Journal of Management and Social Sciences
Vol. 4, No. 1, (Spring 2008) 12-28

3 R'S of Used Car Recovery in Philippine's Approach

CHIU, Candy Lim*
Kyoto University, Japan

ABSTRACT

Used car market has been growing rapidly, because of fleet sales, improved reliability and its longevity that it can be an economical means of product recovery market creation for developing countries like the Philippines. The purpose of this study is to provide in-depth insights into three specific product recoveries in the used car sector. It demonstrated the actual stage of 3 R's operations (reconditioning, repositioning and remanufacturing). This study makes several contributions to the literature of product recovery and innovation. First, it illustrated the concept of used cars as recyclable resources. Second, it described more precise definitions of the "re" of product recovery. Third, gave an in-depth background of the specifics procedures took place at the industrial unit especially in medium and small size used car trading enterprises, from the movements, production processes, quality tests and fulfillment certifications and standards until the distribution to sale points at the domestic market. Fourth, provide proactive approaches to move 3 R's into mainstream business practice. The aim was to disseminate this information more widely, so that best practice from one community could spread to others with similar needs and circumstances.

1. INTRODUCTION

For the past half century the main focus of the industry has been new vehicle productions systems, manufacture and sale. The international dimensions of this revolve around economies of production and distribution, compliance with regulatory standards and content expectations, and provision of adequate service infrastructure. The traffic in used motor vehicles across borders has been an altogether different matter.

In recent years, international trade of recyclable resources (Kojima, 2004) such as used car has increased. The outflow of recyclable waste destined for recycling from Japan to the rest of the world has been expansionary trend. Used vehicles move across country boundaries from higher to lower in socioeconomic terms. In order to achieve ambitious policy targets on end-of-life vehicles recovery/recycling/reuse interrelated sequences of single innovation not only on the upstream side of car making but also to the downstream side of used car recovery.

At the same time, pollution generated during recycling is creating problems, and there are also problems with waste that are unrecoverable, which are being exported as recyclable waste, and non-usable wastes being exported as secondhand goods. Recycling and reuse of car parts are not a recent phenomenon but still not widespread or there is not enough

* The material presented by the author does not necessarily portray the viewpoint of the editors and the management of the Institute of Business & Technology (BIZTEK) or Kyoto University, Japan.

*CHIU, Candy Lim: candyonthecover@yahoo.com

studies has been done to overview the process applied in the industry. From the early days of car repair, people who needed cheap spare parts for their cars would often go to a car dismantler. Car dismantling companies typically had many ELVs standing on their terrain, where people could find the parts they needed.

In a letter to shareholders, employers and customers, Jack Welch summed up the vision of GE's service activities, a significant portion of which comprise remanufacturing, repair and overhaul. His letter provides an excellent example of how a top-level commitment can spawn a completely new and profitable business paradigm (Giuntini and Gaudette, 2003):

> "With this initiative, as with globalization, we are broadening our definition of services – from the traditional activities of parts replacement, overhauling, and reconditioning… to a larger and bolder vision. We have the engineering, the R&D, the product knowledge, the resources, and the management commitment to make the series of hundred-million-dollar investments that will allow us to truly change the performance of our installed base, and by doing so, upgrade the competitiveness and profitability of our customers." (p. 46)

An increase in the re-use of products is important from an environmental point of view. So, entrepreneurs in the developing countries like in the Philippines established 3 R's recovery system that involve buying used/junk cars from developing countries like Japan, and disassembling them at a small plant, followed by the application of the 3 R's by the reuse or recycling of components in an environmentally sound manner.

The purpose of this study is to provide in-depth insights into three specific product recoveries in the used car sector. It demonstrated the actual stage of 3 R's operations. This study gives an in-depth background of the specifics procedures took place at this industrial unit especially in medium and small size used car trading enterprises, from the movements, production processes, quality tests and fulfillment certifications and standards until the distribution to sale points at the domestic market. The findings may serve as a starting point for developing country's study on product recovery by providing an account of used car sectors practices towards building innovation.

2. METHODOLOGY

The used car sector was selected as the primary source of information, as there is an abundance of enterprises which used 3 R's - reconditioning, repositioning and remanufacturing to transforms worn-out vehicles into "as good as new" condition. Interviews were semi-structured and ranged from one to several hours. Interview data was supplemented by intensive fieldwork, observation, business process mapping and secondary data gathering such as company and government documentation was collected. Initial, broad research into 3 R's became focused on the role and application as research avenues were identified.

Desk research was planned to develop a research foundation of Philippine practice upon which informed questions could be framed. Information was found to be general and not always freely available. The limited number of experts in 3 R's and their time constraints placed some pressure on the study. The study was carried out in August 2006 (one month) and continued in April 2007 (one month). The second visits to the used car companies aimed at verifying the findings from the investigation from the first visit. Inevitably, given the lack of established empirical data on the 3 R's, much of the research was qualitative in nature and sought to elaborate the process of 3 R's.

A reflexive approach of data gathering was used similar with Charmaz (1983) and Seitz (2007) in which data collection and analysis are administered simultaneously, in short, interview questions sought to follow up specific aspects which had been identified and

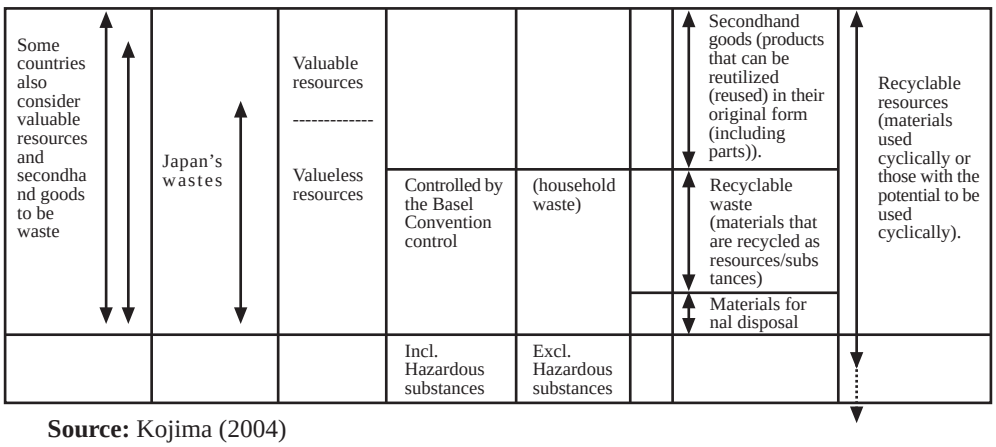
analyzed in previous interviews. Moreover, the interview structure was very flexible so that interviewees could add aspects which they could found significant with the study. The study was limited to used commercial vehicles and trucks 3 R's in order to narrow down the overall scope of the study. Moreover, the used car 3 R's sectors is generally characterized by a "shadowy existence" (Steinhilper, 1998). As a result same with Seitz (2007), the independent side of the sector is difficult to embrace and understand, however, this study took an in-depth insight in terms of understanding the overall 3 R's approach on used car sector.

3. USED CARS AS RECYCLABLE RESOURCES

The concept of new and used products depends on the desirability of customers and its purchasing power. There is the demand to purchase new products than used (Steinhilper, 1998) and there is a general issue between new and used products as perfect substitutes (Saito, 2002). As Purohit (1992, p. 154) stated "durable products are long-lived, there exists the possibility of secondary markets for used products as well as the potential for product obsolescence. This is an important issue in markets where technology changes rapidly, because the introduction of new versions of a product can make earlier versions obsolete."

People can describe that used products as waste or hazardous waste (Villaba, Segarra, Fernandez, Chimenos and Espiell, 2002). This description is further define by Japan's Fundamental Law on Establishing a Sound Material Cycle Society as recyclable wastes which include both valuable and valueless resources that are reused in the form of material recycling, chemical recycling and so forth, which are then reutilized in their original form as shown in Figure 1. So the elements of "re" enters the picture and need to be marketed to demonstrate the positive characteristics and eliminate misconceptions and fundamental assumptions of poor quality and low status of used products.

Figure 1:
Definitions of Recyclable Resources, Secondhand Goods, Recyclable Waste and Waste



Source: Kojima (2004)

At present, industries are moving towards environmentally concerns, gaining significance in the society with the present of reused products such as photocopier, cellular telephone and single use camera. However, automotive sector is one of the first industries to practice recycling (Seitz, 2007) because as car manufacturers become more and more competitive and environmentally conscious, they tend to investigate various means for the complete life cycle of their products in all stages of their life time from design to use and disposal.

Automobiles, whole life span is much longer than any product like copier, has less chance of overcoming technological obsolescence, unless technology used for automobiles is very stable for decades. Automobiles have been constructed to be 'repairable' and thus can be recovered to some extent.

At the time a motor vehicle is designed and built, the manufacturer determines a large number of features that affect the pattern of breakdowns and the nature of repairs that occur over the car's life and that ultimately affect the car's lifetime. And these products will be discarded at the end of their useful lives. However, society requires that a maximum of end-of-life products find their way back into the industrial and consumer cycle to ensure a sustainable development of our society.

In Japan as one of the major exporter of used cars in the Philippines has a total of 78 million end-of-life vehicle (ELV) services every year, million of this are exported and four million are scrapped within the country (Ogushi and Kandikar, 2005). At present 20-30 percent of an ELV is recovered in the form of parts for reuse and 50-55 percent in the form of recycled steel and other metals, i.e., about 80 percent of an ELV is salvaged on a mass basis as shown in Table 1. The remaining 20 percent called ASR or automobile shredder residue, mainly consists of plastics, foam, rubber, dirt, fluids, fiber and glass, and is considered as the most problematic aspect of ELVs (Ogushi and and Kandikar, 2005).

At the time of purchase of a new vehicle or at the time of the next inspection for vehicles in use, vehicle owners pay a recycling fee which is remitted to the Japan Automobile Recycling Promotion Center delegated by the central government to manage these funds. Vehicle owners are then issued a certification from attesting to this payment. Then followed by ELV recycling process as shown in Figure 2 (Mazzanti and Zoboli, 2006): (1) Final owners turn in their end-of-life vehicles to ELV collectors (auto dealers, service garage operators, etc.). (2) After confirming payment of the recycling fee, ELV collectors deliver the vehicles to fluorocarbon recovery operators. (3) Fluorocarbon recovery operators recover the refrigerants, transfer them to the automakers or importers then deliver the ELVs to dismantlers. (4) Dismantlers recover the air bags, transfer them to the automakers or importers, dismantle the ELVs in compliance with established procedures then deliver the vehicle carcasses to shredding and sorting operators. And lastly (5) after shredding the vehicle carcasses and sorting the remaining materials for recycling, shredding and sorting operators then transfer the shredder residue to the automakers' and importers' representative organization delegated with the task of disposal.

Table 1:
ELVs Recovery and Reuse of Parts and Materials

1. Engine (steel, aluminum)	Steel products, aluminum products
2. Coolant (alcohol)	Boiler furnace combustion agent
3. Wire harness	Copper products, etc.
4. Battery (lead)	New batteries
5. Engine oil	Boiler furnace combustion agent
6. Radiator (copper, aluminum)	Brass products, aluminum products
7. Hood/bonnet (steel)	New auto parts, steel products
8. Front bumper (plastic)	New bumpers, internal and external parts, tool boxes, etc.
9. Tire (rubber)	Raw materials, fuel for cement production, etc.
10. Wheel (steel, aluminum)	New auto parts, steel products
11. Body	New auto parts, steel products
12. Door	New auto parts, steel products
13. Seat (foam, fiber)	New auto soundproofing/filler materials
14. Window	Glass wool, etc.
15. Truck/boot	New auto parts, steel products
16. Suspension	Steel products, aluminum products
17. Transmission	Steel products, aluminum products
18. Transmission Oil	Boiler furnace combustion agent
19. Catalytic converter (platinum)	New catalytic converters

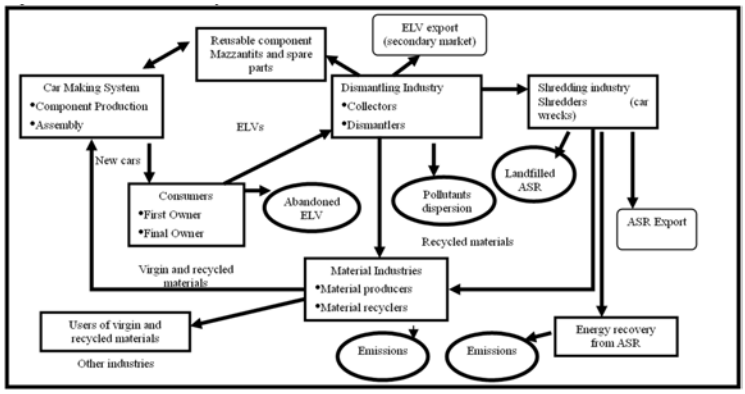
Source: Japan Automotive Manufacturing Association (JAMA) (2007).

The automakers' and importers' delegated representative organization ensures that the

fluorocarbons and air bags are transferred to the appropriate disposal facilities, and designated handling agents ensure that the shredder residue is transferred to recycling facilities. Concurrently, the funds obtained from the recycling fees are remitted by the fund management entity to the automakers and importers, who in turn remit payment to the fluorocarbon recovery operators and the dismantlers for the cost of recovery.

The recovery value of each parts of the vehicle is an inverse function of the product line variety such as recycled auto parts which include reused parts and rebuild parts. Reused parts are parts taken from ELVs, quality inspected and cleaned before sales while rebuild parts are ones taken from ELVs, disassembled, cleaned, quality-inspected, repaired where necessary and reassembled with worn components replaced. The recovery of high-value parts and materials is not very useful if there is no market for recovered and/or manufactured items. So product obsolescence also plays an important role in this respect. Furthermore, automotive manufacturers increasingly face the challenge of understanding and managing complex systems that it will require multidisciplinary approach which requires possible change in ELV management and recovery as shown in Table 2.

Figure 2:
A Sketch of the ELV System



Source: Mazzanti and Zoboli (2006).

Table 2:
Auto Manufacturers' Action Items and Possible Change in End-of-Life Recovery Options

Action items by automobile manufacturer for ELV management	End-of-life recovery option supported by the action			
	Remanufacturing Vehicle	Part Reuse	Material Recycling	Energy Recovery
1. Design and development of new vehicles				
• Reduce: Reducing resource use, number of parts and integration. Making parts smaller and lighter.		X		
• Design for longer life			X	
• Improving recyclability of new vehicles: use of recyclable material		X	X	
• Design for easy disassembly			X	
• Identification of material				
• Reduction of hazardous substances			X	
• Appropriate processing of airbags: Processing airbags on board				
• Pre-assessment				
2. ELV recovery and processing		X		
• Reusing parts: sales of reused and rebuilt parts			X	X
• Technological development of ELV recovery processes			X	
• Expansion of application of recycled material			X	
• Information provision (car structure etc.)		X	X	
• Recycling hybrid vehicle batteries				

Source: Ogushi and Kandlikar (2005, p. 629).

Product reuse, as opposed to material recycling, would seem to be more profitable means of product disposition, both ecologically and economically, as the reprocessing and manufacturing expenditures (time, energy, cost, etc.) are avoided (Amezquita, Hammond and Bras, 1995; Berko-Boateng, Azar, De Jong and Yander, 1993; Haynsworth and Lyons 1987; Navin-Chandra, 1993). Whether motivated by recent legislative efforts or by a moral sense of obligation or by profit, automobile manufacturers are attempting to reduce the environmental impacts of the entire life cycle of their vehicles. Specifically, the manufacturers are attempting to improve the recyclability of their vehicles and thereby reduce the percentage of each car which must be disposed of in a landfill.

4. 3 R's IN USED CAR RECOVERY

The motor vehicle recycling industry is sustained by the value of both used car parts and recycled metals. The key participants in the recycling process are the last vehicle owner, the dismantling facility, the metal shredder, the steel mill, and finally, the landfill (Tipping, 1998). There are also operations that recycle one component only, like car battery and rubber recyclers. Very often cars that have reached the end of their useable life are taken to an auto dismantler's yard. The dismantler will strip the vehicle of all saleable parts. Once it has been stripped and the sump drained of oil, the car body is removed and reused. A system approach to recycling junk cars as a major renewable resource in Philippine setting are given significance to boost automobile recovery that will answer to the increasing trade of junk motor vehicles among developed and developing countries. The volume of materials contained in motor vehicles makes them the major source of scarp materials such as steel, iron, zinc, copper, aluminum, rubber, and plastics that have potentials to open up other forms of business opportunities. As far back as the 1930s, when Henry Ford began remanufacturing automobile engines after the Great Depression brought new car sales to a standstill, companies with an eye to the future have recognized and capitalized on this untapped opportunity.

In the used car industry, there are numerous elements of "re" such as recycling, reuse, repair which are easily viewed similar to all process in all countries, however, in the Philippine setting three "re" are popularly implemented in the industry namely: reconditioning, repositioning and remanufacturing which are contrast to other "re", in which the geometrical form of the product is retained and its associated economical and environmental value is preserved. This study takes into account the differences among the "re" words used in the used car industry for thorough understanding of its process and positioning within the context of the industry.

Background of Other "Re" in Used Car Industry

Recycle, as opposed to the 3 R's recovery options, it returns a product to raw material form and its identity and functionality of returned products are not preserved. The term "recycling" is generally applied to consumable goods e.g. newspapers, glass bottles and aluminum cans but can also be applied to durable goods such as an engine. Recycling in this sense destroys the value added to the raw material by forming it in the original manufacturing process. A recycled product may also be removed from a redundant product and resold with little or no work performed on it e.g. in the automobile sector as part of an end-of-life reclaim and reuse operation. Krikke, Van Harten and Schuur (1998) distinguish three recycling sub-options for returned products and components: (1) high grade material recycling, recovery to the original quality; (2) low grade material recycling, recovery to a lower quality level than original; and (3) alternative material recycling, recovery into entirely new materials.

Reused is generally applied to product that has been used previously. The product will retain the problems it acquired during its previous life as it will not have been repaired. This includes conventional reuse where the item is used again for the same function and

new-life reuse where it is used for a new function.

Repair aims to restore the broken product into working condition. An analysis of the root cause of the problem is generally not performed in the repair process which means the product may not perform like a new product. Typically, a warranty on a repair will only apply to the specific repair and not the whole item. The quality of a product that has been repaired is typically less than the quality of a new one. Repair activities require limited disassembly of the returned product and involve the fixing or replacing its broken parts.

3 R's in Philippine's Approach

Reconditioning

Reconditioning restore the used product functionally to as new or almost new condition or within a specified quality level, which is usually lower than that of a new product and it may not come with a warranty that matches a new product. Reconditioning may return a product to like-new quality but the process may not disassemble and clean all of a product's components. Subassemblies in good condition are cleaned, tested and reconditioned by replacement of worn parts. Visible parts are repainted and re-coated. The reconditioning industry shows that it is possible to find good used cars. If the consumer does not care to be his own general contractor and personally manage the reconditioning.

Reconditioning is made conditionally, meaning it's a must to do it. By choosing to commit to recondition the cars, people know that they can go to the shops they want and find what they looking for a quality used car. Once a used car is taken in, it must be reconditioned before being put on the lot. The dealer wants this process to happen as quickly and as inexpensively as possible. The sooner the car is on the lot, the sooner it can be sold. And every dollar saved in reconditioning is an additional dollar in the dealer's pocket. As one used car dealer (2006) stated, "appearance sells them, but mechanical reconditioning keeps them sold."

Reconditioning/refurbishing is also used when the product is only remanufactured to its original specifications (Ijomah, Bennett and Pearce, 1999). Keeping a used car clean is important, because it's the first impression the customer for the car and for the dealer. The first step in used car reconditioning is a thorough washing, which includes removal of seats and carpet. The ashtray, glove box, and trunk must be spotless, and the engine compartment gets a complete steam cleaning. Any trailer hitches or unique accessories added by the former owner must remove. If left in place, this type of non-standard equipment will raise unnecessary questions in a prospective buyer's mind.

The final steps in the reconditioning process are body and mechanical repairs. Often a used grille or hood is a sufficient replacement for a used car and will save the dealer money. A reputable used car dealer can't afford to sell a car that is unsafe to drive. All necessary mechanical repairs are made to make sure the new owner will have no problems. Reconditioning the cars is a great way to bring more people in and eventually make a sale.

Repositioning

Repositioning is the method of converting right hand drive (RHD) vehicle to left hand drive (LHD) vehicle or vice versa. The Philippine is a country implementing the left hand drive system in the operation of motor vehicles. As such, its highways and traffic control devices are constructed in accordance with this system. One way of ensuring a better outcome is by strategically moving to commit repositioning the used cars prior to registration. It was established that RHD vehicles contributed to accidents due to the incompatibility of the steering wheel position with the left hand drive system "keep right rule." Thus, the practice of repositioning to conform to safety requirements has developed its own repositioning industry whereby specialty shops and facilities bring motor vehicles into

conformity with local safety and emission regulations which have always been practiced even in the European countries that have allowed co-mingling of RHD and LHD vehicles.

Remanufacturing

Remanufacturing is most studied among the 3 R's, number of literature dealt with subject. Some of the most notable work in remanufacturing was performed primarily by Robert Lund (Lund, Clark, Tuler, Barnett, Bollinger, Grand, Kutta and Stanovsky, 1980; Kutta and Lund 1978; Lung, 1983; Lund, 1984; Lund and Denney 1977; Lund and Skeels, 1983a; Lund and Skeels, 1983b) who performed a survey in the early eighties among remanufacturers. The remanufacturing industry got a boost during the Second World War when many manufacturing facilities change from ordinary production to military production, and therefore the products in use were to a large extent remanufactured in order to keep society running. The industry sector that has the most experience in the remanufacturing area is the automotive industry. However, the concept of remanufacturing has spread during the latest decades to other sectors, such as those dealing with electrical apparatus, toner cartridges, household appliances, machinery, cellular phones etc (Kerr and Ryan 2001; Guide and Van Wassenhove 2002; Guide and Van Wassenhove 2003; Sundin 2004).

At present, automotive products account for two-thirds of all remanufacturing (Steinhilper, 1998). Remanufacturing began with small independent companies providing cheap replacement parts. Vehicle manufacturers ignored this business opportunity for many years, viewing it as a "dirty" part of the industry that lacked the glamour of new car production and marketing. However, in the Philippines, remanufacturing started since 1945 with the present of surplus army jeeps wrecked during the Second World War, Filipino tries to remanufacture the used engines and body frames of the Jeep to form its own transport vehicle known as the Jeepney which evolved as another sector in the automobile industry of the country. In the USA, although remanufacturing is a major business, Original Equipment Manufacturers (OEMs) still remain relatively disengaged and account for less than five per cent of total remanufacturing activity (Guide Jr., 2000). In Europe, OEMs have recently discovered the aftermarket potential for remanufactured products, and many are now involved (Seitz and Peattie, 2004).

Remanufacturing is the practice of disassembling, cleaning, refurbishing, replacing parts as necessary and reassembling a product in such a manner that the part is at least as good as, or better than new. By remanufacturing a vehicle, the vehicle may returned to service with a reasonably high degree of confidence that it will endure another full life-cycle. There are notable words synonyms with remanufacture shown in Table 3.

Table 3:
Remanufacture Synonyms

1. Rebuilt is synonymous with remanufacturing when used in connection with motor vehicle parts and systems but not the entire vehicle.
2. Recharged is used in connection with the remanufacture of imaging products e.g. laser toner cartridges.
3. Retread or remoulding is used in the tyre industry.
4. Rewinding is synonymous with remanufacturing in the sector of electrical equipment.
5. Overhaul is synonymous with remanufacturing, particularly in the aerospace industry.

Source: Statham (2006) and Strandberg (1990)

Remanufacturing remains the least mature initiative, and as such presents the largest potential for productivity improvements (Giuntini and Gaudette, 2003). The importance of remanufacturing's role in the context of all the "re" is explained by Nasr and Thurston (2006):

> "Component reuse will typically result in lower overall material and energy use than component remanufacturing. However, only components that retain their

> value and conformance can be reused without compromising the durability or reliability of the final product. Remanufacture allows components to retain their worth, thereby placing this process as a sophisticated element of reuse and repair strategies. Remanufacturing is typically a more efficient means of material recirculation than recycling. Remanufacturing retains more of the energy associated with the original conversion of raw materials to finished product." (p. 16)

3 R's products incur costs that are typically 40-65 percent less than those incurred in the delivery of new products. This is because most of the raw materials already exist in their final form and thus require only a fraction of the material processing required of a new product. In terms of energy consumption, the process of 3 R's for a product require only about 15 percent of the energy used to make the product from scratch.

3 R's Workforce

Virtually all of the material in today's automobiles can technically be reused. The challenge facing engineers is making this recovery process economical. Recovering these components requires the different materials to be separated so that each can be reused individually. This separation can be accomplished either manually, where workers disassembly and sort the vehicle components by hand, or mechanically, where the vehicle is shredded and the materials sorted by properties.

The 3 R's is a much more dynamic and varied production workforce. Blue-collar workers require initial training and skills. In addition, retired and laid-off factory workers would be in high demand, providing the experience in disassembling and reassembling products that they helped build years before. The level of skill varies with the task. Typically, a combination of both skilled and unskilled labor is necessary. Skilled workers are necessary to recover the most valuable parts. Even higher levels of skill and knowledge are necessary to differentiate among the various models and the wear states of valuable components. Different models incorporate a different variety of subassemblies.

Affordable labor is readily available in the Philippines while capacities, competences, technical information and skills for car repair works. In Philippines, the market need for repaired and reused electronic parts originates from the exposure of the societies to, and subsequent unexpected, high-volume demand for, products that are relatively costly when purchased new via international suppliers. However, in-depth training of 3 R's is limited due to 3 R's companies tend to be small names. Therein lies a disincentive for new engineers to get involved in the sector, are seen as major hurdle in driving its development.

3 R's Customers

A motor vehicle in which deteriorates with use or age, in addition, its physical condition eventually reaches the point where there is no more usage for the purpose it was manufactured or it is not economically feasible to keep the motor vehicle any longer. At this point, the vehicle is scrapped. At the same time, it is common to find owners who decide to trade this durable before the end of its lifetime, since a used good which does not appeal to some customers might appeal to other customers. Thus, we might have a substantial gain just by trading appeal to other customers. Thus we might have a substantial gain just by trading used vehicles. This implies the existence of a secondary market. After secondhand goods are reused they are disposed of as waste, but in developing countries like the Philippines that lack of disposal and recycling facilities, the chances of their being properly disposed of are low. It is my view that 3 R's was basically born in the Philippines from this concept since 1945.

3 R's brings lower prices to the consumer, typically on the order of 30-40 percent less than similar new cars. It also means more consumer choice, especially for discontinued cars

that are still available in mint condition, which is currently the case in such industries as retail auto parts. The growth in general used car 3 R's is mainly due to the high cost of new cars in the Philippines. This has led people to look at other options. Second hand care were always the second option, but were fraught with little problems. People found that they wanted a better quality, but not at new car prices.

5. APPLICATION OF 3 R's ON USED CAR

3 R's begins with the reclamation of used durable cars. Typically called "cores," these products are then disassembled into parts, which are cleaned, inspected, and tested to determine whether they meet acceptable quality standards to be reused. Some parts become waste. Others that do not meet standards can be repaired or reconfigured. These used parts and some new ones are then combined to reassemble the original core from which they were reclaimed, or to build a product with a new identity. The products typically have the same or similar performance characteristics and quality standards as new units (Giuntini and Gaudette, 2003).

Reconditioning Process Flow

Auto restoration or reconditioning can be as simple as a good washing, paint touch-ups, removing scratches, cleaning, doing windshield repair, oil changes, engine checkups and inspections on the cars or as complex as a complete engine rebuild. If the rebuilding of the product is not extensive, i.e., if few parts are to be replaced, either of the terms reconditioning or refurbishing is more suitable.

The reconditioning of a used car which come from either cars that are in the shop for repairs, cars being repaired at another facility, scrap cars from junkyards, used cars from auctions, or other vendors. It started by tearing down and disassembly where used cars will be inspected for gross defects or features that are unacceptable. These would be dates, designs, or other features that can be readily identified. The first disassembly job will be engine which includes (injection pumps and nozzles, fuel tank and pipings, radiator and connections, batteries, compressor and compressed air tank), brakes and clutch followed by partial disassembly of transmission, rear axle, differential, front axle, propeller shaft, steering, suspensions, wheel and tire, cab and special attachments, and chassis electrical. The component is then loaded into the fixture and moved onto the power and free carrier for processing into a queue area.

The next step in the process is cleaning, the removal of dust, dirt, grease, oil, synthetic and other materials from whole assemblies, sub-assemblies, components and parts through the use of tools, materials and/or substances such as steam, chemicals and gasoline.

After leaving the cleaning station, materials will be move to a preparation booth. At the preparation station, all work necessary to prepare the casting for welding will be performed. This includes the examination of assemblies, components and parts in comparison to standard specifications. More often, it requires the use of accurate measuring and metering devices. After these operations are completed, the casting will then move to machining station in which parts will undergo processes like machining, welding, adjustment, correction and calibration followed by parts replacement, with the use of brand new and remanufactured parts/components to immediately substitute permanently damaged or remanufacturable parts/components. From machining, all materials will be moved to assembly and installation, these jobs involve the following: (1) assembly of parts/components to make sub-assemblies, (2) assembly of parts/components to make major assemblies, (3) assembly of parts /components and sub-assemblies to make major assemblies, (4) assembly of parts/component, sub-assembly, major assembly and whole used car. And lastly, the testing stage to verify the performance and/or condition of a part/component, subassembly, major assembly, and whole recondition used car.

All right hand drive (RHD) vehicles and components in the country prior to registration shall undergo repositioning to left hand drive (LHD) orientation as well as installation of LHD components for LHD vehicle models using OEM components of their approved equivalent such as steering linkages, accelerator, brake, clutch pedals, hand brake, shifting lever linkage, hydraulic/pneumatic system, headlights of asymmetrical design, air cleaner, ducting system, and external engine oil filtration system.

First, headlights had to be replaced because of the patterns of the beam which were different for RHD and LHD. The beam pattern of the vehicle's light had to also be designed to slope upward towards the left side of the road in order to illuminate all road signs which were placed on the left shoulder. This pattern also helped illuminate pedestrians who were walking or stalled vehicles. Yet the beam pattern was designed to slope down with its horizontal beam pattern trimmed on the right in order to prevent the light from striking the windshield of oncoming vehicles to avoid glaring drivers coming from the opposite direction.

Second, wipers are placed in a position were the sweep of the arm is always towards the driver in order to increase the field of vision of the driver during raining conditions and minimize "blind spots," when vehicle's steering is repositioned to the left, so must the wiper position to allow it to sweep correctly towards the driver. If this were not done, the decrease in filed of vision during heavy rains would put him and others at a risk since there are occasions when while a truck is traveling forward and approaching an intersection, a person or vehicle coming from the left and traveling perpendicularly to his vehicle's line of travel is covered by the "blind spot zone" and both motions are so related and moving toward the same intersecting point that the driver with the incorrectly positioned wiper may not see the person or the vehicle because his vision is blocked by the blind spot until it is too late to avoid the accident. It is for this reason why automobile makers keep windshield pillars to a minimum to increase field of vision and design the sweep of the wiper towards the driver to prevent the occurrence of such situation.

Third, fixing of combination switch such as door switch, headlight, signal light, fog lamp, corner lamp, wiper switch, exhaust brake and washer. Followed by grasp and control of the gear shift lever and the handbrake handle for convenient driving due to unreasonable distance between steering wheel and gear shift lever, as well as the handbrake handle.

Fourth, welding of pipes, when repositioning from RHD to LHD, brake lines have to be lengthened accordingly and this is why these have to be replaced or extended to the appropriate length. The practice of cutting and welding pipes together has been most common to repositioning due to the practice of short cuts and cost cutting which have become a serious problem since it involves the safety of the general public. Almost all practice this method of brazing which is wrong and dangerous since welding a steel brake pipe to a copper pipe and brazed with brass is a sure ingredient to an accident. Welding dissimilar metals cause galvanic corrosion which in turn can cause breakage of the brake pipes that are under pressure. The use of copper brazed with brass to steel could also cause brake failure since copper is malleable steel and vibrations work harden the copper which can cause cracks thereby causing brake failure. It is difficult to imagine what temperature was used to fuse together by welding process steel brake piping to copper pipe with brass brazing rod and have long lasting bond.

Fifth, material considerations such as tubing are preferable to pipe for its better sealing and convenience of reuse and quick serviceability. Flexible hose also need not be limited to moving applications. Hydraulic fittings shall be made of steel. Galvanized pipe or fittings shall be avoided because zinc can react with some oil additives. Copper tubing shall also be avoided because vibration in the hydraulic/pneumatic system can work harden the copper and cause cracks at the flares. And for corrosion precautions shall be made to control corrosion due to galvanic coupling of widely dissimilar metals and alloys when such materials used for tubing, pipe, fittings and attaching or supporting parts are in intimate

contact with each other. Also adequate provision shall be made to protect the tubing pipe and fittings from oxygen concentration cell type of corrosion. Where soft nonmetallic cushions are used to prevent metal-to-metal contact between supporting components and the tubing, pipe and fittings, the cushion material shall be such that it will not absorb and retain significant amounts of water.

Sixth, draglink is the most critical part that links the steering mechanism to the wheels of the vehicle. Due to the change in steering position, the old draglink cannot be used. The practice of cutting with a blow torch and re-welding is unacceptable in the metal industry. The process to manufacture a draglink is so precise that these are done by special machines wherein the metal is not annealed during the fusion process. An OEM part is the specified component since this is a critical item. Failure of the component can cause loss of steering control that would lead to a serious accident.

Seventh, front-end alignment/geometry which consist of wheel alignment and steering angle adjustment for correct tow out on turns and to prevent the tire from coming into contact with the draglink. Lastly, the following parts should also be repositioned such as steering and related assemblies, instrument panel, hand brake assembly or emergency braking control, shifting level, accelerator, brake and clutch pedals.

Remanufacturing

First, disassembly is the process of systematic removal of desirable constituent parts from an assembly while ensuring that there is no impairment of the parts due to the process. Dismantling cabin parts and accessories are fully dismantled to get rid of any rust build-up which normally speeds-up cabin deterioration. A is stripped down, all parts and pieces cleaned in one of the industrial cleaners and inspected visually and with a variety of instruments. Cabin will be sprayed with water curtained exhaust system. Cowl is then processed and finally sprayed with polyurethane paint from edge-to-edge and all corners. All /wearable items are replaced with new commercial grade , and installed to or better.Ê

A method for making a truck body comprising the steps of prefabricating a plurality of individual truck body, pre-assembling together and retaining them in pre-aligned relationship relative to each other, securing combined alignment and releasable fastening means adjacent to edges of each respective pair, releasably attaching each respective pair together by combining alignment and releasable fastening means to form a truck body, releasing all of said fastening means to disassemble said truck body, shipping to a remote location, re-assembling together into pre-aligned relationship, again attaching each respective pairs together by combining alignment and releasable fastening means to re-form said truck body, and welding together to form a structurally integrated truck body.

Engine remanufacturing requires disassembly, replacement of all defective parts, assembly, testing and inspection to bring back the engine's performance to its manufacturer's standard. Such process gives the engine its second cycle of productive life. Not opening a used engine would mean that the long accumulated carbon build-up (tartar) is left inside. Carbon build-up is a major cause of compression leakage and restriction of air flow into the combustion chamber where the fuel is burned. 85 percent of all used engines have worn out piston rings and engine bearings. All of these lead to a decrease in engine efficiency, and increase in fuel consumption and the production of toxic smoke emission. In the remanufacturing process, an engine is opened and cleaned, worn-out parts such as piston rings, main bearings and connecting rod bearings are replaced. This process restores engine efficiency and performance. Computerized calibration is being done to restore its pump's optimal fuel efficiency. Mandatory replacement due to wear and tear, if not replaced, there is a high probability of leading to deterioration of other internal parts of the engine, experiencing excessive oil consumption and/or overheating due to oil and/or water leak, respectively and eventually engine knocking.

Optional engine parts replacement, if defective camshaft and crankshaft are not replaced, it may cause damage to bearings resulting to overheating caused by poor circulation of oil and/or produce slapping sound. If defective cylinder liner is not replaced, it may cause loose compression which leads to all or any of the following: unstable idling, insufficient power, excessive fuel consumption, slapping sound, and emission of white and dark smoke. Valve tappet, if not replaced, slapping noise is produced and/or overheating due to insufficient oil supply leading to deterioration of other internal parts of the engine may occur. Piston pin, if defective piston pin is not replaced, overheating due to insufficient oil supply leading to deterioration of other internal parts of the engine may occur.

Underchassis parts remanufacturing, avoidance of cut and weld method for knuckle arm, draglink and pitman arm. Drum brake differential assembly, It's wider and balanced contact between the drum and the brake pads result to a more reliable braking system. The use of I-Beam leaf spring type gives the following advantages over coil spring/torsion bar type: designed for heavy-duty use, sturdier and more durable, more economical and replacement parts are cheap and commonly available. Remanufactured single tire cargo trucks are all side spring for greater vehicle stability, if rear single tire is center spring, these are original double tire axle converted to single tire. The alteration makes the vehicle unstable and wobbly. Tires and tire setting, all remanufactured trucks are with brand new tires. Safe fluid lines, re-used, cut-and-weld fluid lines are the biggest sources of fluid leak, clogging in fuel supply and return lines resulting to road accidents. Clips are also installed to avoid metal-to-metal or contact or contact between metal and plastic/flexible hose. And lastly, replacement of other underchassis parts such as exhaust tail pipe, rear buzzer, brake hoses, batteries, shock absorbers, fixing the steering turning angle and testing of electrical wiring harness.

The assembly line will consist of the following: solid draglink PNS 1259:1995[1] compliant no-cut-and-weld, under chassis wiring harness installation, steel fluid pipe installation, no copper tube, no cutting and welding of fluid lines, equipped with rear buzzer, engine mounting, cabin assembly, cab wiring harness installation, repositioning of combination of switch, installation of LHD oriented bumper and side mirror assembly, installation of LHD-oriented wiper arm (remanufactured cabin assembly compliant with PNS 1951:2000[2]), cabin mounting, testing of LHD oriented headlights, lights are aimed either towards the curb or right-side of the lane, handbrake handle and gear shift lever are conveniently within reach. LHD-oriented power window control switch, LHD-oriented instrument panel (dashboard/assembly), and repositioned exhaust pipes are directed to the left side of traffic away from the pedestrians.

Testing, using state of the art equipment such as computer aided diagnostics, (Dyno), electronics, hydraulics testers and water leak testing, tech department checks every unit for function and before it is to the customers which include pre-delivery inspection such as inspection manual, correct setting signals of lights, oil level check, above and underchassis thorough inspection, correct double tire setting, correct turning angle measurement and road test. The units will then be delivered to the customer at the designated delivery point.

Table 4:
Material Composition of Different Vehicle Types

	Material Ratio (% by weight)			
Materials	Generic US Vehicle	Generic Japanese Vehicle	Generic EU Compact Vehicle	Golf III
Steel and iron	67	72.2	65	64
Plastic	8	10.1	12	16
Glass	2.8	2.8	2.5	3.1
Rubber	4.2	3.1	6	4
Fluids and lubricants	6	3.4	2.5	5
Non ferrous metals	8	6.2	8	1.6
Electric cable	-	-	-	1.3
Insulation	-	-	-	1.1
Paint	-	-	-	0.9
Other materials	4	2.2	4	3
Total weight (kg)	1438	1270	1210	1025

Based on the study of Hammond, Amezquita and Bras (1998) shown in Table 4 that the most difficulty occurred during remanufacturing of a product is the parts availability with 43 percent such concern are part proliferation, lack of cross referencing for aftermarket supplier's parts, domestic versus imported parts, increase in the variety and a decrease in the volumes and availability of needed replacement parts. The trends towards parts proliferation started between 1982 and 1990 when Japanese automakers nearly doubled the number of model vehicles on the road from forty-seven to eighty-four models due to the present of lean production, while on the other hand US automakers also increased their model vehicles from thirty-six to fifty-three in the same period of time (Womack, Jones and Roos, 1991). However, with proper research and development, this recovery tool can provide possible replacement in the long-run.

6. PROACTIVE APPROACHES FOR 3 R'S

Based on the responses of the used car traders interviewed that there are numerous ways for sustainability of 3 R's in the Philippines in order to move 3 R's into mainstream business practice. In this section, a selection of concept approaches is discussed but it is unclear at this stage which of these methodologies would be most effective.

Education

Currently, there is no known education or part of learning on the 3 R's making knowledge and application relatively zero. As Recharger Magazine stated based on the study of King (2006) that "What is particularly needed is a way of bringing researchers outside of the engineering/business world into a research work. Surely policy studies, sociology, marketing, legal, politics, economics all need to be involved too."

Research

More research studies should be carried out in exposing the recovery of used goods to the global market which offers interchanges of trade, investment, people and knowledge would promote awareness and raise skills levels in product recovery sectors. Such as discovering what customers, OEM, manufacturers really think about second hand, new and "re," and what are their positive and negative perception and understanding.

Product Case Study

Product case studies would benefit from a combination of skills and collaborating to innovate across regional, national and continental borders by giving further examples of recovered products, business models and its specific application to different product areas particularly in sectors where 3 R's is scarce.

Exposure

Exposure of the sectors to wider audiences such as conference or exhibit to showcase recovered products across different industries, it might comprise of national and/or international activities. Workshops could explain technical processes and publications of articles regarding the sector, business, products, statistics and other information related to the industry.

Government Training Centers

Reliable training centers to improve engineering skills for local engineers, which will examine the step by step process of the 3 R's and how it could contribute to the sustainable production and consumption economy. And proposing and testing a range of policies and actions that may attempt to build a formal industry for the country.

7. CONCLUSION

Automobile industry faces a dynamic and challenging environment. Innovation is one of the key for recovery market creation. Over the past decade, there has been an increasing interest in product take-back, product recovery and the re-distribution of these products. The automobile sector, in particular has a string history of product recovery operations such as the "re" of recoveries. Many of these involve the "re" of automobile such as reconditioning, repositioning and remanufacturing, a process of changing organizations to fit the new environment of longer-life cars with multiple owners. Despite its advantages and although the automobile sector has been among the first industries to practice recovery, automobile recovery has remained largely invisible (Waters, 1984). This is particularly true, if the activity is compared to the manufacturing and distribution of new vehicles. Over the recent years, there has been an increasing demand for recycle parts such as used parts, rebuilt parts in repairing a vehicle, etc. in terms of recycling. This study revealed that the 3 R's product recovery in developing countries like the Philippine, represent perhaps the largest untapped resource for product innovation improvement. 3 R's (reconditioning, repositioning and remanufacturing), by contrast to other form of recycling, is the ultimate form of recycling. It conserves not only the raw material content but also much of the value added during the processes required to manufacture new products. 3 R's may seen as 'less glamorous' than the distribution of new cars and may even result in negative brand image.

The lion's share of its impact has been limited to simple items such as beverage containers, steel products, and paper goods. This is because recycling a more complex product, like a car, results in a loss of up to 95 percent of the value added content and it requires large capital to finance machineries and train human resources. However, there is an existence of profitable market and the potential to provide another life from the waste of the world.

3 R's have received only minimal analysis by scholars but they provide a topic of analysis which illustrates principles of product recovery that may be critical in understanding macro and microeconomic phenomenon.

NOTES

1. Requirements for Repositioning Right-Hand Drive to Left-Hand Drive (PNS1259:1995). This standard was formulated to draw up the safety aspects of a vehicle particularly on the parts being repositioned as the main criteria. All right-hand drive (RHD) vehicles and components in the country prior to registration shall undergo repositioning to left-hand drive (LHD) orientation.
2. Road Vehicles Requirements for Rebuilding (PNS1951:2000). This standard was developed to address rebuilding of road vehicles and restoring them to their design capacity and efficiency with the prime consideration of safety.
3. Acknowledgement:The researcher is indebted to all respondents for their cooperation and open arms, to her advisers Prof. Hiromi Shioji D. Econ for his continues guidance, and to Mr. Henry L. Tan for his constructive criticisms and suggestions to the development of this research.

REFERENCES

AMEZQUITA, T., HAMMOND, R. & BRAS, B. (1995). Characterizing the remanufacturability of engineering systems, ASME Advances in Design Automation Conference Boston, Massachusetts, DE- 8. 271-278.

BERKO-BOATENG, V. J., AZAR, J., DE JONG, E. & YANDER, G. A. (1993). Asset recycle management – A total approach to product design for the environment. International Symposium on Electronics and the Environment, Arlington, VA, IEEE, 19-31.

CHARMAZ, K. (1983). The grounded theory method: an explication and interpretation in Emerson, R.M. (Ed.) Contemporary field research: A collection of readings. Boston, MA: Little Brown and Company.

GUIDE, V.D.R. (2000). Production planning and control for remanufacturing: Industry practices and research needs. Journal of Operations Management, 18 (4), 467-783.

GUIDE, V.D.R. & VAN WASSENHOVE, L.N. (2002). The reverse supply chain: smart manufacturers are designing efficient processes for reusing their products. Harvard Business Review, 80(2), 25-6.

GUIDE, V.D.R. & VAN WASSENHOVE, L.N. (2003). Managing product returns for remanufacturing, in Guide, V.D.R. and Van Wassenhove, L.N. (Eds). Business Aspects of Closed-Loop Supply Chains, Carnegie Bosch Institute, Pittsburgh, PA, 355-79.

GIUNTINI, RON AND KEVIN GAUDETTE (2003). Remanufacturing: The next great opportunity for boosting US productivity. Business Horizon, 46, 41-48.

HAMMOND, RICH, TONY AMEZQUITA & BERT BRAS (1998). Issues in the automotive parts remanufacturing industry – A discussion of results from surveys performed among remanufacturers. International Journal of Engineering Design and Automation – Special Issue on Environmentally Conscious Design and Manufacturing, 4(1), 27-46.

HAYNSWORTH, H. C. & LYONS, R. T. (1987). Remanufacturing by design: The missing link. Production and Inventory Management, Second Quarter, 25-28.

IJOMAH, W, BENNETT J P, & PEARCE J (1999). Remanufacturing: Evidence of environmentally conscious business practice in the UK. IEEE Transactions.

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.

KRIKKE, H.R., A. VAN HARTEN, & P.C. SCHUUR (1998). Mixed policies for recovery and disposal of multiple-type consumer products. Journal of Environmental Engineering, 124(4), 368-379.

KING, ANDREW (2006). Comments on CfSD Remanufacturing Workshop Notes.

KOJIMA, MICHIKAZU (2004). Current trade flows in recyclable resources within Asia and related issues. JETRO.

KUTTA, R. M. & LUND, R. T., (1978). Remanufacturing: A Preliminary Assessment. Center for Policy Alternatives, Massachusetts Institute of Technology.

LUND, R. T., (1983). Remanufacturing: United States Experience and Implications for Developing Nations. Center for Policy Alternatives, Massachusetts Institute of Technology.

LUND, R. T., (1984). Remanufacturing. Technology Review, 87, 18-23.

LUND, R. T., CLARK, J. P., TULER, F. R., BARNETT, C. J., BOLLINGER, L., GRAND, R., KUTTA, R. M. & STANOVSKY, C. S., (1980). Energy Savings Through Remanufacturing: A Pre-demonstration Study. Center for Policy Alternatives, Massachusetts Institute of Technology.

LUND, R. T. & DENNEY, W. M., (1977). Opportunities and Implications of Extending Product Life. Center for Policy Alternatives, Massachusetts Institute of Technology.

LUND, R. T. & SKEELS, F. D., (1983a). Guidelines for an Original Equipment Manufacturer Starting a Remanufacturing Operation. Center for Policy Alternatives, Massachusetts Institute of Technology.

LUND, R. T. & SKEELS, F. D., (1983b). Start-up Guidelines for the Independent Remanufacturer. Center for Policy Alternatives, Massachusetts Institute of Technology.

MAZZANTI, M. & ROBERTO ZOBOLI (2006). Economic instruments and induced innovation: The European policies on end-of-life vehicles. Ecological Economics, 58, 318-337.

NASR, NABIL & THURSTON, MICHAEL (2006). Remanufacturing: A Key Enabler to Sustainable Product Systems. New York: Rochester Institute of Technology.

NAVIN-CHANDRA, D., (1993). ReStar: A design tool for environmental recovery analysis. 9th International Conference on Engineering Design, The Hague, Heurista, Zurich, Switzerland, 780-787.

OGUSHI, YASUSHIKO & MILIND KANDLIKAR (2005). The impact of end-of-life vehicle recycling law on automobile recovery in Japan. IEEE, 626-633.

PUROHIT, DEVAVRAT (1992). Exploring the relationship between the markets for new and used durable goods: The case of automobiles. Marketing Science, 11(2), 154-167.
SAITO, RICHARD (2002). Quality differentiation of durable goods in secondary markets. , 57(2), 421-441.
SEITZ, MARGARETE A. (2007). A critical assessment of motives for product recovery: the case of engine remanufacturing. Journal of Cleaner Production, 15, 1147-1157.
SEITZ, M.A. & PEATTIE, K. (2004). Meeting the closed-loop challenge: the case of remanufacturing. California Management Review, 46(2), 74-89.
STATHAM, STEVE (2006). Remanufacturing Towards a Sustainable Future. Pera International, Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University.
STEINHILPER, ROLF (1998). Remanufacturing: The ultimate form of recycling. Germany: Fraunhofer IRB Verlag Press.
STRANDBERG, K.W., (1990). Rebuilding and remanufacturing in mass transit. Mass Transit, 80-82.
SUNDIN, ERIK. (2004). Product and Process Design for Successful Remanufacturing. PhD Dissertation, Linköping's Universitet.
TIPPING, ALANA (1998). What happens to a car when it reaches the end of its life? Environmental Effects of Car Disposal, Statistic New Zealand, Wellington.
VILLABA G, SEGARRA M, FERNANDEZ AI, CHIMENOS JM, & ESPIELL F. (2002). A proposal for quantifying the recyclability of materials. Resources, Conservation and Recycling, 37, 39-53.
WATERS, C.R. (1984). On second thought. Inc., 6, 56-60.
WOMACK, JAMES P., DANIEL T. JONES AND DANIEL ROOS (1990). The Machine that Changed the World: Based on the Massachusetts Institute of Technology 5 Million Dollar 5 year Study on the Future of Automobile. New York: Rawson Associates.