategic issue and a key policy.

According to Geffen and Rothenberg (2000) the connections between material use, production process and environmental effects in manufacturing facilities propose that the significant role of suppliers in acquiring and assimilating external information, spreading the capacity of a company to implement deep-seated innovation, can also hold in the zone of environmental innovation.

As a specific social phenomenon, environmental innovations (also called ecological innovations and eco-innovations) are the interaction between human activities and their effects on natural ecosystems, which is the primary concern.

Arundel and Kemp (1998) stated the basics of environmental innovation, which are new or modified processes, techniques, systems and products to eliminate or reduce environmental damage. According to Florida et al. (2000), there are two dimensions in the relationship between business performance and environmental improvement. First dimension is that environmental innovations as a way to reduce costs through improved or more efficient production processes might be adopted by the

organizations. Second dimension is that by product of changes accomplished to reduce other costs, to improve productivity, and to improve plant performance might be named as environmental improvement. As an example, adopting a chemical free procedure for paint removal for the purpose of speeding up the production process is as a decision taking by a company that also decreases the use of polluting chemicals (Florida and Davison, 2001).

Environmental innovation in technological and non-technological changes results in a reduction of environmental impact. While technological changes occur in products and processes, non-technological changes occur in marketing, organizations and institutions. These changes can include modification and re-design of practices, alternatives to existing practices, or the creation of new practices. Experience shows that higher environmental benefits are usually the results of more radical changes in methods, such as alternatives and creation (OECD, 2009).

The Oslo Manual by OECD (2005) as the internationally recognized standard for measurement of innovation identified four types of innovation: product innovation; process innovation; marketing innovation and organizational innovation. The first two types define innovation in terms of technological product and process innovations. Created technologicaly new products and processes and distinctive technological improvements in products and processes are the components of Tecnological Product and Process (TPP) Innovations. A TPP innovation is named as product innovation if it has been introduced on the market; or named as process innovation if it has been used within a production process. TPP innovations contain a series of activities in science, technology, organization, finance and commerce. A firm that has implemented technologically new or significantly technologically improved products or processes during the period under review is categorized as a TTP innovating firm.

A process innovation is the utilization of a new or drastically improved production or delivery method. Such changes are in techniques, equipment and/or software. A product innovation is the introduction of a good or service, which is new or radically enhanced with respect to its characteristics or intended usages. These radical improvements are in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (OECD, 2005). Lager (2002) explained that developing new products, improving product properties, enhancing product quality etc. are the objectives of product innovation.

Market needs and eventually external customers mostly drive product innovation work that is principally effectiveness-driven. Respectively, the needs of production (i.e. internal customers) mostly drive process innovation work that can be said to be principally efficiency-driven. However, notably, these concrete descriptions and difference of product and process innovation activities do not mean that there can not be a combination of the two activities and objectives in an innovation project. Nevertheless, the importance of distinguishing the two types of innovation activities and objectives is highlighted in these discriptions and separation (Bergfors and Larsson, 2009).

Pujari (2006) discusses that the leading firms in developing eco-innovations by thinking in a positive sustainability mode rather than a reactive mode of just eliminating environmentally problematic features; have fully integrated such tools into their new product development planning. Those tools are like “design for environment” (Pujari, 2006; Gehin et al., 2008), ‘‘life cycle assessment’’ (Gehin et al., 2008; Tingström and Karlsson, 2006), ‘‘environmental effect analysis’’ (Tingström and Karlsson, 2006), “life cycle environmental cost analysis” (Kumaran et al., 2001), and “the design of environmentally conscious products using Computer-aided design (CAD) and Computer-aided engineering (CAE)” (Vinodh, 2011).

Frondel et al. (2007) found an apparent dominance of cleaner production in seven OECD countries: 76.8% of the facilities invest largely in cleaner production technologies much for new production processes, but less for new products. Frondel et al. (2007) study showed that cost savings, general management systems and specific environmental management tools tend to favor clean production, while the regulatory measures and the strictness of environmental policies are more important for end-of-pipe technologies.

Montabon et al. (2007) stated that Environmental Management Practices are positively related with product and process innovation. Papinniemi (1999) said that process innovation’s core aspect is to make possible a profitable business and manufacturing process. While novel features of products are imperative for consumers in product innovation, so likewise, all contributors of operating process features can get customer benefits through process innovation. Baer and Frese (2003) said that process

innovation is expected to convey manifold benefits to an organization and help an organization to succeed competitive gains. But substantial numbers of organizations have implemented these practices without much success.

Rehfeld et al. (2007) study recognizes a positive correlation between environmental organizational measures and environmental product innovations for German manufacturing sector. Moreover, waste disposal measures and product take-back systems are important components of environmental product innovations, regardless to other factors and company specific characteristics. Environmental product innovations are closely linked with environmental process innovations in such a way that changes of the production process are typically induced by product changes.

Brent and Labuschagne (2004) indicated that product and process design issues with manufacturing planning and control problems are integrated in Green System by identifiying, assessing and managing the flow of environmental waste for the purpose of diminishing environmental impact; and trying to maximize resource efficiency for production of sustained components.

Bovea and Wang (2007) emphasized that the factors like manufacturing and product design practices and environmental issues and concerns critically intersect at environmental consciousness. Inderfurth (2005) also added remanufacturing of used products in this critical intersection. Chen and Wang (2008) stated that minimal material usage, enhanced material choices, design for simple of disassembly, product reuse, minimal energy consumption, manufacture without producing hazardous waste and usage of clean technologies are included to the practical aspects of environmental conscious design and Inderfurth (2005) also added remanufacturing of used products to the practical aspects.

Design process where a product's environmentally preferable features, like recyclability, disassembly, maintainability, refurbishability and reusability, which are categorized as design objectives rather than as limitations is called Product Design for Environment (Ashley, 1993).

According to Gehin et al. (2008) Design for Environment is like a global strategy that is intended for developing the environmental performance of the organization through a novel approach to the design of products and processes. Design for Environment is the analysis of Life Cycle Analysis data in order to classify and quantify the environmental impact of the product. Design for Environment has aided to carry environmental realization into the organization. According to Pujari et al. (2003) The Design-for-Environment's approach means that Environmental New Product Development is not a completely different procedure to traditional New Product Development, but includes adding an extra level of difficulty into the New Product Development process. This process must keep delivering basic benefits to consumers, while also speaking stakeholder requirements for enhanced eco-performance and manage any essential trade-offs with existing core or supplementary product benefits.

In companies, there are several forms of Eco-innovation or sustainable development innovation in particular reference to New Product Development. Eventhough a few of product innovations are disruptive innovation (e.g. wind power, hybrid car); according to Hall and Vredenburg (2003), product innovation for sustainability in companies is either public policy persuaded or is market-driven. Incremental or evolutionary innovation (e.g. remanufactured products, recycled content, organic cotton-based clothing, water-based paints, to name a few) are related to most of the sustainable innovation in New Product Development (Pujari, 2006).

As far as the environmental innovation is concerned new eco-efficient technologies can be categorized under technology push factors. Meanwhile preferences for environmentally friendly products or image can be categorized under market pull factors. Technological development (technology push) or demand factors (market pull) are the drivers of technological innovation. Cleff and Rennings (1999) separate ecological product- and process-innovations. The strategic market behavior of firms (market pull effect) significantly drives the environmental product innovation; meanwhile, the regulation (regulatory push/pull effect) drives the environmental process innovation, more. The impact of the regulatory framework (regulatory push/pull) is the extent of the traditional discussion of innovation economists because of the externality problem of eco-innovations (Cleff and Rennings, 1999). Porter and Van der Linde (1995) said that Eco-innovation is heavily influenced by the regulatory framework and especially environmental policy. According to Gehin et al. (2008) the environmental awareness is mostly driven by regulations and standards in any industry. Diverse standards have fortified companies to reconsider their way of production.

Environmentally innovative firms in comparison to the other, more passive firms, show less dependency on hard state regulation. Hence, for pioneers, soft and voluntary environmental policy

measures can be sufficient. Nevertheless, hard measures (command and control instruments, duties) are seemingly still necessary for an infusion of integrated measures to non-innovative firms (Rennings, 2000).

According to Fischer et al. (2003) alternative policy instruments for preserving the environment are often choosen by the Policy-makers. The influence of different policies on company incentives for developing cleaner production technologies is a key consideration which is affecting this choice.

As far as the reduction of ecological impact is concerned; some firms develop and market new technologies; others follow governmental regulations for production processes, yet others basically build up communication or lobbying activities; while some others are inactive in their ecological impact (Boons, 2008).

2.4. Remanufacturing

The remanufacturing industry began during the Second World War. Since the needs were increased and unmet, natural resources became scarce or unreachable due to the war; manufacturing activities were shifted to rebuilt used parts or remanufactured products from the original products. Despite the ongoing war, manufacturing industries were forced to produce alternative economic and industrial growth paths for the society running.

During the past decades, remanufacturing is a significantly growing field of the manufacturing industry due to the environmental requirements and its economical benefits. Remanufacturing is practiced in many industries, especially and mostly in the automotive industry. Some examples of remanufactured products are automobile parts, military vehicles, aircraft parts, industrial robots, furnitures, electric home appliances, photocopiers, computers, printers, toner cartridges, tires, telecommunication equipments, cellular phones, single-use cameras, heavy-duty engines, construction machineries, medical equipments etc.

Standard definition of remanufacturing is the process of restoration of worn, discarded or used durable products to "like-new condition" (APRA, 2010). Remanufacturing is the process of restoring a nonfunctioning complex assembly to a "like-new" functional state by rebuilding and replacing its component parts (Ijomah et al., 1999). Later, Ijomah (2008) extended his definition to that a process of bringing used products to at least original performance specification from the consumers' perspective and giving them warranties at least equal to that of their originals is called remanufacturing and being considered as a crucial strategy in waste management and environmentally conscious manufacturing.

A broadest definition of remanufacturing coming from Sundin and Bras (2005) is "the process of rebuilding a product, during which the product is cleaned, inspected and disassembled; defective components are replaced; and the product is reassembled, tested and inspected again to ensure it meets or exceeds newly manufactured product standards". By and large, the remanufacturing process is separated into these phases: disassembly, cleaning, testing, repairing, parts inspection, component updating, parts replacement and reassembly (Rathore et al., 2011; APRA 2010; Sundin and Bras, 2005). Kerr and Ryan (2001) created very detailed steps in a generic remanufacturing process in their study, also Sundin and Bras (2005) composed a simple figure as steps in a generic remanufacturing process according to above phases. According to Zwolinski et al. (2006) the original design may be enhanced to improve reliability, make maintenance simplier or add more sophisticated controls. The upgrading phase that does not extend the life of inefficient and outdated products is fundamental in ensuring continued viability of remanufacturing.

Remanufacturing is focused on individual components and not only saves the material value of the product, but also saves a considerable fraction of the energy used in production of those components. As a result, significant environmental benefits are created. Not only the repair of all defective components, but also, an overhaul and upgrade of the entire product assembly are included in remanufacturing. Obviously, in comparison to the remanufacturing, smaller environmental benefits created in recycling and the quality of refurbished products does not match the quality of remanufactured products. Customer expectations for a new product are met by the remanufactured products where refurbished products do not match the same (Shah et al., 2010).

Principally, remanufactured products and components function and own the same quality as new products. Environmental and economic costs of manufacturing and disposing of products and components used products and components are reduced by remanufacturing in which recovered End of Life parts are used. By offering customers remanufactured products, fewer resources are utilized by

the companies at the same level of serves. Therefore, the resource intensity can be diminished, and the eco-efficiency of product systems can be increased (Kerr and Ryan, 2001). Kerr and Ryan (2001) come up with a more comprehensive description of a generic remanufacturing process. Different remanufacturing strategies are implemented by the remanufacturing companies. In some cases, total disassembly is used in the products and then error detection is conducted, in some other cases as a first step and inspection is made with the allocation of parts that are in need of replacement. An accurate inspection and evaluation of the remaining product life can be carried out earlier; the processing of products which later will be discarded, will be required less. In several studies, having the inspection performed after the cleaning and disassembly offenly described the remanufacturing process. This way is not always efficient, nevertheless, in case the product has fatal errors it will be useless to remanufacture. Products arriving at the remanufacturing facility are almost always one through a visual inspection for major defects, as a part of product sorting. However, if the product is cleaned, the detailed inspections are easier. Choosing a strategy for efficient remanufacturing is always necessary since each manufacturing process and each type of product being remanufactured are unique (Sundin and Bras, 2005).

Over the past few decades, increasing interest in remanufacturing has initiated several studies. These studies have focused on different aspects of remanufacturing. Majority of remanufacturing studies focus on their environmental importance and upon its suitability to product design. There has not been too much academic study related to understanding remanufacture as a business process nor have any influential tools and techniques been established that will enable remanufacturing companies to manage and control such complex and indeterminate business operations (Ijomah et al., 1999).

Sundin and Bras (2005) claimed that the green image of remanufacturing can make companies benefit from it. Remanufacturing's business notion is established on the proposition that resources that were utilized in the product manufacturing are reused and therefore it enables remanufacturing an advantageous practice (Östlin et al., 2008). Remanufacturing establishes the probability for accomplishing environmental advantages both for upstream and downstream. The reuse of products enables upstream to entail fewer consumption of raw material, and downstream to have fewer waste produced (The European Commission, 2008).

According to Steinhilper (2001) study, realizing the same product at about half of the cost of a new one can be considered as remanufacturing. In general, remanufactured products have a price range between 40% and 80% of a new product price with an average of 60%. This complies not only with the cost but it is a win-win situation for both the customer that have an attractively priced product and the remanufacturer that is being able to operate profitably.

The value in the form of cost of materials, energy, labor and manufacturing operations which are added in a product; is contained in reuse, repair and remanufacturing. However, the product quality which is as good as new is only quaranteed in remanufacturing (King et al., 2006). As well as being environmentally sound, Remanufacturing/refurbishing is environmentally effective and also a more profitable way for the manufacturer to handle returned products. In addition to decreasing final disposal costs of products and components, remanufacturing prevents to increase environmental impacts and costs of manufacturing processes (Kerr and Ryan, 2001). According to the outcomes of Heese et al. (2005) research, in a competitive environment a corporation can start a product take-back and remanufacturing to enlarge its benefits in production costs or market share to the loss of its competitors. Companies that take back used products should drastically decrease their new product prices. This price decrease will surpass the income a customer would gain from selling the used product on the secondary market. Remanufacturing is a value adding regaining action made on the product. The value adding of the remanufacturing action is not only focused on diminishing production cost. Several issues such as providing service, image, environmental accountability, etc, are added to the customer value of the remanufactured product (Toffel, 2004).

Remanufacture can be reflected comparatively superior to the similar end-of-life strategies such as repair and reconditioning because the outcome will be a higher product quality with a prolonged life, making it more commercially feasible (King et al., 2006). End of Life strategies such as remanufacturing that make possible companies to make profits and to improve the environmental performance of the good, sometimes even higher than what is obligated by the legislation (Gehin et al., 2008). The remanufacturing is an end-of-life strategy in which the use of raw materials are decreased, energy is saved and value added is preserved in the design and manufacturing processes.

Since, products are not designed suitable for remanufacturing, remanufacturing processes should be tailored to existing products in most of the cases. But, such adaptations increase costs and this leads to the reconsideration of the remanufacturing process in terms of the overall benefits (Zwolinski et al., 2006).

Nasr and Thurston (2006) stated that there are two levels of remanufacturing design: the product strategy level (which considers primarily sales, marketing, service support, and reverse logistics affairs), and the comprehensive product and manufacturing engineering level. According to Hatcher et al. (2011) Design for Remanufacturing; it is widely recognized that the designing period of any product's lifespan has the major impact on issues such as cost, manufacturing and end-of-life possibilities. The aim of Design for Remanufacturing is to improve remanufacturability. Design for Remanufacturing is regarded as a distinct design activity which includes the deliberation of various design issues related to remanufacturing. Design for Remanufacturing might include decision makings like standardising parts or choosing a more robust material to elevate the remanufacturing process. It is most likely to take place when Original Equipment Manufacturer (OEM) is applying remanufacture themselves, either because of environmental, legislative or financial reasons, or as a way of supplying spare parts. Matsumoto and Umeda (2011) observed that companies' efforts to meet one of the requirements for successful remanufacturing are designing products for remanufacturing. The companies apply Design for Remanufacturing of products to assist remanufacturing, which considerably improves the efficiencies of their remanufacturing processes. According to Matsumoto and Umeda (2011) three core necessities for successful remanufacturing can be pointed as follows: (1) developing systems of gathering for used products; (2) developing effective remanufacturing processes; and (3) promoting consumer demand for remanufactured products. Companies' efforts in order to realize these necessities may be as follows: (1) creating a new collection channel, (2) developing reverse logistic systems in order to gather used products, and (3) designing products for remanufacturing.

Remanufacturing is a recapturing process in which the value is added to material when a product is first manufactured. With diminishing energy consumption and carbon emissions in addition to providing skilled employment, remanufacturing creates a highly important contribution to the creation of a sustainable society. Design for Remanufacture enhances the remanufacturing process and business model and thanks to this a significant increase in competitiveness and innovation takes place. The design ability for classifying and resolving inefficient parts of remanufacturing is inadequately understood or irrelevant to the majority of remanufacturers because as small scale independent remanufacturers they have slight or no control over the designing process. OEMs have control over the design proces and have potential to control remanufacturing; as such OEMs are the keys for establishing Design for Remanufacture yet only a small number of OEMs are presently involved in remanufacturing (Gray and Charter, 2007).

According to Nasr and Thurston (2006) Remanufacturing process's social benefits in terms of decreased energy and material consumption and decreased amount of wastes are not possible to be accomplished if design for remanufacturing does not become an essential component of the product development process. Design for remanufacturing, reuse, and recycling have potential for measurable economic returns for manufacturer, besides resulting comparative advantage in sustainable production. Designs for remanufacturing technologies have a focus on the comprehensive product design issues. These issues are: Design for disassembly (and separation), Design for multiple life-cycles (product reliability, durability, restoration and cleaning), Modular design: functional clusters of components with similar technical (durability) and market life (technology change rate), Product support for take-back decisions (embedded condition or usage monitoring).

The results of Rubio and Corominas's (2008) paper show that remanufacturing is more suitable with lean production practices, and the utilization of a mixed strategy in which manufacturing, partial recovery and disposal are combined; and economic benefits helping to companies to enhance their competitiveness can be generated by remanufacturing.

According to Kerr and Ryan (2001), in theory, remanufacturing can add to more eco-efficient and sustainable product systems. But, the contribution of remanufacturing will be restricted by the suitability of products for remanufacturing. Many aspects of the product system, such as product design, the frequency, volume and state of product returns, transportation distances and costs, the value of remanufactured products and the demand for these products and the cost of remanufacturing

comparative to the cost of other alternatives for dealing with End of Life products; dictate the suitability of a product for remanufacturing.

One of the most broadly adopted implementation strategies for prolonging product life cycle, closing the loop on material flows, and reducing total material consumption is remanufacturing (Nasr et al., 2011). The environmental importance of remanufacturing is to prolong product's life time by creating a second life, since less material is needed to meet customer needs in a product which lasts longer through remanufacturing (Gehin et al., 2008).

According to Steinhilper (2001), for the purpose of assessing product's suitability for remanufacturing, all technical, economical and ecological factors will contribute to the decision and should be taken into consideration. The suitability of products for remanufacturing can be tested by using eight different criteria: (1) technical criteria (type or variety of materials and parts, suitability for disassembly, cleaning, testing, reconditioning), (2) quantitative Criteria (amount of returning products, timely and regional availability), (3) value criteria (value added from material/production/ assembly), (4) time criteria (maximum product life time, single-use cycle time), (5) innovation criteria (technical progress regarding new products and remanufactured products), (6) disposal criteria (efforts and cost of alternative processes to recycle the products and possible hazardous components), (7) criteria regarding interference with new manufacturing (competition or cooperation with OEMs), and (8) other criteria (market behavior, liabilities, patents, intellectual property rights).

There are some other studies on the subject of OEM related to remanufacturing. In these studies OEMs have several benefits over independent remanufacturers and maybe, bigger incentive to remanufacture (Matsumoto and Umeda, 2011).

Despite the general concensus that remanufacturing is an efficient and profitable activity, regrettably, it is not yet a majority option for most OEMs that decide not to adopt the remanufacturing option due to the cost and internal cannibalization (Ferguson and Toktay, 2006). For OEMs remanufacturing is considered as an emerging market with many opportunities (Rubio and Corominas, 2008).

Profitability of remanufacturing for OEMs has been verified in several studies (Hammond et al., 1998). Due to the opportunities created by remanufacturing for increasing profits and gaining feedback on failure modes and durability, OEMs have greater interest in remanufacturing as an encouraging sign (Gerrard and Kandlikar, 2007). Gehin et al. (2008) emphasized that the industry of remanufacturing postures the issue of sharing the costs as well as a product's added value. Reverse Logistics and Disassembly are particularly delicate issues, in terms of their possible disability in performing the OEMs as it frequently remains away from its essential business, as opposed to the parts remanufacturing such as cleaning, testing, restoring or assembly. Consequently, the average process of recovering requires envision immediately, especially at the phase of designing. Considering the product remanufacturability at the stage of designing is therefore not only an issue of designing the product, but also about designing the process and the supply chain related to remanufacturing activity.

Hammond et al. (1998) findings show that considerable process improvements and savings can be obtained by the implementation of lean production techniques (which are one of the main causes of part proliferation and product diversity) in the remanufacturing industry and consequently creating lean remanufacturing processes. Hammond et al. (1998) searched that evaluating the remanufacturability of a product is one of the "real world" trends.

Currently, International legislation intends to push manufacturers to diminish the environmental impacts of their products and manufacturing process, and to punish them in accordance to the amount of waste they produce. Reducing product price and at the same time maintaining quality are required from organizations by the global competition. These competitive, legislative and environmental pressures can be met by remanufacturing. Steinhilper (2001) referred that remanufacturing will be attractive and common one day. In the future, new products will include remanufactured parts as they include reprocessed material from the steel industry today. Remanufacturing has been slowly uptaking in the industries but the industries are getting more aware of its benefits and potentially important role.

3. Conclusion

There have been growing concerns over the economic, social and environmental issues for the purpose of guarantying the long term viability of society at large and the planet for environmental sustainability. Environmental sustainability has importance for ensuring that we have and will

continue to have the water, materials, and resources to protect human health and our environment (EPA, 2011). As this issue is very common and critical in recent times; governments and organizations are taking positive actions; and academic world is working on solving environmental problems and protecting environment before the problems occur. Environmental Management System (EMS) is an effective instrument for organizations to reduce environmental impacts and improve overall performance. Generally, large organizations implement EMS as their social responsibility and voluntary actions. The studies on EMS are productive and comprehensive in the literature. Innovation is a fundamental aspect of the business context in most organizations, and environmental innovation is the new or modified processes, techniques, systems and products to eliminate or reduce environmental damages (Arundel and Kemp, 1998). Technological product and process innovations, as the types of environmental innovation are examined in the literature. Product innovation has been widely studied in the areas of new product development, product design for environment and design for remanufacturing. Despite the numerous studies on production innovation in the literature, those are missing the focus on process innovation. Lager (2002) stated that reduction of production costs, higher production yields, production volume increases and product recoveries, etc. are the objectives of process innovation; and it helps to reduce environmental impacts and also provides competitive advantages in the global and local markets. Another key element for consideration is remanufacturing. According to literature, interest in remanufacturing is rapidly increasing due to the understanding of its potentially important role in changing our environment. Remanufacturing can be profitable for organizations, and can create environmental benefits.

As far as the literature review in this study is concerned, following recommendations can be made for environmental sustainability: Since the majority of organizations are SMSs in the world, not only the large organizations but also SMEs should be measured and evaluated in terms of their hazards and impacts on the environment. Further studies can be focused on specifically related to SMEs to help them to achieve competitive advantages economically with their environmental business actions. Additionally, products should be planned as remanufacturable during their design processes to help remanufacturing processes.

Considering the rapid degradation in environmental conditions, the concern of nearing the earth's limits, and the demands from consumers on preserving the environment; there is an emerging need for further studies on the process innovation in remanufacturing.

References

Anton, W.R.Q., Deltas, G., Khanna, M. (2004), "Incentives for environmental self-regulation and implications for environmental performance". Journal of Environmental Economics and Management, 48(1), 632–654.

APRA (Automotive Parts Rebuilders Remanufacturers Association), (2010), "What is Remanufacturing?". Available at: http://www.apra.org/About/Reman.asp.

Aragon-Correa, J.A., Sharma, S. (2003), "A Contingent Resource-Based View of Proactive Corporate Environmental Strategy". The Academy of Management Review, 28(1), 71-88.

Arimura, T.H., Hibiki, A., Katayama, H. (2008), "Is a voluntary approach an effective environmental policy instrument?: A case for environmental management systems". Journal of Environmental Economics and Management, 55(3), 281-295.

Arundel, A., Kemp, R. (1998), "Survey indicators for environmental innovation". Indicators and Data for European Analysis (IDEA), Idea Paper Series, No. 8.

Arundel, A., Kemp, R., Parto, S. (2007), "Indicators for environmental innovation: what and how to measure". Open Access publications from Maastricht University with number urn:nbn:nl:ui:27-19389. Available at: http://arno.unimaas.nl/show.cgi?fid=15710.

Ashley, S. (1993), "Designing for the environment". Mechanical Engineering, 115(3), 52–55.

Baer, M., Frese, M. (2003), "Innovation is not enough: Climates for initiative and psychological safety, process innovations and firm performance". Journal of Organizational Behaviour, 24(1), 45-68.

Bergfors, M.E., Larsson, A. (2009), "Product and process innovation in process industry: a new perspective on development". Journal of Strategy and Management, 2(3), 261-276.

Biondi, V., Iraldo, F., Meredith, S. (2002), "Achieving sustainability through environmental innovation: the role of SMEs". Int. J. Technology Management, 24(5-6), 612-626.

Bleischwitz, R. (2009), "Eco-innovation - putting the EU on the path to a resource and energy efficient economy". MPRA Paper No. 19939. Available at: http://mpra.ub.uni-muenchen.de/19939/1/MPRA_paper_19939.pdf.

Brio, J.A., Junquera, B. (2003), "A review of the literature on environmental innovation management in SMEs: implications for public policies". Technovation, 23, 939–948.

Brent A.C., Labuschagne C. (2004), "Sustainable Life Cycle Management: Indicators to assess the sustainability of engineering projects and technologies". International Engineering Management Conference, 2004. Available at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1407084.

Bolat, B., Gozlu, S. (2003), "Factors influencing the ISO 14000 Environmental Management System implementation". ITU Dergisi Seri D: Mühendislik, 2(2), 39-48.

Boons, F. (2008), "Analyzing ecological innovations in production and consumption systems: Methodological consequences of a systemic approach". The DIME-workshop, 17-18 January 2008, Karlsruhe. Available at: http://www.dime-eu.org/files/active/0/ISIWorkshopBoons.pdf.

Bovea, M.D., Wang, B. (2007), "Redesign methodology for developing environmentally conscious products". International Journal of Production Research, 45(18-19), 4057-4072.

Callicott, J.B., Mumford, K. (1997), "Ecological Sustainability as a Conservation Concept". Conservation Biology, 11(1), 32-40.

Carter, C.R., Kale, R., Grimm, C.M. (2000), "Environmental purchasing and firm performance: an empirical investigation". Transportation Research, Part E, 36, 219-228.

Chen, K., Wang, J. (2008), "The Data Mining Technology Based on CIMS and Its Application on Automotive Remanufacturing". First International Workshop on Knowledge Discovery and Data Mining, e-Forensics, 2008, 48-52.

Cleff, T., Rennings, K. (1999), "Determinants of Environmental Product and Process Innovation". European Environment, 9(5), 191–201.

Darnall, N., Edwards D., Jr. (2006), "Predicting the Cost of Environmental Management System Adoption: The Role of Capabilities, Resources and Ownership Structure". Strategic Management Journal, 27(4), 301–320.

Dasgupta, S., Hettige, H., Wheeler, D. (2000), "What improves environmental compliance? Evidence from Mexican industry". Journal of Environmental Economics and Management, 39(1), 39–66.

Department for Innovation, Universities & Skills, United Kingdom, (2008), Innovation Nation. Available at: http://www.bis.gov.uk/assets/biscore/corporate/migratedD/ec_group/18-08-C_b.

Dyllick, T., Hockerts, K. (2002), "Beyond The Business Case For Corporate Sustainability". Business Strategy and the Environment, 11(2), 130–141.

EPA (United States Environmental Protection Agency), (2011), "What is sustainability?". Available at: http://www.epa.gov/sustainability/basicinfo.htm#sustainability.

Ferguson, M.E., Toktay, L.B. (2006), "The Effect of Competition on Recovery Strategies". Production and Operations Management, 15(3), 351–368.

Fischer, C., Parry, I.W.H., Pizer, W.A. (2003), "Instrument choice for environmental protection when technological innovation is endogenous". Journal of Environmental Economics and Management, 45(3), 523-545.

Florida, R., Atlas, M., Cline, M. (2000), "What Makes Companies Green? Organizational and Geographic Factors in the Adoption of Environmental Practices". Economic Geography, 77(3), 209-224.

Florida, R., Davison, D. (2001), "Gaining from Green Management: Environmental Management System Inside and Outside the Factory". California Management Review, 43(3), 64-84.

Frondel, M., Horbach, J., Rennings, K. (2007), "End-of-Pipe or Cleaner Production? An Empirical Comparison of Environmental Innovation Decisions Across OECD Countries". Business Strategy and the Environment, 16(8), 571–584.

Fuller, D.A., Ottman, J.A. (2004), "Moderating unintended pollution: the role of sustainable product design". Journal of Business Research, 57(11), 1231-1238.

Galbreth, M., Boyaci, T., Verter, V. (2006), "Product Reuse in Innovative Industries". Available at: http://personnel.mcgill.ca/files/tamer.boyaci/InnovationWP.pdf.

Geffen, C.A., Rothenberg, S. (2000), "Suppliers and Environmental Innovation: The Automotive Paint Process". International Journal of Operations and Production Management, 20(20), 166-186.

Gehin, A., Zwolinski, P., Brissaud, D. (2008), "A tool to implement sustainable end-of-life strategies in the product development phase". Journal of Cleaner Production, 16(5), 566-576.

Gerrard, J., Kandlikar, M. (2007), "Is European end-of-life vehicle legislation living up to expectations? Assessing the impact of the ELV Directive on 'green' innovation and vehicle recovery". Journal of Cleaner Production, 15(1), 17-27.

Goodland, R. (1995), "The concept of Environmental Sustainability". Annual Review of Ecolgy and Systematics, 26, 1-24.

Goodland, R., Daly, H. (1996), "Environmental Sustainability: Universal and Non-Negotiable". Ecological Aplications, 6(4), 1002-1017.

Gray, C., Charter, M. (2007), " Remanufacturing and Product Design". International Journal of Product Development, 6(3-4), 375-392.

Hall, J., Vredenburg, H. (2003), "The Challenges of Innovating for Sustainable Development". MIT Sloan Management Review, 45(1), 61–68.

Hammond, R., Amezquita, T., Bras, B. (1998), "Issues in the Automotive Parts Remanufacturing Industry – A Discussion of Results from Surveys Performed among Remanufacturers". International Journal of Engineering Design and Automation, 4(1), 27-46.

Hatcher, G.D., Ijomah, W.L., Windmill, J.F.C. (2011), "Design for remanufacture: a literature review and future research needs". Journal of Cleaner Production, 19(17-18), 2004-2014.

Heese, H.S., Cattani, K., Ferrer, G., Gilland, W., Roth, A.V. (2005), "Competitive advantage through take-back of used products". European Journalof Operational Research, 164(1), 143–157.

Hopkins, M. (2005), "Measurement of corporate social responsibility". International Journal of Management and Decision Making, 6(3-4), 213-231.

Hopwood, B., Mellor, M., O'Brien, G. (2005), "Sustainable Development: Mapping Different Approaches". Sustainable Development, 13(1), 38–52.

Ijomah, W.L., Bennett, J.P., Pearce, J. (1999), "Remanufacturing: evidence of environmentally conscious business practice in the UK". Environmentally Conscious Design and Inverse Manufacturing, 1999, Proceedings, EcoDesign 99: First International Symposium On, Tokyo, Japan, 192-196.

Ijomah, W.L. (2008), "A tool to improve training and operational effectiveness in Remanufacturing". International Journal of Computer Integrated Manufacturing, 21(6), 676-701.

Inderfurth, K. (2005), "Impact of uncertainties on recovery behavior in a remanufacturing environment A numerical analysis". International Journal of Physical, Distribution & Logistics Management, 35(5), 318-336.

ISO (The International Organization for Standardization), (2009), "Environmental management, The ISO 14000 family of International Standards". Available at: http://www.iso.org/iso/theiso14000family_2009.pdf.

ISO (The International Organization for Standardization), (2011), "ISO 14000 essentials". Available at: http://www.iso.org/iso/iso_14000_essentials.

Jennings, P.D., Zandbergen, P.A. (1995), "Ecologically Sustainable Organizations: An Institutional Approach". The Academy of Management Review, 20(4), 1015-1052.

Kemp, R. (2002), "Technology and the transition to environmental sustainability: The problem of technological regime shifts". Futures, 26(10), 1023-1046.

Kerr, W., Ryan, C. (2001), "Eco-efficiency gains from remanufacturing: A case study of photocopier remanufacturing at Fuji Xerox Australia". Journal of Cleaner Production, 9(1), 75-81.

King, A.M., Burgess, S.C., Ijomah, W., McMohan, C.A. (2006), "Recondition, remanufacture or Recycle?". Sustainable Development, 14(4), 257–267.

Kumaran, D.S., Ong, S.K., Tan, R.B.H., Nee, A.Y.C. (2001), "Environmental life cycle cost analysis of products". Environmental Management and Health, 12(3), 260-276.

Lager, T. (2002), "A structural Analysis of Process Development in Process Industry". R&D Management, 32(1), 87–95.

Matsumoto, M., Umeda, Y. (2011), "An analysis of remanufacturing practices in Japan". Journal of Remanufacturing, 1(2). Available at: http://www.journalofremanufacturing.com/content/1/1/2.

Montabon, F., Sroufe, R., Narasimhan, R. (2007), "An examination of corporate reporting, environmental management practices and firm performance". Journal of Operations Management , 25(5), 998–1014.

Nasr, N., Thurston, M. (2006), "Remanufacturing: A Key Enabler to Sustainable Product Systems". 13th CIRP International Conference on Life Cycle Engineering, 15-18. Available at: http://www.mech.kuleuven.be/lce2006/key4.pdf.

Nasr, N., Hilton, B., German, R. (2011), "A Framework for Sustainable Production and a Strategic Approach to a Key Enabler: Remanufacturing". Advances in Sustainable Manufacturing: Proceeding of th 8th Global Conference on Sustainable Manufacturing, 2011, Part 5, p.189. Available at: http://www.springerlink.com/content/gx18u1m377h1lx7v/.

Nawrocka, D. (2008), "Environmental supply chain management, ISO 14001 and RoHS. How are small companies in the electronics sector managing?". Corporate Social Responsibility and Environmental Management, 15(6), 349–360.

Nemli, E. (2000), "Çevreye Duyarlı Yönetim Anlayışı". İ.Ü.Siyasal Bilgiler Fakültesi Dergisi, No: 23-24, (Ekim 2000-Mart 2001), 211-224.

OECD (Organisation for Economic Co-operation and Development), (2009), "Sustainable Manufacturing and Ecoinnovation: Towards a Green Economy". Policy Brief, 2009. Available at: http://www.oecd.org/dataoecd/34/27/42944011.pdf.

OECD (Organisation for Economic Co-operation and Development), (2005), "Oslo Manual, Guidelines for Collecting and Interpreting Innovation Data". Third Edition, France: OECD Publishing.

Onkila, T. (2011), "Multiple Forms of Stakeholder Interaction in Environmental Management: Business Arguments Regarding Differences in Stakeholder Relationships". Business Strategy and the Environment, 20(6), 379–393.

Östlin, J., Sundin, E., Björkman, M. (2008), "Importance of closed-loop supply chain relationships for product remanufacturing". International Journal of Production Economics, 115(2), 336-348.

Papinniemi, J. (1999), "Creating a model of process innovation for reengineering of business and manufacturing". International Journal of Production Economics, 60-61, 95-101.

Porter, M.E., Van der Linde, C. (1995), "Green and competitive: ending the stalemate". Harvard Business Review, September–October, 1995, 120–134.

Potoski, M., Prakash, A. (2005), "Covenants with Weak Swords: ISO 14001 and Facilities' Environmental Performance". Journal of Policy Analysis and Management, 24(4), 745–769.

Pujari, D., Wright, G., Peattie, K. (2003), "Green and competitive Influences on environmental new product development performance". Journal of Business Research, 56(8), 657– 671.

Pujari, D. (2006), "Eco-innovation and new product development: understanding the influences on market performance". Technovation, 26(1), 76-85.

Rajendran, D., Barrett, R. (2003), "Managing Environmental Risk in Small Business: An Agenda for Research". 16th Annual Conference of Small Enterprise Association of Australia and New Zealand, 28 September – 1 October 2003.

Rathore, P., Kota, S., Chakrabarti, A. (2011), "Sustainability through remanufacturing in India: a case study on mobile handsets". Journal of Cleaner Production, 19(15), 1709-1722.

Rehfeld, K.M., Rennings, K., Ziegler, A. (2007), "Integrated product policy and environmental product innovations: An empirical analysis". Ecological Economics, 61(1), 91–100.

Rennings, K. (2000), "Redefining innovation - eco-innovation research and the contribution from ecological economics". Ecological Economics, 32(2), 319-332.

Rubio, S., Corominas, A. (2008), "Optimal manufacturing–remanufacturing policies in a lean production environment". Computers & Industrial Engineering, 55(1), 234-242.

Sanchez, D.P., Barton, J.R., Bower, D. (2003), "Implementing Environmental Management in SMEs". Corporate Social Responsibility and Environmental Management, 10(2), 67–77.

Shah, P., Gosavib, A., Nagic, R. (2010), "A machine learning approach to optimise the usage of recycled material in a remanufacturing environment". International Journal of Production Research, 48(4), 933–955.

Shrivastava, P. (1994), "Castrated Environment: Greening Organizational Studies". Organization Studies, 15(5), 705-726.

Steinhilper, R. (2001), "Recent Trends and Benefits of Remanufacturing: From Closed Loop Businesses to Synergetic Networks". Environmentally Conscious Design and Inverse Manufacturing, 2001. Proceedings EcoDesign 2001: Second International Symposium on, Tokyo, Japan, 481-488.

Sundin, E. (2004), "Product and process design for successful remanufacturing". Linköping Studies in Science and Technology, Dissertation No. 906, Department of Mechanical Engineering, Linköpings Universitet, SE-581 83 Linköping, Sweden.

Sundin, E., Bras, B. (2005), "Making functional sales environmentally and economically beneficial through product remanufacturing". Journal of Cleaner Production, 13(9), 913-925.

The European Commission, (2008), "Promoting Innovative Business Models with Environmental Benefits". Final report No: 4, Issue 3, November 2008. Available at: http://ec.europa.eu/environment/enveco/innovation_technology/pdf/nbm_report.pdf.

The European Commission, (2010), "SMSs and the environment in the European Union". Danish Technological Institute, Main Report, The Competitiveness and Innovation Programme 2007-2013. Available at: http://ec.europa.eu/enterprise/policies/sme/business-environment/files/main_report_en.pdf.

The European Commission, (2011), "What is an Environmental Management System?". Available at: http://ec.europa.eu/environment/emas/about/enviro_en.htm.

Tingström, J., Karlsson, R. (2006), "The relationship between environmental analyses and the dialogue process in product development". Journal of Cleaner Production, 14(15-16), 1409-1419.

Toffel, M.V. (2004), "Strategic Management of Product Recovery". California Management Review, 46(2), 120-141.

Vinodh, S. (2011), "Environmental conscious product design using CAD and CAE". Clean Technologies and Environmental Policy, 13(2), 359–367.

WCED (The World Commission on Environment and Development), (1987), "The Closing Ceremony of The Eighth and Final Meeting of The World Commission on Environment and Development", Tokyo, Japan.

Wheeler, D., Elkington, J. (2001), "The End of The Corporate Environmental Report? Or The Advent of Cybernetic Sustainability Reporting and Communication". Business Strategy and the Environment, 10(1), 1–14.

Williamson, D., Lynch-Wood, G., Ramsay, J. (2006), "Drivers of Environmental Behaviour in Manufacturing SMEs and the Implications for CSR". Journal of Business Ethics, 67(3), 317–330.

Zwolinski. P., Lopez-Ontiveros, M.A., Brissaud, D. (2006), "Integrated design of remanufacturable products based on product profiles". Journal of Cleaner Production, 14(15–16), 1333–1345.