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The Influence of Reverse Logistics Innovation and Reverse Logistics Performance on Resource Commitment and Reverse Logistics Cost Savings: Automotive Industry vs Automotive Aftermarket Industry

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The objective of this study is to examine the influence of reverse logistics innovation and reverse logistics performance on the relationship between resource commitment and reverse logistics cost savings. The investigation was assembled with the top and middle management in the Thai automotive industry and automotive aftermarket industry. A survey was conducted with 567 respondents and in-depth interview data was gathered from 55 participants. The findings revealed that there were strong positive associations between resource commitment and reverse logistics innovation, reverse logistics innovation and reverse logistics performance and reverse logistics performance and reverse logistics cost savings. Reverse logistics innovation and reverse logistics performance have a full mediating influence on associations of the structural model. In addition, the model is different across the size of firm, time of firm industry entry, category of industry and period of reverse logistics application and further, both level of path and structural model. Respecting qualitative investigation, enterprises that implement reverse a logistics program in terms of remanufacturing, refurbishing, recondition, reuse, recycle, scrap sale and disposal aim to service their customer requirements rather than seeking benefit. Successful utilizers demonstrate higher level management, financial and technological commitment as well as prioritization of strategic direction and continuous implementation.

Key words: *Reverse Logistics Innovation; Reverse Logistics Performance; Resource Commitment; Cost Savings; Return Process.*

Introduction

Currently most supply chain management research is solely dedicated to the forward logistics (Abdullah & Yaakub, 2014) rather than reverse logistics program (Shaik, 2014). This is unfortunate in that the effectively manipulated reverse logistics processes can actually decrease costs. Reverse logistics should be viewed as a chance to establish competitive advantages, retrench costs and improve customer satisfaction (Richey, 2005). With an appropriate managing system of returns, reverse logistics can even develop advantages (Andel, 1997).

Thailand's cost of reverse logistics in 2005 was at an estimated cost of 42 billion Baht (3.5%) of an estimated total cost of logistics of 1,193 billion Baht, with the approximate total cost of logistics 16.8% of the nation's GDP (7,103 billion Baht) (Banomyong, Varadejsatitwong & Prakorbkij, 2005). Even though businesses view reverse logistics as significant, it seems that reverse logistics is still a source of untapped profitability (Anderson, 2009). This is consistent with the opinions of managers who perceive that it is not necessity for extraordinary resource, equipment and system to manipulate reverse logistics in the Thai automotive industry (Veerakachen, 2006).

There has been a scarcity of investigation on reverse logistics and limited assertion of the direct effect of path level relationships among resource commitment, reverse logistics innovation, reverse logistics performance and reverse logistics cost savings and the examinations which do report the structural connections among these factors are still insufficient. In addition there are few investigations which emphasize medium and moderate influence. Thus, this study contributes to the existing literature by examining the structural relationships among resource commitment, reverse logistics innovation, reverse logistics performance and reverse logistics cost saving. Further contributions to the research should investigate the medium influence of reverse logistics innovation and reverse logistics performance as well as the moderate influence of size of firm, time of firm industry entry, category of industry and period of reverse logistics application, for both model and path levels. The final recommended contribution is to elaborate recent research with in-depth interviews.

Literature Review

A literature review was beneficial to advocating the model described in detail in next section.

Reverse logistics program

Reverse logistics is defined as the process of planning, implementing and controlling the efficient, cost effective flow of raw materials, in-process inventory, completed merchandise and related details and facts from consumption point to the origin point with the aim of recapturing usefulness or suitable disposal (Council of Logistics Management, 1997). The present study explains that reverse logistics refers to turn back of commodity, source reduction, recycling, substitution of material, reuse of material, waste disposal, refurbishing, repair and remanufacturing (Kumar & Yamaoka, 2007; Piyachat, 2017). With regard to a reverse logistics program, it can be divided into two general facets, turn back of principal goods and principal packing.

Resource commitment

Resource commitment refers to firm's resource allocation, both intangible and tangible resources, in order to raise efficiency, fulfil customer requirements, and improve market share (Hunt, 2004; Irai, & Lu, 2018). Resource commitment can be separated into three dimensions inclusive of managerial, financial and technology resource commitments (Richey, 2004; Dasig Jr, 2017). In the first dimension, managerial resource commitment is associated with allocation of skilled, talented and specialist human resources to establish and manage strategy. The next dimension, financial resource commitment refers to the financial allocation to provide for manufacturing costs. Lastly, technology resource commitment is associated with allocation of information systems and technology which can result in sustainable competitive advantage as technological potentials are arduous to emulate (Daugherty, Autry & Ellinger, 2001). A crucial hurdle to a fruitful implementation of reverse logistics is inadequate resource commitment (Richey, Chen, Genchev & Daugherty, 2005).

Reverse logistics innovations

Reverse logistics innovation is clarified as the capacity of a firm to uncover inventive, creative, innovative, fresh and or exotic notions, deportments, processes and products in taking out reverse logistics activities to diminish environmental obligations and provide for sustainable expansion (Hart, 2005; Bernik, Azis, Kartini, & Harsanto, 2015). The sustainability resourcefulness abilities of reverse logistics are often described as innovation of the reverse logistics program. The innovations of the reverse logistics program are separated into five aspects: customization, formalization, flexibility, information related ability and cross functional integration (Richey et al., 2005). Although it is generally admitted that successful reverse logistics innovation can enhance customer satisfaction (Li & Olorunniwo, 2008; Varsani, 2018) and generate cost savings (Jack, Powers & Skinner, 2010; Malinda, 2018), the influence of reverse logistics is frequently disregarded and deficient in organization comprehension.

Reverse logistics performance

Reverse logistics performance can be appraised by two well-known aspects including economic and environmental performance. Economic performance is associated with manufacturing productivity and successfulness, financial performance, customer contentment and responsiveness. Meanwhile, environmental performance refers to inventive or innovative proficient process and acceptance of the supply chain cooperation, transcending the rigorous rules, protecting the environment and diminishing contamination and pollution (Huang & Yang, 2014).

Reverse logistics cost savings

The reverse logistics structure comprises consideration of: cost of movement and delivery, carrying and storing; robbery and stealing; outdated and or unfashionable products; gathering, grouping, identifying, tackling, refurbishing, repackaging and variance in book value. However the projected exact cost of reverse logistics is difficult due to fluctuated quantity of return which many companies overlook and neglect (Delany & Wilson, 2000; Humaidi, Shahrom, & Abdullah, Quhratul. 2018). Regarding cost of reverse logistics, the carrying and delivery cost is essential as collecting limited and unpredictable amounts of turn back goods leads to excessive total reverse logistics cost. Meanwhile the storing cost and robbing or stealing cost are minimal whereas outdated, unfashionable, gathering, grouping, identifying, tackling, refurbishing and repackaging costs are expensive. Firms that successfully tackle with returned goods, for example customer's independent return product policy, will be efficient to respond immediately, increase contentment and bring about superior ability to make profits (Dawe, 1995).

Research Methodology
Sample, instruments and methodology

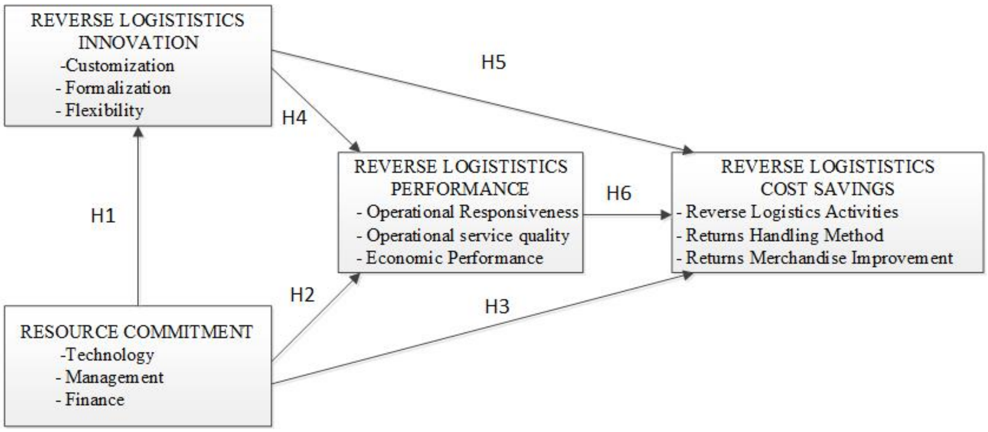
The study was designed with the top and middle management in the Thai automotive industry and automotive aftermarket industry. A survey was conducted with 567 respondents and in-depth interviews were conducted with55 participants. A 5-point Likert scale survey included resource commitment (RC), reverse logistics innovation (RLI), reverse logistics performance (RLP) and reverse logistics cost saving (RLC). The Cronbach's alpha of all questionnaires is greater than 0.70 whereas the item-objective congruence (IOC) of all items is greater than 0.5. All factor loadings are greater than 0.6 and the average variance extracted (AVE) is greater than 0.5 and discriminant validity (DV) is greater than 1.0. Thus both reliability and validity are satisfied (Fornell & Larcker, 1981). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were applied to evaluate construction of each factor while structural equation model (SEM) was used to investigate the structural relationship model. Qualitative information was analysed using content analysis.

Hypothesis and theoretical framework

The aims of the study are to examine the association between:
(1) resource commitment and reverse logistics innovation;
(2) resource commitment and reverse logistics performance;
(3) resource commitment and reverse logistics cost savings;
(4) reverse logistics innovation and reverse logistics performance;
(5) reverse logistics innovation and reverse logistics cost savings and
(6) reverse logistics performance and reverse logistics cost savings.
The study aims are to examine the mediate influence on:
(7) the relationship between resource commitment and reverse logistics performance through reverse logistics innovation;
(8) the relationship between reverse logistics innovation and reverse logistics cost savings through reverse logistics performance and
(9) the relationship between resource commitment and reverse logistics cost savings through reverse logistics performance.
Further the study aims to examine the moderate influence of
(10) size of firm on the model;
(11) the time of firm entry to the industry on the model;
(12) of category of industry on the model and
(13) of period of reverse logistics application on the model.

The initial theoretical framework is presented in Figure 1 below.

Figure 1. Initial Theoretical Framework



Results and Findings

The greater part of the respondents were male, accounting for 66.0 %, with the age above 40 years old equal to 35.4 %. Respondent educational level was predominantly a bachelor's degree, 60.8% with work in automotive industry accounting for 62.3%, working for small and medium firms for 58.4%, age of business above 15 years 50.4%, and working in a non-union company, 56.6%. The period of reverse logistics application of less than 3 years was 58.7%. Respondents assessed the level of resource commitment, reverse logistics innovation, reverse logistics cost savings to be at some extent whereas reverse logistics economics, operational responsiveness and service quality performance are evaluated at extensive extent.

Model fits testing

Regarding the initial theoretical framework, the outcome of Chi-square (CMIN) is 185.968 at p = 0.000, degree of freedom (df) is 44, CMIN/df is 4.227, NFI is 0.964, IFI is 0.972, TLI is 0.958, CFI is 0.972, AGFI is 0.911, PGFI is 0.536 and RMSEA is 0.076. The Chi-square is crucial statistics. Nevertheless, a statistical significance test is responsive to size of sample, which signifies that the Chi-square statistic commonly denies the model when enormous samples are applied (Jöreskog & Sörbom, 1996). Consequently some researchers suggest that a model could also be admitted if the larger number of fit indices show superior adoption measures and only a few are smaller than the preferred criteria (Bagozzi & Yi, 1988; Jingnan, Yunus, Kamal, 2018). Even though the result of Chi-square statistic of the initial theoretical model presented significance at a 0.05 criterion, the remaining findings were greater than the lowest threshold. Thus, it could be summarized that this framework is appropriate to clarify the relationships among variables.

Direct effect testing

The findings for each research question are shown in Table 1 below. According to these, it can be summarized that H1, H4 and H6 were accepted whereas H2, H3 and H5 were rejected. Subsequently three hypotheses were removed from the initial theoretical framework. The revised proposed structural model is depicted in Figure 2 below and the revised theoretical framework is depicted in Figure 3 below. The hypotheses examination of the revised theoretical framework are presented in Table 2 below.

Regarding the revised proposed model, the outcome of Hoelter's number is 193, Chi-square (CMIN) = 188.416 at p = 0.000, degree of freedom (df) is 47, CMIN/df is 4.009, NFI is 0.963, IFI is 0.972, TLI is 0.961, CFI is 0.972, AGFI is 0.916, PGFI is 0.572, and RMSEA is 0.073 as most of the results are larger than the preferable criterion. Thus it can be concluded that the revised theoretical framework is appropriate to clarify the interrelationships among items and latent variables.

Table 1: Hypotheses Examination of the Initial Theoretical Model

Relationship between	Estimate	S.E.	C.R.	*p*-value
H1: Resource commitment and Reverse logistics innovation	0.747	0.035	21.048	***
H2: Resource commitment and Reverse logistics performance	0.005	0.044	0.107	0.915
H3: Resource commitment and Reverse logistics cost savings	0.025	0.049	0.501	0.616
H4: Reverse logistics innovation and Reverse logistics performance	0.502	0.057	8.746	***
H5: Reverse logistics innovation and Reverse logistics cost savings	0.064	0.082	0.779	0.436
H6: Reverse logistics performance and Reverse logistics cost savings	1.041	0.113	9.211	***

Table2: Hypotheses Examination of the Revised Theoretical Model

Relationship between	Estimate	S.E.	C.R.	*p*-value
H1: Resource commitment and Reverse logistics innovation	0.748	0.035	21.167	***
H4: Reverse logistics innovation and Reverse logistics performance	0.516	0.033	15.521	***
H6: Reverse logistics performance and Reverse	1.178	0.079	14.920	***

logistics cost savings				

Figure 2: Structural Model of the Revised Theoretical Model

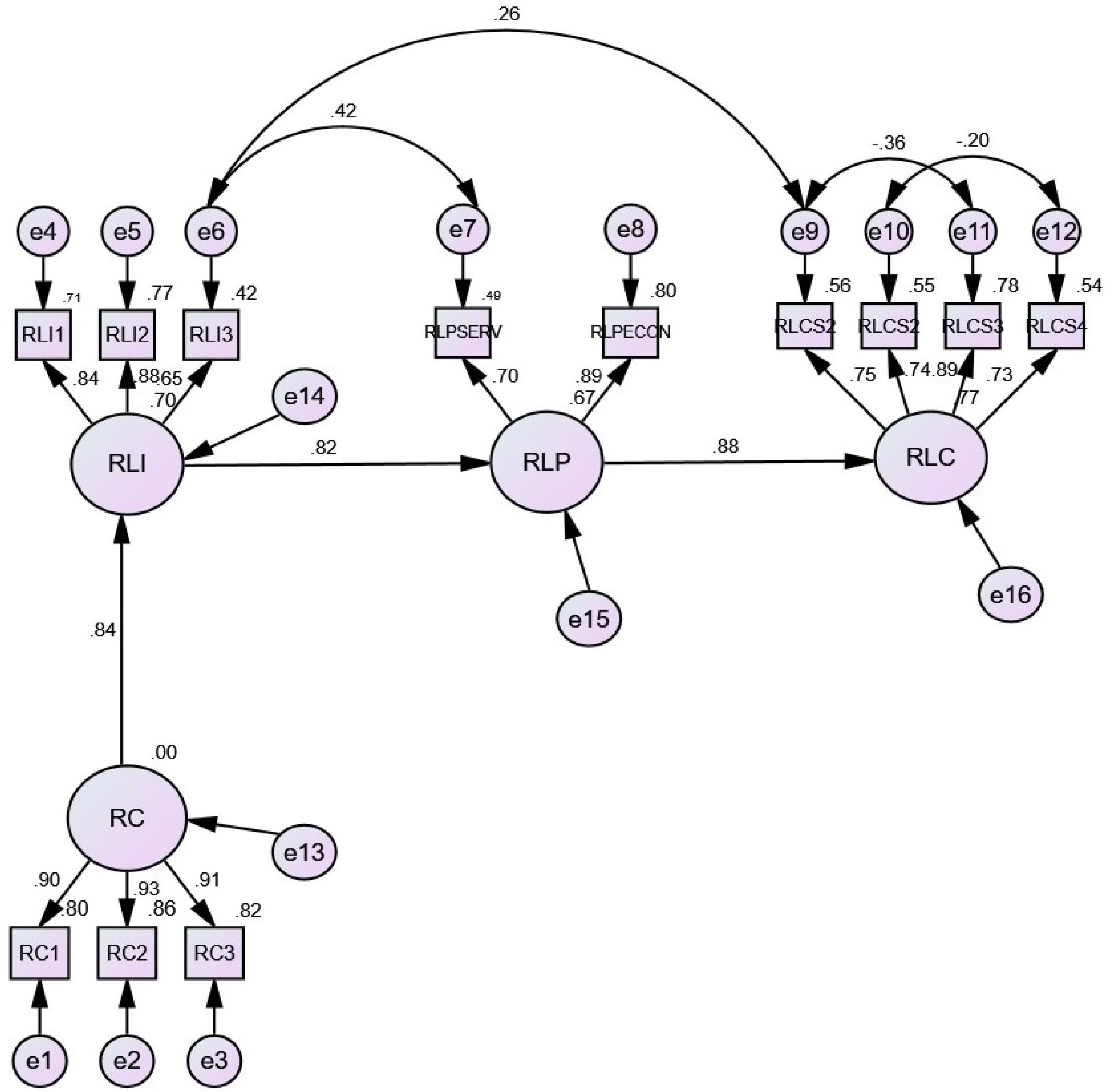
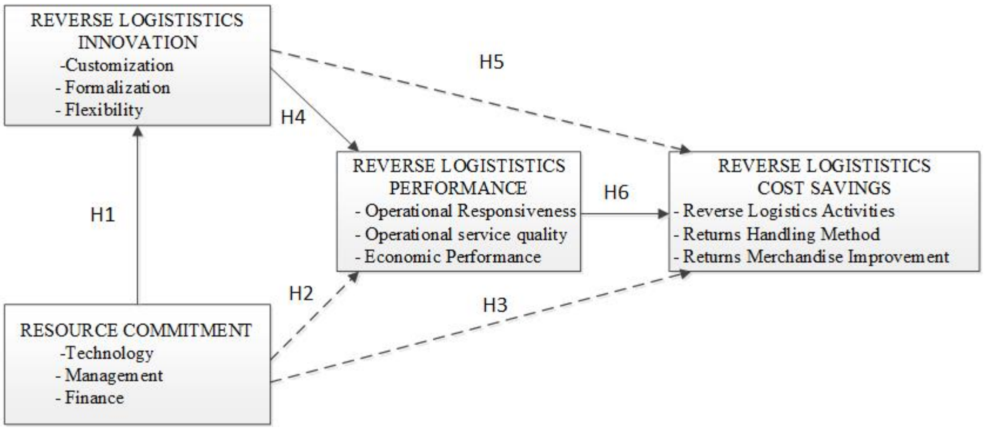


Figure 3: Revised Theoretical Framework



Mediate effect testing

Since resource commitment is no longer significant with zero direct effect on reverse logistics performance, reverse logistics innovation is no longer significant together with zero on reverse logistics cost savings. Resource commitment is no longer significant and has zero on reverse logistics cost savings. Thus, it can be summarized that the relationships are better described by a fully mediated influence of reverse logistics innovation and reverse logistics performance. Thus, H7, H8 and H9 were supported with fully mediation.

Table 3: Standardized Direct, Indirect, and Total Effects among Variables of the Revised Model

Relationship between	Standardized direct effect	Standardized indirect effect	Standardized total effect
H7: Resource commitment and Reverse logistics performance	0.000	0.686	0.686
H8: Reverse logistics innovation and Reverse logistics cost savings	0.000	0.718	0.718
H9: Resource commitment and Reverse logistics cost savings	0.000	0.602	0.602

Regarding the results in Table 3 above, the equations for the revised theoretical framework were conducted.

$$Z\,RLI = 0.839\,RC \tag{1}$$

$$Z\,RLP = 0.686\,RC \tag{2}$$

$$Z\ RLC = 0.602\ RC + 0.718\ RL \tag{3}$$

Moderate effect testing

According to results presented in Table 4 below, the *p*-value is 0.000, and it can be extrapolated that the relationships of the structural model are dissimilar across the size of firm, time of firm entry into industry, category of industry and period of reverse logistics application. Therefore, H10, H11, H12 and H13 are supported.

Table 4: Test of Moderate Effect of the Size of Firm, Time of Firm Enter to Industry, Category of Industry, and Period of Reverse Logistics Application on the Revised Theoretical Framework

Details/Model	Unconstrained	Fully constrained	Difference	*p*-value
H10: Test of the size of company (2 Groups: SMEs and Large Company)				0.000
Chi-square (CMIN or $\chi 2$)	314.764	349.731	34.967	
Degree of freedom (df)	94	105	11	
H11: Test of the time of company entrance to the industry (3 Groups: Late, Medium, and Early Entrance)				0.000
Chi-square (CMIN or $\chi 2$)	720.546	792.399	71.853	
Degree of freedom (df)	141	163	22	
H12: Test of the industry (2 Groups: Automotive industry and Automotive aftermarket industry)				0.000
Chi-square (CMIN or $\chi 2$)	427.014	474.387	47.373	
Degree of freedom (df)	94	105	11	
H13: length of reverse logistics implementation (2 Groups: Less than 3 years and Above than 3 years)				0.006
Chi-square (CMIN or $\chi 2$)	297.674	324.131	26.457	
Degree of freedom (df)	94	105	11	

Quality results from automotive industry

Generally, automaker companies commonly perform as focal companies in the supply chain of automotive industry. These automobile assemblers have more power of negotiation than their suppliers. Automotive assemblers will provide a supplier manual with related instructions, specify specifications of products, requirements and procedures and suppliers must take action when an automaker company notifies them of any problem with delivered products. Manufacturers will use this manual as a guideline for evaluating supplier performance both in forward and reverse logistics. In the meantime, suppliers must strictly follow the manual.

In general, the source of problems concerning products delivered to an automobile assembler can be separated into two categories including deficient product and erroneous shipment. When an imperfect product is discovered, an automobile assembler will immediately notify the supplier and ask for action. A supplier will send a responsible employee, which normally is a quality assurance (QA) employee, together with newly qualified products, to the manufacturer factory and perform an inspection on the deficient product. If the inspection reveals that the product is truly imperfect, the quality assurance employee will substitute the deficient product with the new, qualified products. In the case of a large product which cannot be transported by the quality assurance employee, it will be delivered expediently.

Once the substitution process is performed, an automobile assembler will issue an official claim document which the supplier keeps as formal evidence. A supplier also responds to this official document by investigating and informing a rational cause of deficiency and approach to prevent and solve the identified problem in the future. Alternately problems with a delivered product may also result from erroneous shipment. If the real shipment product is inconsistent with the requirement in specification of product or amount, an automobile assembler may request a substitution of some elements of the products or send back the entire shipment to a supplier. The action will be dependent on the discussion between the automaker firm and relevant supplier. In either case of deficient product or erroneous shipment, a supplier must take reparative actions immediately.

Once the pull system, just in time and lean manufacturing, has been implemented, the supplier is not allowed to send a product in advance of schedule. However, an automaker firm generally shares a quarter or a monthly forecast of demand as well as production planning with its suppliers. A supplier must notify the automaker firm when they evaluate that they cannot perform as per the given plan, upon notification the manufacturer will consider looking for new possible suppliers. Due to fluctuating demand, which has an effect to supplier production line in terms of set up time, quality control, man power planning and production cost, suppliers normally select Hejunka which leads to approximately 5-30% of surplus inventory relying on the rate of defect as well as the product dimension.

Presently, automaker companies apply both forward and backward vertical integration; the automobile makers own some supplier companies and distribution channels for both new and used vehicles. Thus, the automaker companies have an influence in both the automotive industry and automotive aftermarket industry. Generally, car makers implement pull system, just in time (JIT), Toyota Production System (TPS) and lean manufacturing thus lowering both inventory and defective part rates. Normally, these systems were taught and applied in supplier process. Statistics technique was used to calculate minimum inventory volume.

Regarding inhouse production of car assembly, only large parts which takes time to produce such as body parts, hood, bonnet and doors are allowed to be stored. Routinely, a dealer will store only consumable products such as lubricant oil, oil and air filters. In addition, suppliers have an agreement to keep designs and inspection records for all parts of obsolete models and to be able to produce required parts for 15 years to support aftermarket requirements. Since supplier companies are located near automobile assemblers, damage caused by transportation is at low level. In addition, both supplier companies and automotive makers implement a milk-run system to reduce transportation costs and capability to return packaging and palettes.

Regarding car manufacturers, companies apply reverse logistics in terms of remanufacturing, refurbishment, reconditioning and disposal. Remanufacturing requires high technology and specific tools for inspection especially electric inspection and thus remanufacturing is implemented with regard to high value parts such as the gears, compressor and battery. Additionally, refurbishing is implemented when customers purchase modified models which have customized standard accessories from standard such as sport, luxury or safety automotive models. Manufacturers can increase price through this refurbishment process varying from 5% to 30% on average. Refurbished parts normally include a max wheel, car seat, car spoiler, car skirt, grill, bumper, tire, LED and door handles. After removing an original part and replacing it with a modified/accessorised part, the original part will be returned to the manufacturing line and its' quality will be inspected. A part that passes this quality assurance assessment is sent for refurbishing, such as abrasion and painting, which makes it a new part. Since these refurbished parts have never been used, they are sold at the same price as new parts.

A further consideration with regard to refurbishing is in the context of used cars. When customers decide to buy a new car some of them need to sell their existing vehicle first. To service customer needs and facilitate the sale, the automaker company often buys the used car from these customers. A used car is returned to be checked for damage and usage condition.

Then the main parts of the car, the engine, gears, suspension, electrics, braking system and safety system will be reconditioned depending on their damage and condition. Following this, a used car is checked again. If it passes quality and safety control, it will be returned to sell as a used car. The ratio of investment to return in this instance is approximately 1:2 (100% return rate). Reconditioning of a used car occurs at a lower volume and value than a new car (approximately 1:7), the reconditioning of used car aims to support customer requirements rather than profit making. Finally, disposal, normally once a year, is implemented with 'dead' stock. As low inventory level leads to low 'dead' stock level, some defective parts are then sold as scrap. Some companies buy defective parts and may sell the said defective parts to a private service centre or second-hand shop, which reduces reliability and company image. Thus, some deficient parts will be destroyed or cut into small parts rather than on-sold.

When considering auto part firms, research participants reported that they were normally involved with reverse logistics by all of the rework, repair and refurbishment process. Since suppliers emphasize efficiency, resulting in higher productivity and lower defective parts, return rate is low. Some companies propose that scraps were loaded to a spinning process to separate water, oil/lubricant and clean scrap. Water was returned to the recycle process whereas oil/lubricant was treated through the reuse or recycle process. Scrap was returned to specific process initiatives relevant to the company and is then returned as raw materials to be processed as new product or sold to other companies who require this material. In addition, the respondents from the company supplying raw steel materials commented that scrap was used as raw material for other small parts as well as used to make shelves and baskets used in the factory. Defective steel and aluminium parts were returned to smelting and then once again became raw material. Meanwhile, the rubber company respondents stated that defective tyres were returned to the mashing process to become powder and wax that top sport grounds. Some suppliers applied reverse logistics in the design process by packaging designs which can be used for all parts or can be modified for new models. Some of suppliers used the milk-run strategy to take packaging back without employing other third parties a logistics company.

Quality results from automotive aftermarket industry

Automotive aftermarket industry products can be sent back after the vehicle departs from the assembly line during the length of the car warranty when any part breaks and end consumers may decide to take the car to a service centre to make their claim and install the new part. After the warranty period, end customers may decide to select either the automaker service centre dealer, a branded service centre or a private service centre. If the service cost of the dealer or branded service centre is obviously expensive, end consumers intend to opt for the private service centre.

Dealers usually substitute defective products with a new qualified product for their consumer and then communicate with the automaker firm to make a claim for the defective product. Generally a dealer will store a sufficient spare part inventory to provide for its consumers and can also request a new part before preparing a claim on the substitution if necessary. The claim is made by communicating to the automaker company in regard to the defective part's composition and a photo of the part and the car maker has the right to ask for the broken/defective part to be returned for investigation. For transparency of practice, the dealer imperative is to get approval or authorization to replace the new part for the customer and return the defective part to the manufacturer. When the claim is endorsed, the newly qualified substitution part is sent to the dealer or money is credited back to the dealer's account based on the existing contract. When the returned product arrives at the automaker factory, it is initially investigated. If the cause of problem is the part quality, the automobile company will contact the supplier who produces that part and make a claim. The processes of inspection, part substitution and claim submission are very homogeneous both in cases between the manufacturer and the 1st tier supplier and between the 1st tier supplier and the 2nd tier supplier. Due to replacement part supply being less urgent than substitution of defective parts on the assembly line, the whole claim process may be completed within several weeks.

Participants from dealers of automaker firms stated that in the case where customers do not require a broken part and decide to leave it at the dealer service centre, these parts will be eliminated or disposed. These enterprises are determined to embark on the reverse logistics program along with the green logistics program in order to escalate their business image of. Branded and private service centre participants responded that they usually perform reverse logistics process with 5 product categories. First, most of the tyre is sold to a company and the tyre is sold as a second hand tyre, used as fuel, torn to get steel wire that can be sold or returned as raw materials including to build artificial reefs. Second, the battery is disassembled for lead and plastic, then returned to the transforming process to become a new product such as a solar cell. Third, scraps of steel or plastic are returned to the smelting process, then sold as raw material. Fourth, oil/lubricant was returned to transforming process for other type of oil/lubricant. Some types of oil/lubricant can be used as ingredients for paint. Lastly, miscellaneous spare parts such as shock absorbers and bearings are disassembled to obtain oil/lubricant which is returned for reuse by a filtering process. Some parts such as shock absorbers, bearings and speakers, after disassembly are broken down into smaller parts that can be sold and then returned to the recycling process.

Quality results of an overview situations and recommendation of reverse logistics program

Participants from both industries responded that there is rarely some level of resource commitment, information system support, and innovation employed in reverse logistics process which is in consistent with information found from quantitative methodology. On the other hand, resource commitment, information system support and innovation are almost always dedicated to the forward logistics. The participants from the automotive industry proposed that they decided to neglect reverse logistics program because it was not worth the high cost of long term investment. The managers proposed that it was not appropriate as the company needed to compete to survive in the contemporary climate of high competition. In contrast, the participants from the automotive aftermarket industry suggested that customer satisfaction was most important for their business and thus, the operational responsiveness and service quality dimensions were implemented at an extensive level.

Reverse logistics process can be viewed as a part of closed-loop supply chain. Participants further stated that both forward and reverse logistics commonly consumed the same pool of resources and information support as the software or website employed to communicate or share information between an automaker company and supplier as well as the same pool of machine and equipment to produce new parts and rework, repair, or refurbish defective parts. The automotive industry managers further clarified that due to low level of value add gained from the reverse logistics process compared to forward logistics, it is not necessary to determine definite machines or equipment or systems to manipulate reverse logistics.

Alternately, managers from branded service and private centres explained that since customer satisfaction is essential, they tend to replace an imperfect part with the new one which results in an extensive volume of defective parts, more than the dealer can return to a car assembler. Since an automotive aftermarket firm cannot return a defective product, a high ratio of reverse logistics cost compared to total logistics costs occurs in the automotive industry. Thus, automotive aftermarket industry participants commented that it was worthwhile to invest in the machines, systems and innovation involved in reverse logistics process.

Currently in Thailand there a large proportion of automobiles which cause high levels of pollution, accidents and traffic problems. The high volume of these types of vehicles arises due to government policy problems, excise tax problems and lack of company expertise with disassembly and scrapping cars. Transportation law does not determine how long a car is permitted to drive on the road and there are even less strict laws concerning the recycling or disposal of a car. In addition, vehicle tax of older cars is lower than that of a new car. The price of new car is quite expensive one considered in terms of national income and so the Thai people tend to use a car for a long period of time. In Thailand, the price of a car includes excise tax which results in an expensive purchase price compared to other countries.

Some countries such as Japan, U.S., and EU, separate excise tax from product price. When they return their car to the system, they received the excise tax as a rebate. After deducting excise tax, the price of used car is lower than that of Thailand. Thus, Thailand cannot export used cars due to the higher price of used cars in the regional market. With less strict laws about recycling or disposing of vehicles and a tendency to use a car for long time, it is unnecessary to disassemble and scrap cars. To date, Thailand does not have companies who have expertise in the disassembly and scrapping of a car. Thailand is ranked as the country with the highest number of car accidents in the world and there is a high incidence of cars being inspected by an insurance company. Since there are no companies with expertise to disassemble and scrap a car, insurance companies evaluate and sell cars at salvage price, which extensively lowers the absolute price.

Discussions

The resource-based view (RBV) has relevance to the attributes of a firm's assets which are scarce, precious, non-exchangeable and hard to resemble and enable a firm to be at the forefront of competition as these resources provide a route to perpetual benefit in competitiveness. Commonly, assets which generate benefit in competitiveness include funds, factory, machines and particularly human resources, which are crucial because they are both peculiar and hard to replicate by rivals. Resource-based theory suggests that companies are considered as bundles of resources which can be both tangible and intangible, including input factors, assets, competencies or capabilities (Peteraf, 1993). Thus, many companies emphasize the innovative utilization of resources in logistics to generate and increase value for end users.

Correspondingly, qualitative results reflect that the imperfect parts return worth is mainly generated by such main parts as the engine, compressor, gears and battery, etc. Effective procedures to correctly classify the returned parts and identify the problems raised makes returns process more efficient (Teng, Ho & Shumar, 2005). The processes of remanufacturing, refurbishing and reconditioning require expertise employees, high levels technology and the appropriate equipment in order to create innovation that quality assures returned parts and the safety of their use. The enterprise supplies sufficient resources including technological and financial support and good counselling and advice will provide an opportunity for workers to communicate and collaborate on perspectives and suggestions which can bring about reverse logistics innovation and result in superior competitive advantage (Hunt & Morgan, 1996).

Since respondents evaluated reverse logistics both economic performance and operational service quality and operation responsiveness performance at an extensive level, this is consistent with qualitative results. Managers commented that the company implemented reverse logistics process so as to encourage employees to discover product innovation, process innovation, information system and technology innovation. Product innovation is involved with the design process, where the company designs standard or common usage parts through eco-design. Common usage parts can be used for all models or can be modified when a new model is introduced. Eco-design is involved with raw materials which can be reused or recycled or easily disposed. Companies create process innovation which can assist remanufacturing, repairing, reworking, reconditioning and the disposal process. Suppliers were also found to use a process innovation called the milk run system which can decrease both cost of distribution and inventory, resulting in higher profitability (Wu, Wang, He, Xuan & He, 2018). Both innovations can reduce raw material usage which is the main cost of reverse logistics in both the automotive and automotive aftermarket industry.

With regard to the size of company, small and medium companies can make a more effortless response to market changes and requirements and attract a novel workforce which includes more growth-oriented personnel who may provoke innovation and frequently, initially, establish themselves through product innovation as a differentiator (Ettlie, 1983). In contrast, large companies are stable, not requiring any change. Some large companies operate by following orders from headquarters, which creates fewer opportunities for innovation, resulting in less performance and cost savings than small and medium firms. The companies entered the industry lately will consume resources to acquire innovation that exceeds those with middle and early entry to the industry. Early entrants obtain the advantages of innovation as they invested prior to their rivals and could achieve greater performance percentage than their competitors. In contrast, those with ‘middle’ entry spend exceeding concentration on their efficiency and diminishing cost.

According to automobile assemblers and supplier, emphasis on quality control of forward logistics, results in low levels of deficient parts. The automotive industry managers further clarified that due to a low level of value, added gains were experienced from the reverse logistics process compared to forward logistics. They commented that it is not necessary to determine definite machine or equipment or systems to manipulate reverse logistics processes. Normally, a reverse logistics process is used to enhance customer service. On the other hand, managers from branded and private service centres insisted that customer satisfaction is essential together with the value added gains from the reverse logistics process, which is greater than that of automotive industry. Thus, automotive aftermarket managers commented that it is worthwhile to invest in machines, systems and innovation involved with the reverse logistics process which aims to both service customers and make profit.

Since the reverse logistics program will create results in the long term and it is difficult to measure the benefits to company image, it will be customer behaviour that judges the implementation of this program. In addition, the ignorance of environmental benefits does not reflect the actual benefit of reverse logistics execution. Accordingly there are negligible attractive effects from implementing a reverse logistics program (Škapa & Klapalová, 2012; Due Au, 2016) particularly, lower cost savings and there is no difference between novel users or long-time users. Correspondingly, managers noticed that the reverse logistics program has been neglected or discontinued or even lacking in implementation and thus, it is considered an unsuccessful program though implemented by the respective company for a long time.

Conclusions

A powerful reverse logistics program can offer the organizational opportunity to a company to differentiate itself in the marketplace (Stock, Speh & Shear, 2006; Saputri, & Mulyaningsih, 2016). Advocating about the extent of reverse logistics cost as well as increasing operational effectiveness are crucial to create an organizational reputation and attracting end users (Daugherty, Myers & Richey, 2002). Although reverse flows can lead to inspiration and more explicit enlightenment regarding necessary change for improvement, some companies have dedicated too few organizational resources and supplied too little management harnessing to effectively manipulate the requirements of their supply chain members and customers in the reverse logistics area (Andel, 1997; Ayuningrat, Noermijati., & Hadiwidjojo, 2016).

Many companies have tended to neglect and minimize reverse flow as it entails additional cost or imperative problems. The key success issues for reverse logistics managers include: provision of greater and more suitable resource focus, advocacy of the flexibility of the return system, improved re-work and repair process, increased service quality and innovation and inclusion of a reverse logistics program in policy and strategic management. Further, reverse logistics accounts for a high proportion of GDP of the country and thus, the government should launch policies to attract return of implementation such as tax reduction, lower interest rates and special agreements for software, systems and technology investment.

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