Preface

INTRODUCTION

Environmental management has received increasing attention from business practitioners and academic researchers in recent years. The growing importance of green supply chain management is driven largely by the escalating deterioration of the environment, expanded legislation, intensified global competition, and value-seeking initiatives. Green supply chain management, along with reverse logistics, has its roots in both environmental and supply chain management literature. Adding the ‘green’ component to supply chain management involves addressing the influence and relationships between traditional supply chain management and the natural environment.

A survey of 133 corporate managers revealed that 60 percent of the group considered environmental issues to be highly important and 82 percent expected that the importance would further increase in the years to come (Murphy et al., 1995). Unlike forward supply chains, research on reverse logistics and green supply chains have a relatively short history and issues at both the strategic and tactical levels are largely unexplored. As sound reverse logistics networks serve as the foundation for efficient and effective green supply chains where industrial ecology, profitability, and substantiality are primary concerns, a better understanding of the current situation of research on such topics is needed.

The concept of reverse logistics has evolved over the years as practices and research proceed to various levels. According to the European Working Group on Reverse Logistics (REVLOG), reverse logistics is defined as ‘the process of planning, implementing, and controlling backward flows of raw materials, in process inventory, packaging and finished goods, from a manufacturing distribution or use point, to a point of recovery or a point of proper disposal.’ Reverse logistics is a complex process, which can take different forms of flow. The first step of reverse logistics is the collection of used goods or parts from the distribution channel. These used items are shipped from end customers back to processing centers, the original manufacturers, and suppliers. Meanwhile, the used goods or parts could be disassembled and scrapped, and then re-enter into production as raw materials. Returned goods could also be sent back to suppliers and supply chain partners to refurbish or remanufacture. Reverse logistics is a big part of business, which represents up to 95% of total costs in the recycling process (Stock, 1998). In the magazine industry alone, for instance, “reverse” activities can amount to more than $6 billion each year.

Reverse logistics plays a critical role in helping to connect various Rs, such as Recycle, Reuse, Reclaim, Redesign, Reduction, and Remanufacturing, within an integrated “closed-loop” supply chain, which starts with suppliers, continues to manufacturers and distributors, gets to end customers, and returns to the suppliers. The practice of reverse logistics requires much higher level coordination among varied functions and entities and brings new challenges, such as coordination of two markets,
uncertainty in the supply of used goods, return and disposal decisions, preponement and postponement of products, and design of distribution/collection network, to managers. Accordingly, reverse logistics operations and the involved supply chains are significantly more complex than traditional ones which contain only “forward flows”.

Fundamentals of green supply chain management as a competitive initiative are explained by Porter and van der Linde (1995), which argue that investments in greening lead to resource saving, waste eliminating, and productivity improving. As a consequence, green supply chain management assists to lower the environmental impact of a firm, enhance its business efficiency, and possibly create major competitive advantages through operations and innovations.

Three management approaches are proposed to greening: reactive, proactive, and value-seeking (Kopicki et al., 1993). In the reactive approach, companies comply with environmental regulations by committing minimal resources. They start to procure goods with some recycled contents and use filters to lower the environmental impact of production. In the proactive approach, companies tend to expand the resources devoted to green management. Recycling, reuse, and green design are employed by the companies to pre-empt new environmental laws. Value-seeking is the most far reaching approach, where companies actively integrate environmental activities into a business strategy and operate to reduce the impact on the environment as a strategic initiative.

Green supply chain management covers a variety of business activities, such as green design, including product design for environmental compatibility and recovery, environmental conscious design (ECD), and life cycle assessment (LCA); green operations, including green engineering, network design for reverse flow, green manufacturing (e.g. production planning and scheduling, inventory management), and waste management (e.g. resource reduction and disposal). The greening commitment follows a “top-down” approach and requires both cross-functional (individual company) and cross-organizational (supply chain partners) collaboration.

The health care industry is one of the largest enterprises in the United States, which accounts for a significant portion of national economic output in this country. Health care supply chain has received increasing attention from health care providers, insurance companies, government agencies, consumers and academic researchers in recent years. Since the U.S. has recently entered a state of economic recession, there is an increased focus on providing cost containment and inventory control for health care suppliers while avoiding a sacrifice in quality for health care services provided to consumers. Largely value output, inventory control, and supply chain management drive the growing importance of integration within the health care supply chain. In order to achieve cost containment, inventory control and avoid sacrifice in quality, the health care supply chain needs to be integrated and efficient.

U.S. healthcare is currently a poor value proposition in relation to its cost. This must change. Driven by the fundamental forces of financing, consumer preferences, and technology, the U.S. is heading for a profound revolution in healthcare, one that will affect not only the system itself but also the larger U.S. business community (Herzlinger, 2010). The reason cost containment is so important for the health care industry is due to the magnitude of this industry. Catlin, Cowan, Heffler, & Washington (2007) project an 18.7 percent increase in health care spending over the next ten years. Kelle, Schneider, Wiley-Patton, & Woosley (2008) recognize that there has been a shift from public to private financing in the United States in an attempt to control health care expenditures. Due to the economic crisis, an increasing focus has been placed on exploring alternative methods of cost containment.

Despite the size and importance of the health care industry, very little attention has been paid to the areas of health care supply chain management and inventory management in recent years. Bower
& Garda (2008) estimate that inventory investments in health care range between 10 percent and 18 percent of total revenue. Therefore, controlling expenditures in this area may have profound impacts on the overall efficiency of the health care organization and supply network. Increasing this efficiency will then lead to higher profitability for health care providers as well.

A typical healthcare supply chain is a complex network consisting of many different parties at various stages of the value chain. Consistent with Burns & Pauly (2002), the three major types of players are: Producers (product manufacturers), Purchasers (group purchasing organizations, or GPOs, and wholesalers/distributors), and healthcare providers (who make the product/service available to the end customer) such as acute-care hospitals and long-term facilities, surgical and diagnostic centers, physicians’ clinics, pharmacies and other facilities. In many cases several players intervene between the manufacturer of a product and the end customer. Such factors create diverse, complex, and fragmented healthcare supply chain management across the industry. The management of products, inventory, and processes for both clinical and non-clinical services is mainly independent and non-integrated, resulting in much inefficiency.

The health care industry operates in a unique manner. Unlike traditional supply chains, decisions made in the health care supply chain are not as clearly defined. Most traditional supply chains make decisions geared towards the achievement of an optimal economic operating setting whereas the health care supply chain endures several constraints making trade-offs harder to be achieved. Stakeholders and their interrelationships, product characteristics, and policies employed all impact health care supply chain management, inventory control, and value output. Doctors are the primary caregivers in the health care system; however, they are contracted service providers and are not hospital employees. Therefore, some control must be relinquished to physicians, which may decrease efficiency in the health care supply chain management and inventory control. Also, hospital administrators are expected to manage complicated distribution networks and inventory control problems. These hospital administrators are very intelligent people, however, they may not be properly trained or have the proper educational background to efficiently resolve these issues. Other industries have engineers or supply chain professionals attend to these problems (Pitta and Laurie, 2008). Policies employed must clearly state the hospital’s rules and procedures. These policies should employ organizational justices and cover contingency plans in order to increase efficiency as well.

Also, there are a variety of drugs offered by hospitals. Physicians are in charge of prescribing drugs and it is important for the doctors to have the right drugs to choose from. However, one physician’s opinion often differs from the opinion of another physician and both physicians’ opinions differ again once new drugs are developed so there is often a wide selection carried by hospitals, which increases health care expenditures substantially.

**CURRENT RESEARCH**

**From Reverse Logistics to Green Supply Chains**

The current research on reverse logistics and green supply chain management is very recent and its origins can be easily traced back to the early 1990s. Due to environmental, legislative, and economic reasons, business practitioners and academic researchers began to realize the importance and potential benefits of green supply chain management. Product recovery and recycling issues are explored in some earlier literature. Automobile, electronic products, and paper recycling are among the most common

Reverse logistics began to catch the attention of researchers around the same time. Wu and Dunn (1995) argue that environmentally responsible logistics systems are urgently needed in supply chains. The significance of reverse logistics programs and the processes of their development and implementation are highlighted in Murphy and Poist (2000), and the financial hidden values in reverse logistics are discussed in Mollenkopf and Closs (2005). A reversed network requires careful design, planning, and control. Traditional forward supply chain models in general are not suitable for logistics systems with reversed or bidirectional flows, for which standard set of models is yet to be established.

Researchers can get insights from practices used in forward supply chains but they need to adopt a new business approach to the entire process. Dekker et al. (2004) classify the research on reverse logistics into three fundamental areas: a) management of the recovery and distribution of EOL products; b) production planning and inventory management; and c) supply chain management issues in reverse logistics. The first area explores varied physical flows in the reverse logistics system. Research topics include the process of EOL product returns, the design of the reverse logistics network and its interaction with the forward flow, and logistics scheduling and routing. In the second area of production planning and inventory control, research is focusing on the coordination of product recovery and its relation with traditional production planning. Major research questions include the effects of reverse flow of product returns on traditional inventory management, and the design of remanufacturing and recycling systems. The research in the last category of ‘supply chain management issues in reverse logistics’ mainly deals with strategic decisions, such as the role of information technology, environmental regulation and management of reverse logistics, as well as the long-term behavior of closed-loop supply chains.

Quantitative methods have been applied in the research. Mathematical programming, such as linear programming (LP) and mixed integer programming (MIP), is widely used for modeling production lot sizing and routing problems in reverse logistics systems. A stream of research is particular focusing on the integrated production, inventory, and distribution problems with reverse flows. Such research is often motivated by industry practices. For instance, a production and distribution problem for products delivered in reusable containers is studied in Del Castillo and Cochran (1996). The model is defined for a two-stage network with a forward flow from a plant to a depot and a reverse flow of empty containers back to the plant. A hierarchical solution approach is proposed, where LP models are designed to determine the master production-distribution plan. Similar issues are addressed in Chen et al. (2007), where a container vessel scheduling problem with bidirectional flows between a single origin and a single destination is modeled and solved through a linear program and a greedy heuristic method. An integrated production and distribution problem motivated by the practice of a medical equipment leasing and service network is analyzed in Lei et al. (2009). The network supplies, repairs, inventories, and distributes both new and refurbished medical devices to business customers. A partial LP relaxation-based heuristic approach is proposed to solve the problem.

Stochastic programming and stochastic dynamic programming methods are also employed in the research to study reverse logistics and remanufacturing systems, where demand, lead times, and information uncertainty are important factors. For instance, Kelle and Silver (1989) investigate the return and reuse of containers (e.g. kegs or plastic cartons). Forecasting is important since the time from issue
to return of an individual container is usually unknown and there is a chance that the container is never returned. A stochastic programming model is developed to address the various knowledge with respect to the returns. Product take-back systems are analyzed in Klausner and Hendrickson (2000). An alternative take-back system would combine profitable remanufacturing and unprofitable materials recycling. A model that allows determining the optimal amount to spend on buy-back and the optimal unit cost of reverse logistics is established, which can be used to select a suitable reverse logistics system for EOL products.

Remanufacturing and inventory systems in a stochastic setting are important areas. Inderfurth et al. (2001) develop a periodic review model for studying product recovery in stochastic remanufacturing systems with multiple reuse options. Mahadeven et al. (2003) focus on a product recovery and production-inventory control model. A remanufacturing facility that receives a stream of returned products according to a Poisson process is analyzed. Several heuristics based on traditional inventory models are proposed. Takahashi et al. (2007) consider a remanufacturing system with reproduction and disposal. Two control policies are provided and Markov analysis is used to evaluate the performance.

Meanwhile, multi-echelon green supply chains are also investigated. Listes and Dekker (2005) present a stochastic programming based approach by which a deterministic location model for product recovery network design may be extended to explicitly account for the uncertainties. Stochastic models are used to understand a representative real case study on recycling sand. Recently, El-Sayed et al. (2010) develop a multi-period, multi-echelon, forward-reverse logistics network design under risk model. The network structure consists of three echelons in the forward direction, (suppliers, facilities, and distribution centers) and two echelons in the reverse direction (disassembly and redistribution centers), with stochastic demands. The problem is formulated in a stochastic mixed integer linear programming (SMILP) decision making form as a multi-stage stochastic program.

A variety of issues are addressed in the research on reverse logistics and green supply chain management with more attention given to green operations. Both quantitative and qualitative approaches are used, where research concerned with strategic issues are conducted by using qualitative methods such as case study and conceptual descriptions, and tactical and operational decisions are analyzed by using quantitative techniques such as linear programming and stochastic programming. In addition, it can be observed that there has been a trend to use mathematical models to analyze green supply chain problems in recent years.

Health Care Supply Chains

The current research on health care supply chain origins has been much more common in recent years due to the economic crisis the United States is currently facing. Due to economic reasons, health care providers, insurance companies, government agencies, consumers and academic researchers began to realize the importance and potential benefits of health care cost containment and inventory control. Since the financial aspect of health care supply chains is clearly overwhelming, much research on this field is focused on relevant costs. However, Castles (2008) investigates trends in the level of government involvement with the health care systems through the examination of data reported by OECD from 1970 to 2007 and predicts a convergence toward a mixed system of both public and private health care.

In existing research, focus has been geared toward the description of the health care system rather than developing innovative models or performing quantitative analyses. However, descriptive studies are essential for documenting actual health care supply practices. Burns et al. (2008) attempt to investigate
the health care value chain, uncover significant industry trends, and identify the major stakeholder groups involved with health care by examining the health care industry for three years. Through examination, it was discovered that both vertical and horizontal integration were present in health care. Vertical integration was exemplified by hospitals teaming with insurance agencies or ambulatory services to combine various parts of the delivery network, whereas, hospitals purchasing other hospitals or the formation of groups purchasing organizations illustrates horizontal integration. Burns et al. (2008) yield the results that payers, fiscal intermediaries, providers, purchasers, and producers are all identified as groups of stakeholders.

While searching for ways to more efficiently integrate the health care supply chain it is essential not to sacrifice quality or value. Kelle et al. (2008) state that in the health care value chain, value is described by the interrelations of relevant stakeholders. Value chains are substantial marketing tools because they present managers with the opportunity to assess the specific value of each member of the supply network. Supply chains present a mechanism for providing value to consumers. Originally the value chain focused on a company’s internal activities specifically designed to create value for consumers, however, this concept has been extended to include the entire product and service delivery system (Bower & Garda, 1985). Pitta & Laurie (2008) discuss a model of the health care value chain and supply chains that exists in many practical situations. In order for this system to be successful or for value to be created, quality information must be transferred efficiently since medical care received by patients relies heavily on information processing. Through exploring the value chain, managers can find any specific problem areas that can be altered to create enhanced quality for customers. Health care supply chain managements and inventory control management vary in complexity and managerial importance from scenario to scenario. However, a model to improve inventory management practices being employed in hospitals is vital because of the sizeable expenditures in this industry. Due to the unique characteristics of the health care industry, a multi-item coordination should be considered. Also, supply chain management can be fitted into a planning framework. Other strategic approaches that have been explored in the area of health care supply chain management and inventory control are the outsourcing of distribution activities, allowing suppliers to manage inventory levels at various distribution points, and the use of common statistical techniques to achieve organizational and system goals.

Vissers, Bertrand, & De Vries (2008) define a planning framework for hospitals. The primary objective was to balance service and efficiency throughout the organization. Investigators identified three characteristics that fit hospital production control setting. These three characteristics include a demand that is larger than supply, restrictions on supply defined by contracting organizations, and high patient expectations on service quality. These five levels consist of patient planning and control, patient group planning and control, resources planning and control, patient volumes planning and control, and strategic planning. An EOQ model has been extended to a \( (R,s,c,S) \) model providing a steady framework for inventory control and supply chain management. This approach resulted in substantial gains, which were observed in improved service levels, reduction of costs, and substantially lower system costs, for the participating hospital.

Catlin et al. (2008) show that the optimal allocation of the space for the order quantities of the items is proportional with the square root of the demand over space rate. This is proportional to the available free space. The reorder stock point is the sum of expected demand during the lead time plus the safety stock. The lead time is the refill time. Dionne, Mitton, Shoveller, Peacock, & Barer (2009) provide an inventory of popular strategies for cost reduction or cost containment in the health services research literature and propose a coherent framework to organize this inventory. The purpose of this framework
is to inform decision-makers when grappling with the opposing forces they face in choosing a cost reduction strategy.

Castles (2008) indicates that the trade-off between the number of orders and free storage space for a given service level can be expressed in a simple functional form depending on the remaining free storage space for cycle stock, so the function implicitly includes the service level trade-off. For a fixed service level, the trade-off curve has a hyperbola shape that is shifted to the right with increasing service level requirement. This property allows a simple trade-off analysis that answers managerial questions including service level versus expected number of daily orders, number or drugs stored versus service levels, storage volume versus service level and worker capacity requirement, and extension on the number of drugs carried versus additional worker capacity requirement.

Creating a centralized system in hospitals will help control and integrate deterministic aspects of the health care supply chain. This integration will create more efficiency and in turn provide cost containment, inventory control, and added quality for customers. However, it is only possible to predict and control deterministic factors of the hospital. In the future, research conducted may help to discover a model of way of predicting non-deterministic aspects of the hospital. Also hospital varies from one to the next more research should be done on developing a model based on both deterministic and non-deterministic factors, which can eventually be used as a universal model for more accurate predictions in the health care supply chain.

The most serious issue in health care is that its costs are too high and rising too quickly while the quality of service is lagging behind. Peck, Nightingale, & Kim (2010) view this dilemma as a consequence of complexity associated with current health care systems. They report the Axiomatic approach, which has been used to optimize many complex engineering systems, can be applied towards unraveling the complexity associated with a healthcare system and suggesting optimal design solutions. Their paper presents cases of the Axiomatic approach in health care including the improvement of patient flow in emergency rooms and organizational design for a multi-campus mental health hospital.

The recent rapid increase in the amount of medical information has pushed hospitals to confront an essential issue which is how to utilize healthcare information technology to improve healthcare services quality. Customer relationship management system (CRMS) is an innovative technology which facilitates the process to acquire, develop, and maintain customer relationships more efficiently and effectively. Hung, Hung, Tsai, & Jiang (2010) propose an integrated model that incorporates both organizational and system related factors as primary determiners of CRMS adoption in hospitals.

De Vries (2010) explores the process of reshaping a hospital inventory system of medicines by means of an exploratory case study. The study indicates that decisions made during this reshaping process are heavily influenced by the dynamics of the relationships and interactions between the stakeholders involved in the project. There are also some strong indications especially in a health care setting, the existence of multiple stakeholders having a multi-goal focus regarding the inventory system can have a strong influence on the outcomes of inventory projects.

Onishi (2010) develops the FUGI (Futures of Global Interdependence) global modeling system, a scientific policy modeling and future simulation tool. The FUGI global model M200 classifies the world into 200 countries/regions where each national/regional model is globally interdependent. Each national/regional model has nine subsystems, including healthcare. This is a super complex dynamic system model using integrated multidisciplinary systems analysis where number of structural equations is over 170,000.
FUTURE TRENDS

From Reverse Logistics to Green Supply Chains

Although common practices in reverse logistics and green supply chain management have been examined, neither practitioners nor researchers have complete knowledge on these activities since they vary in complexity and managerial significance from scenario to scenario. They are often treated as a series of fairly independent activities rather than a business process and therefore more emphasis is given to the operational or tactical as opposed to the strategic level. As the demand for energy and raw materials continues to rise and the supply chain becomes more globalized and multi-organizational based, effective management strategies and principles are imperatively needed to reduce the ecological impact of industrial activity, enhance business efficiency, competitiveness, and sustainability. Hence, a comprehensive and systematic approach to study reverse logistics and green supply chain management is necessary.

Closed-Loop Supply Chain

As the closed-loop supply chain management has received increased attention in recent years, research on strategic factors is needed such that a theoretical framework may be established. The integration of various functional areas, such as research and development, engineering and manufacturing, marketing and distribution, and information systems, should be explored to construct a systematic structure that is committed to the green supply chain. Greening efforts should be carried out throughout the entire supply chain, where coordination among downstream customers, midstream manufacturers, and upstream suppliers is imperative. Research efforts should be devoted to studying the information and data sharing among supply chain members in the setting of green supply chain management.

New Technologies and Green Supply Chain

Technological innovations and applications bring new values to logistics and supply chain management. New technologies, such as global position systems (GPS), geographical information systems (GIS), and radio frequency identification (RFID), have changed traditional logistics and supply chain operations. Although the research on such topics is available in recent years, most work focuses on supply chain systems with forward flows. Greater efforts are needed to obtain useful knowledge, develop practical principles, and provide meaningful insights into key questions such as: How to effectively use these intelligence systems in green supply chains? What are the benefits, challenges, and consequences of using these technologies? There is no doubt that this will be one of the hottest research areas in the future.

Production-Distribution Systems with Bidirectional Flows

Integrated production and distribution problems have been studied quite extensively in the traditional supply chain context in the research. In contrast, existing solution methodologies and techniques for integrated scheduling of production, inventory, and distribution operations with bidirectional flows are very limited. On the other hand, in real-life practice, more and more original equipment manufacturers
(OEM) are now engaged in the implementation of new business policies under which defective products, by-products, and products with short life cycles need to be brought back to the production sites for reengineering and remanufacturing. The inherent complexity of reverse logistics and green operations make it a challenging work, and the coordination and management process are much more complicated than those in traditional networks. From both practical and academic viewpoints, integrated production and distribution problems involving bidirectional flows have the potential to receive more attention in the research in the future.

**Green Supply Chain in Emerging Economies**

Lastly, current research on reverse logistics and green supply chain management has mostly been led by researchers in advanced economies (e.g. European Union and the US). While the US tends to embrace liberal policies and green movements, European countries have strong environmental tradition characterized by both legislative and societal aspects. However, reverse logistics and green supply chain management in developing countries are largely untouched in academic research. Hence, it would be necessary to extend current research and explore these issues in emerging economies, where green supply chain management represents an unprecedented opportunity for bringing additional value to the society and it should deserve more attention from practitioners, academicians, and researchers in the coming years.

**Health Care Supply Chains**

**Patient Protection and Affordable Care Act**

On May 23, 2010, President Barack Obama passed the Patient Protection and Affordable Care Act (PPACA). Many scholars acknowledge that Obama’s new legislation act provides funding and mandates new requirements in order to improve health care quality. The act also establishes quality measures, requires providers to report data on these measures, provides more meaningful quality information to the public, and begins to pay providers and insurers for improved quality. Siberman (2010) states that the increased use in health care data will also be utilized to change federal payment policies in order to provide consumers with incentives of quality and efficiency. More extensive research will provide models of efficient practices that will improve the health care supply chain.

**Consumer-Directed Healthcare**

In line with Powell & Laufer (2010), consumer-directed healthcare promises to reduce costs and increase quality by expanding provider choice for prospective patients since implementation shifts the locus of healthcare system control from cost-shifting negotiations between employers, providers, and payers to new-found purchasing power of prospective patients. Patients can shop around through high-deductible insurance, employer- or government-subsidized health savings accounts, transparent pricing, and accurate information on clinical performance, etc. As in any other well-behaved market, when patients shop, there is a link between financial reward and value for the individual patient. However, current absence of price competition, agency problems, and high barriers to entry in local markets are market failures that break this link in U.S. healthcare.
Radio Frequency Identification

US hospitals spend millions of dollars on lost, misplaced and stolen equipment every year. For many health care manufacturers, the lot level visibility is lost as products proceed through the supply chain. Radio frequency identification (RFID) makes it simple to provide traceability at each and every packaging level accessed throughout the health care supply chain. RFID can bring benefit inventory management and supply chain operations greatly since RFID improves both security and product handling. Also, it is possible for RFID labels to be read through multiple layers of packaging without operator intervention, which may reduce the labor and time required for product handling in the health care supply chain (Black et al., 2010).

The health care industry is still concerned about counterfeiting, diversion, mishandling, mislabeling and mistaken administration of prescription drugs. It is estimated by the World Health Organization that up to 10% of worldwide medications are counterfeit. Counterfeit drug sales will likely total $75 billion worldwide in 2010, an increase of more than 90% over 2005 levels (Feig, 2010). Researchers are beginning to develop more intricate automated track-and-trace systems through the use of bar coding and RFID. Qu, Simpson, & Stanfield (2010) demonstrate that an RFID-enabled equipment tracking system could significantly increase equipment utilization. In addition, the proposed model may be used to evaluate the equipment preparation and maintenance policies in hospitals with RFID, and could be easily extended to quantifying the benefits of RFID tracking systems in other industries.

Virtually Centralized Supply Chain Management

Virtually centralized supply chain management is one option that can assist healthcare supply chains by controlling costs and improving service. Virtual centralization is integrating operations from the perspective market rather than the health system. An example of a virtual centralized supply chain is a consolidated service center (CSC), which is jointly owned and managed by multiple hospitals and healthcare systems. A CSC brings together geographically based groups of hospitals to form single entities that work together to centralize contracting, procurement, distribution, and logistical operations. The CSC serves as the focal point not only of distribution, but also of centralized contracting, procurement, and customer service (Parker & DeLay, 2008).

Patient-Centered Medical Home

Through the course of the next ten years, the new implementations will be tested and new models will be evaluated in order to improve health care coordination, transitions of care from one care setting to another, quality, health outcomes, and cost effectiveness and inventory control in the health care supply chain. According to Berry & Mirabito (2010), adoption of the patient-centered medical home transforms healthcare delivery into a system that benefits everyone. The concept of patient-centered medical homes offers a structure for integrating innovations that can transform the delivery of healthcare. In this setting, every patient can develop an ongoing relationship with a primary care physician supported by a team of caregivers through an electronic medical record, which facilitates coordinated communication and decisions. Access expands beyond the traditional physician office visit to satellite services tailored to individual needs. Services center on whole-person care, including wellness and preventive counseling, as well as acute and chronic care.
Schneller & Wilson (2010) summarize five top trends for healthcare supply chain management. In order to be fully effective, there must be more emphasis on the link between supply chain and clinical care and outcomes. Comparative effectiveness research, evidence of superiority, quality, and patient-centered healthcare are all important considerations for optimal supply chain management.

CONCLUSION

Our world is changing rapidly and business practitioners, in corporation with academic researchers, must respond quickly and develop effective solution methodologies and techniques to handle these new challenges in systems with forward and reverse flows of materials, information, and capital among various supply chain entities. Green supply chain management is a promising area of practice and research given the fact that increased attention has been paid to environmental issues, economic benefits, as well as sustainability in recent years.

In this article, we have provided a summary of the current research on reverse logistics and green supply chain management which has a relatively short history since the 1990s. Our main goal is to analyze the evolution and characteristics of the research on such topics and provide ideas and directions for future research. The recent development in reverse logistics and green supply chain management is encouraging and has revealed important findings, which shed more lights on varied areas, ranging from green product and process design, remanufacturing and reengineering, to reverse network design and waste management.

Based on our analysis, we found that researchers have explored both strategic and tactical topics, with more interests given to the latter area. Both qualitative and quantitative methods are applied in the research for achieving conceptual and operational knowledge. Considerable efforts have been devoted to studying product recovery and recycling, reverse logistics models, production and inventory systems, as well as multi-echelon green supply chains. These research activities are both relevant and of great significance, which have laid the foundation for further investigations.

With a substantial large number of variables, constraints, and parameters, the problems with which we are dealing in green supply chain systems are much more complicated than those in traditional forward supply chains. Moreover, the inherent complexity of environmental issues poses serious challenges to business managers and researchers. Traditional modeling methods and solutions, which are widely available, are no longer suitable for these situations and innovative research approaches and techniques must be developed. We have highlighted several directions for future research on green supply chain management, which include, for instance, closed-loop supply chains, new information technologies, integrated supply chain systems with bidirectional flows, and green supply chains in emerging markets.

The primary needs from today’s businesses are not tactical or operational in nature. In fact, they tend to be strategic and unstructured in general with more requirements in the areas of intra- and interfirm collaboration and diffusion of best practices. Many changes in policies, practices, concepts, and technologies can be expected in the years to come, which can bring fresh opportunities for meaningful academic research in green supply chain management.

Certainly, healthcare supply chain management is unique, because unlike other industries, there are a wide and diverse range of items which need to be ordered on a daily basis in order for a hospital to operate effectively and efficiently. Products and services provided include medical consumables, pharmaceuticals, catering and food, laundry cleaning, waste management and disposal, home-care products,
information technology, vehicle fleet management and general research supplies. The manufacturers that
supply the healthcare environment are, in most cases, restricted in their capacity to influence the final
consumer (patient or health professional).

Critics of the American healthcare system recite a long list of problems, including rising out-of-
pocket costs, inconvenient access, overuse of emergency departments, uncoordinated medical records,
and declining numbers of primary care doctors. It is time to reinvent the system. Creating a centralized
system in hospitals will help to control and integrate deterministic aspects of the health care supply chain.
This integration will create more efficiency and in turn provide cost containment, inventory control, and
added quality for customers.

Also the newly passed Patient Protection and Affordable Care Act in 2010 will help improve the
quality of care, which should lead to better health outcomes through the legislation’s investments in
enhanced quality measurement and reporting. Virtually centralized supply chain management, consumer-
directed healthcare and patient-centered medical home hold big promise. Research is continually being
explored to reveal some of the fundamental inefficiencies in our current health care supply chain system
and offers ways to improve the United State’s health care.

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