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**Innovations in Logistics
and Supply Chain
Management Technologies
for Dynamic Economies**



ZongWei Luo



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Innovations in Logistics and Supply Chain Management Technologies for Dynamic Economies

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Preface

APPLIED LOGISTICS: INNOVATIONS FOR A DYNAMIC ECONOMY

1. Introduction

Logistics has been instrumental in connecting and smoothing business activities, with importance well beyond organization boundaries to Supply Chains Management (SCM). Today's dynamic economy calls for innovative logistics operations and supply chain management to address uncertainties and improve efficiencies for business agility. Towards this, a journal, the International Journal of Applied Logistics (IJAL), was founded two years ago in 2009. The mission of the International Journal of Applied Logistics (IJAL) is to provide a prestigious forum of innovative findings for applied research and development in logistics and supply chain management. Providing researchers, practitioners, and academicians with insight into a wide range of topics, this journal disseminates the theories and technological progressions in applied research, advances in logistics and supply chains, and industry experiences in the adoption of developed and emerging theories and technologies to enhance competitiveness towards enabling efficient and sustainable knowledge-driven economy.

So far, seven issues of IJAL have appeared. The winter issue of 2011 is in print at the time of this writing, making the eighth issue in IJAL's two year early history. So far IJAL has maintained a good pipeline for publication with future issues planned well into 2012. All of these have shown that the primary objectives of IJAL are well received and that IJAL does provide a prestigious forum of excellence for applied research and development in logistics and supply chain management. The journal is dedicated to the applied logistics and supply chain management theory and technology development, innovation and transformation in various economic sectors, demonstrated in the papers that have appeared so far and in those which will appear in the future. The journal has made its commitment to the timely dissemination of the theory and technology developments in applied research and development in logistics and supply chains and industry experiences in adoption of the developed and emerging theories and technologies by industries to enhance their competitiveness towards enabling efficient and sustainable knowledge driven economy.

While constructed to be international, multidisciplinary, and practice relevant, the journal of IJAL continues to seek original articles that explore applied theories and technological developments and report their industry adoption in logistics and supply chain management towards enabling an efficient and sustainable knowledge driven economy.

This book is dedicated to this journal of IJAL. With a good collection of chapters in this book, we would devote the following sections to review the directions for relevant innovation in applied logistics

by consolidating the materials published in IJAL and a few books edited by me in the last two years. In Section 2 we would discuss service innovation in logistics operations and SCM. In Section 3 we would place emphasis on supply chain relationship management for sustainability and how it could help enterprises during their upgrade, transform and relocation. In Section 4 we would discuss innovation in supply chain carbon management for sustainable development. A low carbon logistics for low carbon lifestyle is presented. Section 5 would be devoted to the sustainability analytics, an emerging area for further development in applied logistics.

2. Service Innovation in Applied Logistics

Recent technology advance in service science and logistics informatics has brought major development boost to logistics and supply chain management industries. It enables electronic means of logistics service operations, penetrating various value chains of logistics services. The service science view has been changing participants' behavior in logistics service value chain, driving the logistics services and operation more efficient and in the meantime improving service experiences. With service innovation in the logistics industry continuously increasing, more and more efforts have been directed to value add e-means (i.e. IT means for innovation) for logistics services. With new e-means development, changes have been evident and reflected on the presentation and processes of logistics information, operations, and services.

2.1 Collaborative Innovation in Applied Logistics

Collaborative innovation is the way to go in the context of service innovation in logistic and supply chain management. Today's logistics industry benefits from the formation of business community. The development of business community would lead to recognition of community value, resulting in a good ecosystem for business sustainability. The logistics business community would emphasize the common values among geographically dispersed community participants. Knowledge and information exchanges are the basic means for achieving that.

In reality, information exchange among community participants is just and has been the one of basic requirements for conducting everyday business. In a dynamic economy, the difference is that the depth and width of information to be exchanged is unimaginable in a few years back. Now, logistics objects are expected to identified, tracked, and augmented with digital information. Traditional approaches to recognizing these objects typically rely on either complex pattern recognition techniques or bar code type technologies. With Radio Frequency Identification (RFID) technology and now the Internet of Things (IoT), unobtrusive methods of sensing the presence of and identifying tagged logistics objects are now available. With the development of wireless positioning technologies, the position of tagged objects could be determined as well. This interconnection among logistics objects with identification and positioning would supply better quality of information, thus enhance logistics information visibility.

When a wide variety of such IoT sensors are becoming increasingly cheaper, their deployment is becoming increasingly wider, making the Internet of things a reality. These novel technologies have promised better logistics information visibility for logistics participants. To benefit from this enhanced information visibility, logistics information could be used and analyzed to help identify similar logistics service patterns for participants to use. Further, the unique identification provided by RFID tagging enables convenient means to make the service experience better.

With the proliferation of service science, RFID and other sensing technology, logistics industry would start considering to adopt these innovative technologies as feasible and strategic business solutions to integrate logistics applications for business processes within the company and across with business partners, forming value chains and communities. In order for a logistics service community to be successful, there demand advanced mechanisms required that fit naturally with and move beyond the way on how the logistics business is conducted. In a logistics service community, these new technologies would become to facilitate innovative packaging of related logistics information, product and service offerings for logistics operations to meet different service needs. They can potentially further promote high quality of logistics services and products for service provisioning. They will also enable platforms of resource visibility and traceability for logistics services implementations, publication, discovery, and consumption. A good ecosystem could form in the logistics community for such collaborative service innovation to support sharing, access, and managing diverse logistics resources.

However, there exists a major gap between the physical and electronic worlds, where advanced technologies and methods are needed to collect data and establish connections between them. Although RFID and Internet of Things are among such promising technologies, there are still many issues. For example, in the value chain of logistics, diversified community participants will have various needs. Although Internet of Things would be able to gather and present data for enabling insight generation, there still demands to help participants understand the technology and address their data privacy concerns.

2.2 Customer Focused Innovation in Applied Logistics

Logistics service community has shown potentials in developing a better eco-system for service innovation in logistics industry. Many case studies have been preformed to reveal technical and business potentials. Efforts are visible to drive innovation and adoption to enable a more customer friendly and focused logistics services.

However, relevant information to an individual customer may vary widely under different contexts. Many activities on pervasive information systems focusing on context-aware delivery of application-specific information are only able to operate within narrow application domains and cannot be generalized to handle other heterogeneous types of information. Techniques are needed to extend locales to generalize to support more flexible grouping and broader applications for those context-aware, e.g. location-based, services.

Further, service experience may encounter breakdowns due to functional failures, missing feedback, and inconsistent interaction models. RFID and IoT's promise of better information visibility and unique object identification would help establish better information feedback and experience reinforcement. However, technologies still need to include capacities to enhance service systems to adapt the services to understand a customer's behavior in a particular context.

2.3 Service Science in Applied Logistics

We would see a need for service science in applied logistics to understand and address those issues. The interdisciplinary field of service science and applied logistics yet has a lot more to be discovered. Until now, in the market, it is lack of valuable hotspot observations and reports for this interdisciplinary field. Strong demand is there for latest materials disclosing innovative findings for applied research and development in this field between service science and applied logistics.

Thus, contribution of materials is desired to share experiences and lessons learned. Worldwide researchers, practitioners, and academicians have begun to focus their attention into the service sector for insights to develop service science discipline in applied logistics. In fact, applied logistics presents a meaningful yet challenging test-bed for those efforts. I would expect very soon this service science in applied logistics would be developed with a good number of significant research activities relevant to logistics and supply chain industries towards those needs.

To this end, service science in applied logistics shall accelerate applied service science research and create industry practice synergy and consolidation with industry experiences dissemination in the adoption of the developed and emerging theories and technologies to enhance logistics service quality and competitiveness. Service science in applied logistics includes study of enabling technologies, e.g. RFID, Internet of Things and other advanced technologies. It shall include study of research and development methods for innovative ways to reengineer traditional services in logistics and supply chain management. It shall also include study of innovation strategies and mechanisms for future development of logistics and supply chain management.

3. Relationship Management in Applied Logistics

Traditional Supply Chain Management (SCM) aims at movement of goods and services from one end of this chain to the other through different stages so as to improve the efficiency, productivity and profitability of the entire process. As SCM spans across the economic functions of the entire value chain of a product or service, it is vital for a company to join in, form, or coordinate its business related supply chains, forming various kinds of business relationships. Supply chain relationship management, or relationship management in supply chains, increasingly becomes one of the core functions in today's market place for companies to strive for business competitiveness.

3.1. Enterprises in Transition Demands for Better Supply Chain Relationship Management

The world today is a turning point with respect to the way of economic development. So is China. Pearl River Delta (PRD), a south region in China, is a region where the world largest manufacturing base is located. In PRD, various economic functions of the entire value chain of a product or service are conveniently located together in a close geographical area. The enterprises have established various smoothly running industrial clusters with various business relationships formed.

With the emphasis now on environmental protection and high technology development in China's trade policy, many of those enterprises, small and medium sized and labor-intensive, have been losing their competitiveness. They are in low-end industries, with low capitalization, in relatively low technological conditions. Transformation, upgrade, and relocation are the only way out for them, which have now become the national encouraged policy, being enforced in China. Hong Kong government is urged to take pro-active role in helping them access financial resources, technology know-how, and market intelligence information.

Upgrade, transform, and relocation present challenges on the supply chain management for those enterprises. The supply chains would become even longer and more complex with more diverse transportation networks across different and sparse regions. This would put serious threats on enterprises' products and services market potentials as it hinders the market observation and feedback.

Strong demand is there for market information disclosing and sharing leading to the discovery of market demand and feedback, especially during the transform period. The information often is rather expensive to obtain in the long and complex supply chains, as they tend to span across the economic functions of the entire value chain of a product or service. It is vital for a company to join in, form, or coordinate its business related supply chains, forming close business relationships with business partners. Supply chain relationship management, thus, increasingly becomes one of the core functions in today's market place for companies to strive for business competitiveness. The supply chain relationship modeling and analysis will lead to informed decision making and better market adaptation capabilities in the fast changing business environment.

3.2. Supply Chain Relationship Management to Sustain Business Operations and Growth

Supply chain relationship management emerges to be a key business capability to help address these challenges in the upgrade, transform and relocation of these enterprises, especially small ones. SCM, spanning across the economic functions of the entire value chain of a product or service, presents challenges and opportunities for relationship management to enhance enterprises' capability for market adaptation. Traditional SCM, aiming at movement of goods and services from one end of this chain to the other through different stages so as to improve the efficiency, productivity and profitability of the entire process, often widen the distance of an enterprise to the market. Supply chain relationship management, on the other hand, helps narrow the distance for agile market adaptation, studying the business interconnections of how a company can join in, form, or coordinate its business related supply chains by establishing various business relationships with its partners. Supply chain relationship management increasingly becomes one of the core functions in today's market place for companies to strive for business competitiveness. Supply chain relationship management presents the following characteristics in order to help enterprises' decision intelligences for dynamic market adaptation:

3.3. Supply Chain Relationship Management Provides a Foundation for Supply Chain Financing

Now it is a critical moment to innovate technologies and solutions for those enterprises to transform and upgrade while in consistency with China's new processing trade policy. Market potential and financial resources are the major two concerns for them. At financial resources side, for example, cross border financing technology and solution innovation is particularly important as to improve the financing situations for Hong Kong invested enterprises in PRD and to help them retain the employment in the middle of current finance tsunami.

In reality, financial instruments and market have been constantly evolving adapting to the overall economy development. While abundant innovation in financial products and practices has been occurring in the markets like stocks and derivatives, new types of financial instruments and markets for technology access and financing are evolving to cope with the need for the low carbon and sustainable economy development, a worldwide trend.

This would cause the financial instruments and markets to become even more sophisticated. With more and more sophisticated and innovative financial product development and the rapid growth of complex data volume in financial market and firms, financial risks and market regulation become a key issue for

government regulatory bodies. This has urgently called for technologies assistance and development with advanced capabilities such as effective and efficient market monitoring and regulation to help deal with potential risks and identify new opportunities.

Supply chain relationship management, helps narrow the distance for agile market adaptation, studying the business interconnections of how a company can join in, form, or coordinate its business related supply chains by establishing various business relationships with its partners. It provides a good foundation for innovative financing in applied logistics. With support of this relationship management, advanced analytic tools could be developed for supply chain financing to cope with large data volume dispersed in different supply chain participants and to help deal with the risks and identify opportunities. We expect innovation in advanced analytics to provide innovative concepts, methods, tools, and application development to drive better decision makings with practical relevance to sustainable economy development. The innovative supply chain relationship models and financial technologies would help enterprises to sustain their operations and growth, e.g. during the process of transform, upgrade, and relocation, to deal with risks and identify opportunities by developing sustainable competitive advantages.

4. Low Carbon Logistics: Towards Low Carbon Lifestyle

The world now is at the point to pursue a low carbon development roadmap that would eventually decouple economic growth from greenhouse gas and other polluting emissions, through technological and business innovations. Worldwide, logistics and supply chain sector is among the top 3 largest carbon emission contributors. Supply chain management undoubtedly shall undertake the burden of facilitating this carbon emission reduction and by pursuing a low carbon supply chain management practice. The unanimous global pursuit of a sustainable environment has called for advocating the grand challenge of low carbon supply chain management research for business and technology innovation to pave the foundation for a low carbon economy.

Measurement of carbon emissions is broadly adopted as a proxy for quantifying damage to the environment. Low carbon SCM would play a major role in carbon reduction, thus, promoting a long term sustainable economy development and well being. The branding value of low carbon development as well as the sustainable development methods would strengthen comparative advantages of environmentally-aware industries, supporting economic transformation by developing a technology rich, high value add, and service oriented low carbon economy. Carbon competitiveness is already considered as the critical benchmark of national economic competition. Therefore, supply chain carbon competitiveness will absolutely redefine an economy's competitive strength.

4.1. Carbon Management and Impact Analysis

With growing concern on environmental considerations in supply chain industries, numerous corporations are facing new challenge on carbon management in supply chains. A few of global companies which provide management services are developing various tools of carbon management. Since carbon management would exert considerable impacts with changes on supply chain activities, effective tools become critical to illustrate and measure the carbon inter-dependencies and inter-impact among activities.

For example, in the supply chain management, it is inevitable to make changes on supply chain activities. Due to these activities have different connections or relationships with each other, some of them change would lead to changes to the rest accordingly. In order to measure these changes, it would

require tools to model and represent the inter-connections of activities to calculate the impact to the rest. With respect to supply chain carbon management, it is necessary to develop models to represent the inter-connections of supply chain activities and calculate the change impact of carbon intensity caused by carbon reduction fluctuation.

In supply chain carbon management, all activities could be considered competitive peers to each other, which mean each of them is wishing to fulfill their own objectives by proposing and insisting their demand for their own benefit. But, is it possible for each of them to reach the maximal total return at the same time? What is the carbon impact to the whole supply chain? These questions are frequently asked when those supply chain activities are owned or executed by different interested parties respectively. All of them are pursuing to their own maximal interest in this carbon constrained economy. If those activities are running by the same party, then not all activities are necessary to reach their biggest gain. It is natural to have different priority to enforce the carbon impact to the activities in the supply chains when optimizing the carbon impact or de-carbonizing the whole chains.

With the rapid development of carbon accounting technique, a computable tool for carbon impact analysis to supply chain management is becoming viable, although still with considerable barriers ahead.

4.2 From Low carbon Logistics Towards Low Carbon Lifestyle

At present, low carbon development has been penetrating into various disciplines, becoming pervasive. This low carbon trend has been arousing interests from all kinds of people, including politicians, business professionals, and academic researchers, originating from environmental movement towards national strategy and policy worldwide.

What everyone can contribute is to choose a low carbon lifestyle. A low carbon lifestyle calls for sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs, a common yet often seen definition for sustainability. To achieve this sustainability, it is naturally the responsibility of each and every person on the Earth. Everyone can help, although no single man in the world can achieve it without the collaboration of others, whoever is from different countries, leaving in different lives, working in different continents. Just like a logistics service community, it is so critical for the world to have common values and to develop common goals, to motivate each other and to appreciate each other to pursue a low carbon lifestyle. In this sense, people sharing a common value of low carbon lifestyle can collaboratively contribute positive results to address the issues of global warming or climate change. It is very well related to low carbon logistics and supply chain management. That is, low carbon lifestyle calls for low carbon logistics. For example, people would start to buy products with low carbon footprints, live closer to work places, and travel by a public transportation instead of a small car on vocations.

4.3. A Persuasive Approach to Low Carbon Lifestyle

However, low carbon technology and practice adoption in everyday life, not to mention business or industry, is not smooth. Low carbon is often associated with terms like more expenditure and less convenience in everyday life. Thus, while low carbon lifestyle is good to practice, it needs a lot of persuasion to change people's attitude and behavior towards environmental and social responsibility. A carbon footprint label is a good starting point as somehow it reflects what people advocate for sustainability. However, this carbon label is not coming out easy. A lifecycle point of view for developing carbon ac-

counting for a product or service is already well received. It would be a good benchmark for those who would like to practice low carbon lifestyle.

In fact, there are an increasing number of enterprises intending to make the carbon information available to their customers. In order to deliver product carbon footprint information to the customers, a physical label is placed on the product providing a calculated carbon footprint value. So far, quite a few carbon labels have been designed and some of them are now applying in some pilot projects. For example, Groupe Casino, a French retailer together with the French Environment and Energy Management Agency (ADEME) has launched a carbon label, on which the real carbon footprint value and the carbon intensity are both recognizable. The Carbon Trust, a UK organization, provides a carbon reduction label, with a footprint value displayed along with tips for consumers to help them reduce carbon emissions during the usage phase.

However, such a way of tagging physical label on a product is flexible enough to reflect the dynamic nature of carbon accounting. For instance, fruits bought in different seasons of the year or different regions will be put in different cold chains resulting in different carbon footprint value. We have seen research activities which proposed to use mobile phones to retrieve and display dynamic carbon footprint, which help consumers to tell the difference at the item level available at the point of sale. A consumer uses his or her mobile phone, using NFC technologies, to touch the tagged product and the carbon footprint information is displayed on the phone. In this way, multiple instances of the same product with different carbon footprints are correctly presented.

4.4 Captology for Low Carbon Lifestyle

Such mobile phones are called captology, a special form of persuasive technology involving the development of information and communication technologies together with persuasion. Persuasive technology is broadly defined as technology that is designed to change attitudes or behaviors of the users through persuasion and social influence, but not through coercion. The carbon label discussed earlier is also one of such technologies. Traditionally, such technologies usually involving psychology and rhetoric are widely used in sales, advertising, public health, management and etc. Captology is short for “computers as persuasive technologies”, an interdisciplinary overlapping between persuasions in general (influence, motivation, behavior change, etc.) and computing technologies.

There is an increasing demand for captology and the field of captology is expanding quickly. Every day an increasingly amount of captology and its applications are designed with intention to change what people think and do. Besides mobile phones, typical captology include pervasive sensors, social media and social network as well. Mobile phone has been considered as one of most significant technologies as they are used everywhere, every time, by almost everybody. What’s more, there are already some applications of mobile phones in the context of captology towards low carbon lifestyles. For instance, we have seen a project called green virtual pet that connects a user’s carbon behavior with a virtual pet that is always “living” in that user’s mobile phone. Emotion of the pet, a polar bear, would change according to the level of that user’s carbon emission level. When the level decreases, you would expect a happier bear. Otherwise, the bear would feel sad.

This type of captology applications have been extended to social networks. A social network provides online communities that specially focus on people connections. It thus has great impact on people nowadays. With convergence of mobile, instant messaging and Internet, social network has become an ideal captology for low carbon lifestyle persuasion by integrating principles of social comparison,

social facilitation, reciprocity, competition, cooperation, recognition and giving praise. Naturally, those social networks provide significant foundation to develop captology driven platforms and applications for people to share ideas, events, interests and activities towards low carbon lifestyles.

5. The Way Forward: Sustainability Analytics

So far, we have presented a few directions for innovation in applied logistics for a dynamic economy. First we have discussed service innovation in logistics operations and SCM. We have also reviewed supply chain relationship management and its role for sustainability. Supply chain relationship management, while helping enterprises during their upgrade, transform and relocation, provides a good foundation for supply chain financing innovation. Such supply chain innovation and financing becomes one of the core functions in today's market place for companies to innovate technologies and solutions for those enterprises to transform, upgrade and relocation with improved market potential and financial resources accessibility.

Low carbon or sustainable development is the world trend. Potential innovations in supply chain carbon management for sustainable development are also reviewed. We have further presented an overview from low carbon logistics to low carbon lifestyle.

While captology and its applications are being developed for persuade people to practice low carbon lifestyle, its own sustainability resides side by side with a low carbon business or industry. So far, low carbon technology and practice adoption in business or industry is not smooth. In fact, it is more difficult as low carbon is often associated with terms like more capital expenditure and less operation efficiency. Thus, while low carbon development is an important matter, sustainability now has to move beyond environmental concerns to a holistic view, over emerging business models, low carbon and clean technologies, technology access and finance, and policy and regulations.

Now what is next for future development in applied logistics to provide possible solutions? Lastly we would review such a potential area - sustainability analytics, an emerging area for further development in applied logistics.

5.1 Why Sustainability Analytics?

Sustainability is the "capacity to endure", where bearable environment, equitable society and viable economy are well integrated with social, culture, legal, business, financial and environmental aspects. To reach for this integration for sustainable development, it is centric to understand and study the mechanisms for interactions and impact among those aspects. This demands advanced analysis for sustainability to cope with dispersed data in all those aspects and to help deal with risks and identify opportunities for the stakeholders in the concerned economy ecosystem(s). Central to this advanced analytics is to explore sustainability at different levels, granularities, and scales, correspondingly reflecting different degrees of environmental health, social capacity, and economic viability. This is what sustainability analytics has to offer.

5.2. Sustainability Analytics Capacity

In practical sense, sustainability analytics, in analogy to business intelligence, heavily relies on data availability. At present, technology (e.g. RFID, sensing devices, and Internet of Things) could be lever-

aged to collect data, which are then processed and analyzed with meaningful and hopefully actionable business insights for informed decision makings.

However, sustainability analytics has to provide a unified framework based on which diversified analysis could be performed and results can be disseminated smoothly among different stakeholders. So this unified framework at least has to provide the following capacity in order to support sustainable operations:

- Data capturing capacity to identify, collect and process diversified sustainability relevant raw data.
- Data fusion capacity to gather, store, and aggregate sustainability relevant data
- Data intelligence capacity to understand and unveil the hidden relationship and dynamics embedded in the data
- Data dissemination capacity to provide stakeholders with clear and consistent information about sustainability for informed decisions.

5.3. Barriers Down the Road

The need for sustainability analytics is becoming increasingly clearer. However, barriers down the road are expected. The following are the major two:

- First, sustainability relevant data so far is rather difficult to obtain. Infrastructure is yet to develop for data capturing (for example, carbon foot print data in complex supply chain networks). Managing such data is also a complex issue requiring extensible infrastructure to cope with data heterogeneity and dynamics.
- Second, sustainability analytics applications so far is not well connected with every data business operations. This reflects that sustainability in a sense of an organization's ability to meet both its business needs and larger social and environmental needs is not a top-tier concern yet at the moment.

We would recommend placing sustainability analytics at a top agenda, essentially towards developing a sustainable competitive advantage for enterprise(s), industrial chain(s), or regional economies, associating revenues with sustainable products and services delivered to their customers. We expect a bright future of sustainability analytics if it is put in a right study context.

Enjoy your read.

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