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An Overview of Reverse Logistics Management in the Australian Manufacturing Industries

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Abstract: This paper is a discussion of reverse logistics management literature, a conceptual model showing the recovery processes and their relationships, preliminary research data, analysis and implications for the manufacturing organisations. A discussion of the findings and their implications highlighting the important role of information technologies for efficient data collection and processing of recovery operations lead to capturing value from effective management of reverse logistics.

I. Introduction

Reverse logistics is planning, implementing and controlling the efficient and cost effective flow of raw materials, in-process inventory, finished goods and related information from the end user to any previous point closer to origin, which may be in or out of the original supply chain. Similarly reverse logistics can be considered as an essential feature of strategic marketing and effective customer relationship management, as well as environmental protection and sustainable development of manufacturing organizations. It entails processing returned merchandise due to damage, seasonal inventory, restock, salvage, recalls, and excess inventory. Further reverse logistics management also includes recycling programs, hazardous material management programs, obsolete equipment disposition, and asset recovery. Although there are numerous reasons for goods to be returned, Dekker and Brito (2002) have categorised returns into few groups such as manufacturing returns, commercial returns, product recalls, warranty returns, service returns, end-of-use returns and end-of-life returns. On the other hand Roy (2003) described numbers of opportunities of reverse logistics such as economical gains by recapturing some of the costs of raw materials, used components, used products and rejects and reuse of discarded products from commercial returns and excess inventory of products and materials (Bayles 2001). Similarly Kokkinaki, Dekker, Lee and Pappis (2001) identified number of direct and indirect benefits of reverse logistics such as regaining value, achieving a competitive advantage and a positive impact on the environment.

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So it is important to perform reverse logistics efficiently and effectively to obtain maximum benefits of its opportunities. Therefore the research is focused on investigating how

information technologies can be useful to improve performances of the reverse logistics. The study was included identification of processes in reverse logistics, parties of performing the processes, and then impacts of information technologies on performing reverse logistics processes and associated operations.

This paper presents preliminary findings on reverse logistics with original equipment manufacturers. The data were collated through a postal questionnaire survey with randomly selected 310 original business machine and equipment manufacturers in Australia.

II. Literature Review

According to Logistics Management Council reverse logistics is the process of planning, implementing, and controlling efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal (Rogers and Tibben-Lembke, 1999). Considering both upstream and downstream production operations, Fernandez (2003) suggests that reverse logistics can apply to different types of items such as used products, unused products, components, parts and raw materials. On the other hand Dekker and Brito (2002) categorised the returns into number of groups based on the reasons for returning such as manufacturing returns, commercial returns, product recalls, warranty returns, service returns, end-of-use returns and end-of-life returns. However Morrell (2001) is of the opinion that reverse logistics is “the forgotten child of the supply chain” since many organizations do not treat reverse logistics with the same care as traditional (forward) logistics.

Opportunities and reasons for reverse logistics according to Andel (1997) include profits while Roy (2003) suggests economical gains from recapturing some value from raw materials, used components, used products and rejected goods. On the other hand Bayles (2001) explicated reuse of discarded products from commercial returns and excess inventory of products also as opportunities from reverse logistics.

On the other hand, due to emergence of e-business, where customers purchase goods without trying and without touch or feel, more flexible return policy and an efficient reverse logistics system are essential. Smith, Bailey and Brynjolfsson, (2000) and Boyer, Hallowell and Roth (2002) explain that invisibility and physical distance between customer and seller, lack of face to face interaction with customers in electronic businesses and inefficient reverse logistics can destroy customer trust in electronic businesses. Average percentage of customer returns from Internet sales range from 30 to 50 % (Nairn, 2003). Economic gains are important reverse logistics management issue suggested by Roy (2003). This is supported by Kokkinaki, Dekker, Lee and Pappis (2001) who are of the opinion that number of direct and indirect benefits of reverse logistic such as regaining value, achieving a competitive advantage and a positive impact on the environment, are making organizations consider reverse logistics as an essential feature of strategic marketing, effective customer relationship management, as well as environmental protection and sustainable development of manufacturing organizations.

II. 1 Reasons for Performing Reverse Logistics

Important reasons for managing reverse logistics management identified from literature are discussed below.

II. 2 Electronic Business

Electronic business is sale of goods via electronic channels such as the Internet. Customers purchase goods by virtual conceptualisation of size and quality in most online shops. This definitely warrants a large amount of returns forcing organization to have efficient reverse logistics system (Trebilock, 2002). Similarly Sarkis et al (2004) suggest that growth of electronic business has precipitate the need of efficient and effective reverse logistics management. On the other hand Bizrate.com (1999) reported that 94% of online buyers commit to purchase due to protection of product return policy. This is astonishing as estimated average percentage of customer returns in Internet sales is accounted for 30 to 50 percent (Nairn, 2003; Mason, 2002; Sharma, Wickramasinghe and Singh 2005; Rogers and Tibben-Lemke, 1999). Predicted business to customer [B2C] Internet sale in the Asia Pacific region in 2006 is estimated to be US$ 210 Billion. Jupiter Communication on the other hand estimates a tremendous growth in B2B online transaction, US$ 6 trillions by 2005 within the USA market, where as described by Brito, Flapper and Dekker (2002) in B2B e-business, the products come back in bulk.

Other reasons for e-business returns according to Lee (2002) are due to errors in ordering, picking or shipping, damages due to transportation handling or cancellation of orders. This is further supported by Haris and Goodman (2001) explaining that growing frustrations among ebusiness customers over, unfulfilled promises, indifference, unrealistic response time, and poorly trained workers are also reasons for higher returns. However, the quantity and time of the returns arrival are key-questions of both business-to-business and business to customer e-businesses. According to Pan, Ratchford and Shankar (2001) online sales processes comprise pre-sales service, transactions, physical order fulfilments and after sales services. Last two processes are mainly concerned on logistics activities while the last is mostly depended on reverse logistics management.

II. 3 Strategic Marketing and Liberal Return Policies

Strategic marketing and liberal return policies are also major contributors to the growing need for efficient reverse logistics management (Krumwiede and Sheu, 2002). These policies are essential for sales from direct store, catalogue, telephone, television and electronic business etc. Accordingly customers have some control of the product they purchase and develop trust. Higher customer protection legislations allow customers to return products if they are not satisfied Brito and Dekker, (2003) and Krumwiede and Sheu (2002). Customers rightfully, and sometimes wrongfully, take advantage of this opportunity. Therefore businesses are highly vulnerable for higher return rates both online and offline. Dekker et al (2002), identified returns from retail outlets to be 10%, catalogs, telemarketing and the television sales to be 35 percent (Trebilcock 2002) and Internet sales returns to be 30 to 50 percent (Nairn 2003; Mason 2002; Sharma et al 2005). Similarly customer protection regulation and competition among vendors, also lead unlimited returns, which require additional logistics management strategies (Rogers and Tibben-Lembke, 1998).

II. 4 Commercial and Warranty Returns

Commercial returns in reverse logistics denote product returns due to non satisfaction with business transaction process or product quality (Lee, 2002). The commercial returns start from two destinations. Retailer returns products to manufacturers and customers return products to manufacturer via a retailer. Brito et al (2002) described that, financial risk transferability from the buyer to the seller and roles and position of different parties in the supply chain are the key factors, which control volume and quality of commercial returns. Warranty returns include products that failed during use or damaged during delivery from manufacturer to buyers. Similarly commercial and warranty returns include returns due to product mismatch, safety concerns and manufacturer recalls.

II. 5 End of Life and End of Use Returns

Brito et al (2002) suggest that end of use or end of scheduled life returns also require efficient reverse logistics management. This occurrs once a product's scheduled life is complete which may include such as end of lease or contract and end of life of a product, or when the product can't be used for primary function. For end-of-use returns, the challenge is determining the match between demand for used products and the supply, impacted by time, quantity and quality. Therefore Sarkis, Meade and Talluri, (2004) suggest an effective and efficient reverse logistics

management system, which provide information through the Internet channel.

II. 6 Environmental Protection and Legal Regulations

Returns have triggered a growing interest in reverse logistics in recent years due to environmental protection, competitive advantage and for regaining value (Brito et al, 2002). Legal regulations in returns management are becoming strict in countries like Germany, Netherlands, Europe, USA and Japan are due to negative effects of wasting energy and resources, pollution of air, water and environment (Fernandez, 2003). As a result, these governments have impose disposal tariffs and bans, place restrictions on waste transportation, waste prevention and emission which have increased producers' responsibility to manage returns effectively (Krikke, Pappis, Tsoulfas and Bloemhof-Ruwaard, 2001). The challenge here is managing of upcoming out-dated computers for example. The number of personal computer returns is predicted to be 500 million units by 2007 in the U.S.A. As electronic products are the source of many toxic substances such as lead, mercury, cadmium, chromium and bromine these products are ranked as the fastest-growing category of solid waste by the Environmental Protection Agency (Kokkinaki et al, 2001; Europa, 2000). Accordingly, disposing of returned personal computers has become a good example of a product for which reverse logistics is essential for protecting environmental as well as recapturing value or asset recovery, however, more importantly for environmental protection.

II. 7 Economic Gains

According to Brito et al (2002) effective reverse logistics management support economic gain or regaining value from reuse of products or parts or recycling materials. Lund (1998) and Roy (2003) described that over 70,000 re-manufacturing firms in the U.S.A. typically for jet and car engines, auto parts and copiers are relying on reverse logistics to recover value from the reuse of products, modules, parts, components or recyclable raw materials. As a result manufacturers are able to provide quick and better customer service with a shorter lead-time and lower operating margin using the recovered material, part, component and modules (Roy 2003). The increased emphasis on new products and product "freshness" also warrant a clear distribution channel requiring an efficient means of bringing back obsolete, outdated and clearance items. This according to Roy (2003) is seen with Xerox replacing or upgrading hundreds of office printing machines every month. As a result, Xerox is able to act quickly to provide state of the art technology so as to retain their customers.

II. 8 Customer Loyalty and Retention Rate

Potential benefits of strategic reverse logistics management identified by Jiang et al (2005) and Sharma et al (2005) are increased customer retention rates, increased customer loyalty which leads to positive word of mouth, increased exist barriers for their customers. Jiang et al further illustrate that a customer retention rate of 5% could increase company profit to from 25 to 95 percent. Retention of online customers especially is highly important because online shoppers can a new shopfront with the click of a mouse. As cited in Jiang et al (2005), Boston Consulting Group estimates acquiring a new customer to online channel cost US $82 compared to US$38 for store based sale and US$11 for catalogue-based sales. Further, They emphasised that excellence in physically delivery of services in forward logistics and reverse logistics of an electronic businesses could create a powerful competitive differentiation. It is therefore important to investigate how organizations can strategically manage this increased volume of returns.

II. 9 Barriers of Reverse Logistics Management

Although the importance of reverse logistics is clearly highlighted in the discussion above, there a number of barriers identified from literature. These are discussed in the following section.

Firstly reverse logistics has not been given the same importance as forward supply chain due to a lack of understanding about return management benefits by the organizations (Lee, 2002). Accordingly companies ignored allocating necessary resources for proper management of reverse logistics. Tibben-Lembke (2002) touted that electronic businesses have suffered greatly due to an under estimation of difficulties in determining the physical and psychological values of reverse logistics. This view is supported by Spiegel (2000) describing that some electronic businesses lose 70% of their time due to lack of technologically advanced collaboration and automation of all aspects of logistics operations. In addition Rogers et al (1998) identified reverse logistics barriers to be a lack of importance of reverse logistics relative to other issues, company policies, a lack of information systems, competition, management inattention, financial resources, personnel resources and legal issues.

II. 10 Lack of Modern Information Systems

Commercial software specifically designed to support reverse logistics is not yet available (Caldwell 1999). Similarly Nagel and Meyer (1999) emphasized that a lack of information causes bottlenecks, which leads to difficulties in systems resulting in substantial loss to companies. Zhao (2001) highlighted that a lack of technology-supported systems for reverse logistic processes result in delays, higher costs for operations, invisibility of returned products handled by third parties, repeat operations leading to additional cost to manufacturer and, unawareness and inattention of partner process. Due to the unavailability of dedicated information systems to identify validity of returned products at the point of entering leads to some illegal returns. For example, "non-defective returns" can actually account for 55% or more of the total returns (Lee, 2002). An ill-managed reverse logistic operation can have substantial adverse effect on the profit margin due to waste of resources for process management and rework.

Jiang et al (2005) and Sarkis et al (2004) pinpoint that properly integrated web base information system could link all departments including reverse logistics of electronic businesses as a value network to share information and communication accurately, in a timely manner and rapidly with little effort. Consequently these businesses could manage replicating efficiency in reverse logistics with the speed, accuracy and convenience so as to maintain higher reliability, resilience and innovativeness. Increasingly, pervasive, collaborative communications and information sharing and transparent multi-enterprise network could help to minimize the drawbacks experienced in the reverse logistics management processes (Harris and Goodman, 2001). Sharma et al (2005) also suggest that developing a web based information system for reverse value chain is a challenge that will entail essential competitive advantages as it could integrate many different business processes and stakeholders.

II. 11 Poor Management of Intermediaries

Since returns are mostly handled by third parties differences with reverse transportation and in-house carriage lays difficulties to schedule the best trip for vans, trucks or other means of conveyance, both in terms of money and time. Similarly it is also not always easy to predict the exact amount of material in a certain collection center (Carella et al, 2002). However Krumwiede and Sheu (2002) emphasized that lack of guideline and lack of collaborative information sharing facilities are barriers for effectively manage intermediaries of reverse logistics. Therefore the returns are invisible from the information systems, they are not fully utilized and/or not considered for next business operations till physically arrived to store in unknown time. But the manufacturer has to bear all costs and loses involved in holding, and lost opportunity during this period (Zhao 2001).

II. 12 Meeting Recovery Deadline

According to Carella, et al (2002) an efficient model of reverse logistics is vital for companies that produce for make-to-order contract or repair large industrial machineries, like conditioner, heating plants, train, ship, airplane or its components for their clients. Because without a better model they are unable to respond to their customers in a timely manner and help them avoid shortages. However, failing to do so could lead to huge penalty costs to the company.

II. 13 Conceptual Model for Reverse Logistics Management

Based on the issues discussed above, it is apparent that an effective reverse logistics model is essential. To capture business value and efficiencies in reverse logistics it is important to understand the processes of reverse logistics. It was noted that although different aspects of reverse logistics were mentioned in different publications, a logical and comprehensive presentation of the processes showing the logistics of returned goods has not been addressed. Therefore from the review of literature a conceptual model for the management of reverse logistics is developed and presented as Figure 1. It provides a comprehensive illustration of reverse logistics management processes and operations.

The reverse logistic processes and their relationships, included in figure 1 have been identified from literature and by analyzing previous models addressing certain aspects of reverse logistics. The conceptual model is a comprehensive model for reverse logistics management.

Recovery processes included the conceptual model were identified from previous models. Kokkinaki, Dekker, Nunen and Pappis (1999:2000) included four recovery operations; redistribution, reuse, remanufacture and recycle. Thierry et al (1995) presented a model with resale, reuse, repair, refurbish, remanufacturing, cannibalization, recycling, landfill, and incineration recovery processes. Fleischmann et al (2002) identified the processes of redistribution, reuse, repair, refurbish, recycle and landfill in their reverse logistics model. Lee (2002) discussed resale, reuse, refurbish, and retrieval as return recovery options of his model. Krikke et al (2001) and Roger et al (1998) identified redistribution, resale, reuse, upgrade, remanufacture, refurbish, recycle and landfill as recovery operations of their models. Brito et al (2003) recognized seven recovery operations for their model; redistribution, reuse, repair, remanufacture, refurbish, retrieval and recycle. De Koster, de Brito and van de Vendel (2002) included repair, remanufacture, refurbish, retrieval, recycle and landfill as recovery operations of their model. The reverse logistics model of Lonn and Stuart (2003) described redistribution, resale, repair and landfill as recovery operations while Meade and Sarkis (2002) models consists reuse, remanufacture, recycle and landfill recoveries. Kokkinaki, Dekker, Koster and Pappis (2001) and Kokkinaki, Dekker, Lee and Pappis (2001) included redistribution, resale, reuse, remanufacture, recycle and landfill as recovery operations in the reverse logistics model. Accordingly a conceptual model for reverse logistics management (Figure 1) was developed.

This model (Figure 1) includes three main sections:

- forward logistics operations,
- preliminary reverse logistics operations and,
- Reverse logistics recovery operations.

Forward logistics section;

This is basically the traditional supply chain through which finished products are passed from manufacturer to final customer.

- production [u], warehouse [v], distributor [w], wholesaler and retailer [x] and, customer [y].

Preliminary reverse logistics operations;

This represents the preliminary operations, which take place from the time a customer or dealer decides to return a product or products till the product(s) are to be reprocessed through one or more recovery processes. Seven preliminary recovery processes were identified from the literature.

- inform [a], return authorization [b], gate keeping [c], collection [d], inspection [e], selection [f] and, sorting [g].

Reverse logistics recovery operations;

Methods of returned products reprocessed are considered as recovery processes. Thirteen recovery processes were identified from the literature review based on the level of changes made on and methods of handling of the returned product(s).

- redistribution [h], resale [i], reuse [j], donate [k], upgrade [l], repair [m], refurbishing (module level recovery) [n], remanufacturing (component level recovery) [o], retrieval (selective part level recovery) [p], recycling (material level recovery) [q], hazard waste management (material level recovery) [r], incineration (energy level recovery) [s] and, landfill (environment recovery) [t].

Arrows in Figure 1 show the flow of returned goods. Returns commence at point [a] and flow to [g]. From [g] the returned goods flow to points [h], [i], [j], [k], [l], [m], [n], [o], [p], [q], [r], [s] and, [t] according to recovery decisions made in the first five preliminary operations [a, b, c, d, e, f and g]. From product recovery operations [h], [i], [j], [k] [l] and, [m] goods flow to [v] [w] [x] and [y]. Outcomes of module, component, part, material and hazard waste recovery operations flow to [u], [m] and [l] via the warehouse. This indicates that any part recovered from reverse logistics is either used for the production of other goods or used to repair or upgrade products. Some goods may be selected for [s] and [t].

The above ideas have been put together in figure 1 to show the sequence the processes occur. As shown in the proposed model (figure 1), reverse logistics begins at point [a]. Any partner of the forward supply chain [u, v, w, x and y] can take the decision to return goods due to commercial and warranty issues, end life and end of use issues, environmental issues, sustainable development issues and strategic marketing and retailing policies. The partner or the customer then informs the manufacturer or its agent of the decision.

All of the above discussed recovery operation depends on product life and the level of depreciation. Brito and Dekker (2003) identified three kinds of product depreciation; intrinsic, homogeneity and economic. Intrinsic deterioration is age of the product. Homogeneity deterioration is age of a product's parts and economic deterioration is value of depreciation.

As suggested by Croxton et al, (2001) managing all the above recoveries is a complex task that consists of a number of sub processes. These sub processes can be divided into two groups such as strategic processes and operational processes. Strategic processes address environment and legal, gate keeping, disposition guidelines, mange return flow, credit handling and secondary markets. Operational sub processes manage returns on ground such as preparing to accept returns, receiving returns, recovery decisions, customer and supplier credit management and analyzing returns. Further according to them these two groups of processes require an interface to cover customer service and relationship management, demand management, order fulfillment, manufacturing management, supplier relationship management and product development management. All this processes and their relationships emphasize the importunacy of having very effective and efficient information management system.

The conceptual model also includes issues identified from literature such as information management (Zhao 2001; Spiegel 2000; Lee 2002; Caldwell 1999; Brito et al 2002; Sarkis et al 2004), strategic marketing, liberal return policies and customer management (Brito et al 2003; Krumwiede et al 2002; Rogers et al 1998), environment protection and legal regulation (Brito et al 2002; Fernandez 2003; Krikke et al 2001; Kokkinaki et al 2001; Europa 2000; Yeldham 2003), intermediaries management (Carella et al 2002; Krumwiede et al 2002; Zhao 2001), meeting recovery deadlines (Carella et al 2002), economical gains (Andel 1997; Brito et al 2002; Lund 1998; Roy 2003) and higher customer or dealers loyalty and retention rate (Jiang et al 2005; Sharma et al 2005, Roy 2003, Brito et al 2002). Further it also aimed to investigate how modern information technologies can be useful to provide better service in reverse logistics management in all types of business models specially which has higher return rate such as retail store and off line business models returns 10 percent (Dekker and Van der Laan, 2002), catalogs, telemarketing and the television models returns 35 percent (Trebilcock 2002) and Internet sales returns 30 to 50 percent (Nairn 2003; Mason 2002; Sharma et al 2005).

Instead of considering all varieties of products together the research is focus on computers and business machines and equipments due to a number of reasons such as comparatively higher percentage of return as a product category 8.5 percent (Rogers and Tibben-Lembke 1998) and nature of machine and equipment such as shorter lifetime of products, higher depreciation rate, high opportunities for secondary market or secondary usage, varieties of basic and additional warranties, huge amounts of used products being disposed, ever expanding market volumes of dealing, perishable nature of goods, high information requirements, high variability and cascade reuse opportunities, and also due to expensive products replacements (Fleischmann et al 2002; Roy 2003; Rogers and Tibben-Lembke 1998; Trebilock 2002; Dekker et al 2002). Therefore this information highly emphasized the necessity of a better reverse logistics system for effective and efficient management of returned machines and equipments. Therefore the research is focused on Australian computer and business machine and equipment manufacturing organizations.

To validate the model research with manufacturing organisations and e-business organisations is undertaken via surveys.

III. Research Approach and Methodology

Research presented in this paper is with manufacturing organisations accomplished via a postal questionnaire survey. The survey questionnaire included a list of carefully structured questions chosen after careful testing for the purpose of eliciting reliable responses (Hussey and Hussey, 1997). It is a positivist methodology whereby a statistical sample is drawn from the population of subjects to make deduction about the population (Collis et al 2003). The survey study was planned to identify and investigate preliminary recovery processes for reverse logistics practiced by the Australian original equipment manufacturers. According to Cavana et al (2001) use of a postal questionnaire survey is more appropriate to gather large amount of data statistically sampled from a survey population, which represent a large geographical area. Therefore the postal questionnaire survey was the most suitable methodology for this research. In addition some other considerations such as budget constraints, time constraints, geographical limitations, and width of the sample frame, were also taken into account when selecting this methodology.

The postal questionnaire was pre-tested with thirty-eight researchers. Based on suggestions of nineteen responses the questionnaire was modified. Modifications included change of question format and the wording for better understanding. The questionnaire survey collated data from a sample of randomly selected 310 Australian original "business machine and equipments" manufacturers which had over Aus$ 1 million annual income. The manufacturers were randomly chosen from two national business directories (The Business Who's Who of Australia, May 2005, http://bww.dnb.com.au/ and IBIS World of Australia, May 2005, http://www.ibisworld.com.au). A sample of 310 manufacturing organizations was based on the views of Cavana et al (2001), and Sekeran (1992; 2000; 2003) who suggest that sample sizes larger than 30 and less than 500 are appropriate for most research. Original "business machine and equipments" manufacturers were selected as the sample population for this research as they are bound to accept the returned products and provide after sales services due to number of reasons discussed in literature review.

A total of 51 usable responses were received. Response rate 16.45% was contemplated to be reasonable based on the view of Collis and Hussey (2003) that 10% or less response rate of postal questionnaires was not uncommon.

IV. Data Analysis

Data analysis included in this paper was tabulated to show some preliminary findings. The data elicited through the survey were collated from Likert Scales, which are commonly used in business research for useful conclusions (Sekeran 1992; 2000; 2003). Tabular methods of presentation of the data gathered from the postal questionnaire were summarised and analysed using SPSS, a statistical analysis software package.

V. Findings

Findings of the research date and discussions are presented reflecting issues associated with reverse logistics, information management and information technologies. It also includes findings about reverse logistics performances, market information, product life span and returned products reprocessing time. Some reflections on income and costs are also included. Other issues discussed include business selling models, benefits and barriers of reverse logistics, leadership issues and technologies applied in managing reverse logistics information by the Australian original equipment manufacturers.

Responses were summarised into five categories based on the type of products shown in column one of Table 1. Column two indicates the extent of reverse logistics in each industry. It is clear from Table 1 that large numbers of respondents were electronic and electrical equipment and parts manufacturers, and automotives and parts manufacturers. Both of these product categories represent almost seventy percent of total respondents, while other three categories accounted for remaining thirty percent. Although the numbers of respondents in last three products categories were low, they indicate that reverse logistics is practised in these industries.

From the findings in columns one and two of Table 1, it is apparent that reverse logistics is an important business process. From this information it is clear that nearly 75% of responding manufacturing organizations perform reverse logistics.

Performing reverse logistics could be comparatively easy if the organization's customer base is limited to a smaller geographical area. However from the Table 1, it is clear that large numbers of manufacturing organizations operate globally although they have an important role in the national market of Australia. This indicates that reverse logistics is not only for the local market, but for international returns as well. Therefore management of returned product information is essential for the provision of an effective reverse logistics service.

In Table 2, we present product categories with short and long life spans (three years or fewer and over three years), and the time taken by the organisations to reprocess returned products. It is clear from Table 2 that products with longer life spans are bound to be returned more than those that have a short life span. However, products with shorter life spans are also returned and thus require more stringent reverse logistics management strategy to avoid loss of value from depreciation. Similarly, Table 2 shows that processing time for most of the returned goods is less than a week. However, average return reprocessing time of a returned good just over 3 weeks indicating that a returned product has to spend an average of 2% of its life in reverse logistics processes. While

the goods are in the recovery processes neither manufacturers nor customers receive any benefit or utility from these items, instead it is accounted for depreciation. To achieve value from the returned goods it is essential to minimise the processing time.

Table 3 outlines the cost of reverse logistics by comparing it to organizations' annual income. According to data in Table 3, it is seen that although organizations have annual incomes of up to Aus$ 100 million, the cost of reverse logistics is only 2% to 3% of annual income. This clearly indicates that reverse logistics is not an important business process in these manufacturing organisations. Findings indicate that the Australian manufacturing organisations are paying poor attention to reverse logistics and thus losing out on substantial opportunities by ignoring reverse logistics.

Table 4 lists the business models that the respondents use to sell their products. The last three columns of the Table 4 show the usage of different business models in each market. It is important to note that the respondents were allowed to select more than one business model if applicable. It is clear from Table 4, that wholesaling (84%), retailing (63%), telephone (63%) and catalogue (57%) business models are largely used by manufacturing organizations in Australia to sell their products in regional, national and global markets. It is important to note that, B2B and B2C e-business business models are not as popular as expected, especially to reach out to global customers.

The respondents were allowed to select more than one business models if applicable. From the data, it is shown that 89% use two or more business models to distribute their products while 55% use four or more strategies. Therefore it is inferred that for all business models reverse logistics processes have to be put in place to manage returns. To manage returns from several selling models an efficient information management system would be useful.

Reasons for performing reverse logistics and their importance indicated in percentages are presented in Table 5. It is important to note that the respondents were allowed to select more than one reason for reverse logistics if applicable. According to data in Table 5, the two most important reasons for reverse logistics are customer service (84%) and strategic (73%) such as goodwill and brand image. Competition is another reason, while some less important ones are law, legal disposal requirements, recapturing value and assets and a clean channel.

Company image and goodwill are the most important benefits of reverse logistics identified from this research. Other reasons are competitive advantage, recapturing value from components and legal obligations. As seen in Table 6, recapturing value is important for only half the respondents, and this could be the reason for the less importance given to reverse logistics, or on the hand this could also indicate that if the reverse logistics processes are better managed, more value could be captured from returned goods.

In Table 7 we present a list of barriers for reverse logistics and percentage as indicated by the respondents. The respondents were allowed to select for more than one barrier for reverse logistics if applicable. According to Table 7 the three main barriers for reverse logistics are low importance compared to other business processes, improper information management and a lack of personnel resources. It is imperative to note that the barrier of unavailability of efficient and effective reverse logistics information management systems has been identified as the second most important barrier for reverse logistics by the manufacturing organizations in Australia. This finding is supported by the literature (Zhao 2001 Lee 2002; Sarkis et al 2004; Spiegel 2000 and Rogers et al 1998) which identified that a lack of information system as a main barrier. This implies that application of effective information systems will drastically improve the reverse logistics information management for capturing value.

Other less important reasons are a lack of interest from the management, not having company policies in place to support reverse logistics, and poor partnerships to manage the processes.

According to data in Table 1 it is apparent that reverse logistics in most organisations is the responsibility of the operations manager. Manufacturing managers and marketing managers also are given the responsibility in some cases. However, a dedicated reverse logistics manager is not a position in any of the organisations implying that it is not very important.

List of technologies used in reverse logistics management are shown in Table 9. According to Table 9, the most important technologies supporting reverse logistics are telephone, fax and computers. Mobile technologies are being applied as well together with other technologies.

This implies that information technologies have a very important role in collating and processing reverse logistics information.

However according to Table 9, it is clear that most of the information technologies such as Internet, extranet, ERP, barcode and EDI, are not fully exploited for reverse logistics management. Therefore the responded manufacturing organizations have to take strategic action for incorporating these technologies that could facilitate online real time reverse logistics information management. Because it could help manufactures to receive number of benefits of efficient information management such as minimum waiting time for information, minimum use and waste of resources [such as papers, envelopes, money and labour], higher efficiency in information sharing and exchange, online conference and decision making. Similarly implementation of online real time reverse logistics information updating, managing, updating and sharing system will enhance quality of managing customer service and reverse logistics.

VI. Discussion

From the data presented above it is clear that reverse logistics is important for industries manufacturing electrical and electronic goods and automotive parts more than other

industries. It also highlights that reverse logistics is an important business process for goods sold in regional, national and international markets. Finding indicate that products with a longer life span are more likely to be returned and require reverse logistics management more than products with short life spans. The most important reasons identified for reverse logistics are customer service, strategic and competitive reasons.

Although anecdotal evidence indicates recapturing value from returned goods to be an important reverse logistics benefit, this research indicates that company image and goodwill to customers are more compelling benefits. The most important barrier identified is the diminutive role of reverse logistics in companies. Ad hoc information management methods, a lack of resources and top management support are other important barriers to reverse logistics in the Australian manufacturing industries.

This research highlights that in most organisations reverse logistics is the responsibility of the operations manager. This implies that reverse logistics is not important or large enough to warrant a role for its management or department. It is very clear from this research that a large number of technologies are used to manage reverse logistics in Australia. This implies that at this stage there is no dedicated system for the management of reverse logistics.

VII. Conclusion

This is a research in progress paper, which has discussed some preliminary findings. Issues identified from a review of literature on reverse logistics have highlighted its importance and ability to capture value. An analysis of models addressing different aspects of reverse logistics have been comprehensively put together to show the flow of processes and information to maximise value. However, research findings indicate that manufacturing organisations have not realised the value of reverse logistics and have not given it the same importance as other processes. Hence to some extent it still is 'the forgotten child of supply chain'.

The next phase of this research will explore reverse logistics in the e-business space as literature indicates that returns from e-business purchases are very high.

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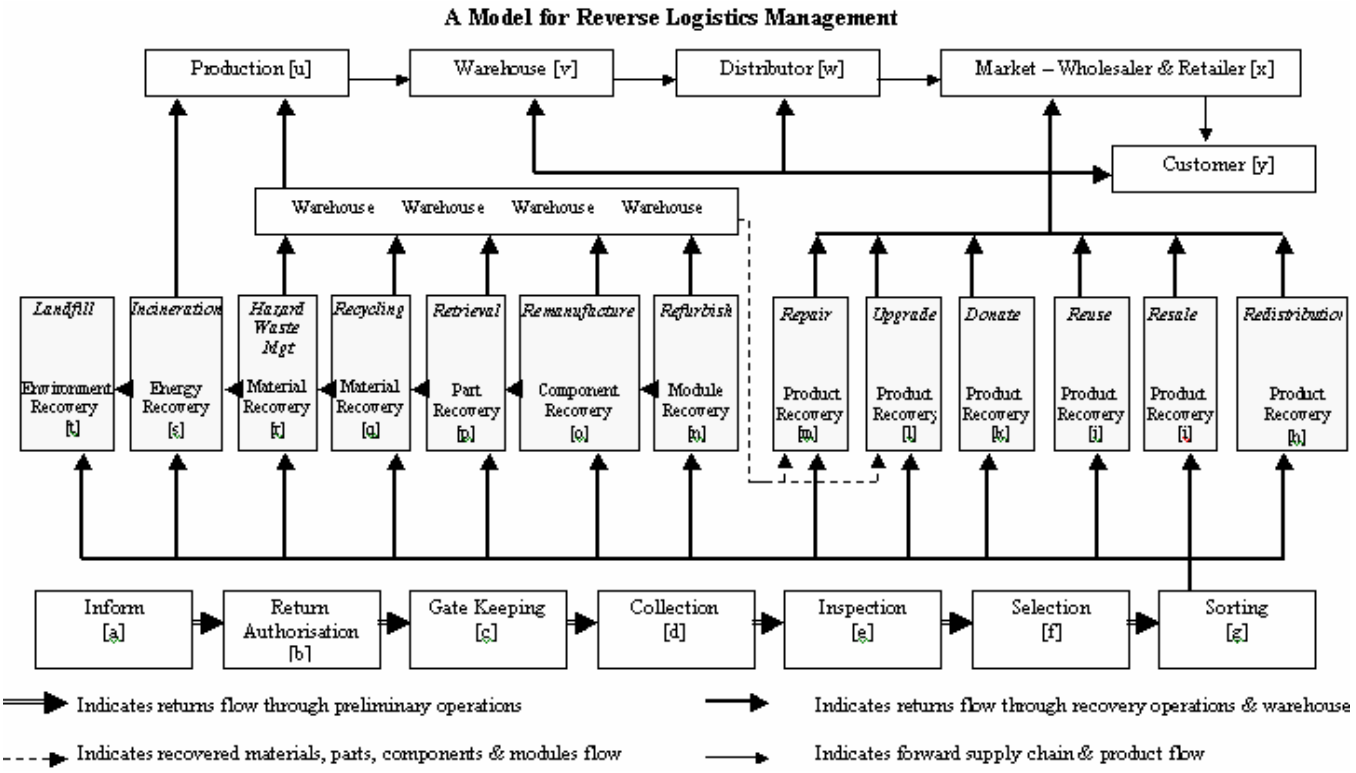
Figure 1: Conceptual Model for Reverse Logistics Management



Product Categories	Responses (Percentage)	Co's Performing Reverse Logistics		Geographical Area of Market		
		Yes (Percentage)	No (Percentage)	Global (Percentage)	National (Percentage)	Regional (Percentage)
Electronic and Electrical Equipment and Parts	43.14	77.27	22.73	47.06	23.53	29.41
Automotives and Parts	25.49	76.92	23.08	70.00	20.00	10.00
Mining and Irrigation Equipment	11.76	83.33	16.67	80.00	20.00	0.00
Construction Equipment	11.76	50.00	50.00	66.67	33.33	0.00
Medical and Scientific Equipment	7.84	75.00	25.00	66.67	33.33	0.00
Overall		**74.51**	**25.49**	**60.53**	**23.68**	**15.79**
Total	**100.00**	**100.00**		**100.00**		

TABLE 1 Product Categories, Performance of Reverse Logistics and Geographical Area of Market of the Respondents

Product Categories	Product's Life Span		Returned Reprocessing Time [Weeks]			
	3 years or less (Percentage)	Over 3 years (Percentage)	Less than 1 (Percentage)	1 to 4 (Percentage)	4 to 8 (Percentage)	Over 8 (Percentage)
Automotives and Parts	50.00	50.00	60.00	40.00	0.00	0.00
Medical and Scientific Equipment	33. 33	66.67	33.33	33.33	33.33	0.00
Electronic and Electrical Equipment and Parts	11.76	88.24	23.53	58.82	5.88	11.76
Construction Equipment	0.00	100.00	66.67	0.00	0.00	33.33
Mining and Irrigation Equipment	0.00	100.00	0.00	60.00	0.00	40.00
Overall	**21.05**	**78.95**	**34.21**	**47.37**	**5.26**	**13.16**
Total	**100.00**		**100.00**			

TABLE 2 Products life span and reprocessing time

Product Categories	Annual Income Aus$ Millions			Annual Reverse Logistics Cost Aus$ Millions	
	100 or less (Percentage)	101-250 (Percentage)	Over 250 (Percentage)	5 or less (Percentage)	Over 5 (Percentage)
Construction Equipment	100.0	0.0	0.0	100.0	0.0
Medical and Scientific Equipment	100.0	0.0	0.0	100.0	0.0
Electronic and Electrical Equipment and Parts	70.6	17.6	11.8	94.1	5.9
Automotives and Parts	60.0	10.0	30.0	100.0	0.0
Mining and Irrigation Equipment	40.0	20.0	40.0	80.0	20.0
Overall	**68.4**	**13.2**	**18.4**	**94.7**	**2.6**
Total	**100.00**			**100.00**	

TABLE 3 Annual income and reverse logistics cost

Business Model	Percentage of Users	Percentage of Users in		
		Global Marketing	National Marketing	Regional Marketing
Wholesaling	84.21	86.96	77.78	83.33
Retailing	63.16	69.57	66.67	33.33
Telephone	63.16	60.87	77.78	50.00
Catalogue	57.89	60.87	55.56	50.00
B2B ebusiness	39.47	47.83	33.33	16.67
B2C ebusiness	28.95	34.78	33.33	0.00
Other	28.95	34.78	33.33	0.00
Total		**60.53**	**23.68**	**15.79**

TABLE 4 Business models used for marketing

Reasons for Reverse Logistics	Percentage Respondents
Customer service	84.21
Strategic	73.68
Competitive reasons	44.74
Customer protection Laws	23.68
Legal disposal issues	18.42
Recapture value	15.79
Recover assets	15.79
Clean channel	10.53
Protect margin	5.26
Others	2.63

TABLE 5 Reasons for reverse logistics

Benefits	Average Annual Value Aus$ Million	Percentage Respondents
Goodwill and company image		71.05
Resale of returned goods	0.81	65.79
Competitive advantage		57.89
Recapture value from components	0.24	50.00
Legal obligations		50.00
Environment protection		39.47

TABLE 6 Benefits of reverse logistics

Barriers of Reverse Logistics	Percentage Respondents
Low importance of reverse logistics compared to other issues	28.95
Improper information management	21.05
Lack of personal resources	21.05
Management inattention	13.16
Company policies	10.53
Competitive issues	10.53
Poor partnerships	10.53
Lack of financial resources	5.26
Legal issues	5.26

TABLE 7 Barriers of reverse logistics

Designation	Number of Manufacturing Organization	Perform Reverse Logistics	
		Yes	No
Operations Manager	11	9	2
Manufacturing Manager	9	5	4
Marketing Manager	5	4	1
Logistic Manager	4	4	-
Production Manager	3	3	-
Supply Chain Manager	2	2	-
General Manager	4	1	3
Business Manager	1	1	-
CEO	1	1	-
Director	1	1	-
Distribution Manager	1	1	-
Engineer	1	1	-
IT manager	1	1	-
MRP controller	1	1	-
Plant Manager	1	1	-
Product Manager	1	1	-
Public Relation Manager	1	1	-
Accountant	1	-	1
Quality Manager	1	-	1
Sales Manager	1	-	1
Missing	9	-	-
Total	**60**	**38**	**13**

TABLE 8 Reverse logistics leadership

Technologies	Percentage of Users
Land Telephone / Fax	97.37
Computers - Laptop / Desktop, Servers	92.11
Mobile phone / PDA / Other Palm device	65.79
Intranet	55.26
Tracking & Tracing System	47.37
ERP- Enterprise Resource Planning	39.47
Barcode & Scanning System	34.21
Data Mining & Data Logging System	34.21
Extranet	28.95
Internet–B2B standard	28.95
Electronic Data Interchange-EDI	28.95
Internet–B2C standard	26.32
Decision Support System	18.42
Global Positioning & Geographic Information System	7.89
Radio Frequency Identification -RFID	5.41

TABLE 9 Technologies used to manage reverse logistics